#### WEST BENGAL STATE UNIVERSITY Course Outcome or Learning Outcome Three year B.A. /B.Sc. degree course Under CBCS semester system GENERAL COURSE IN ECONOMICS With effect from the session: 2018 – 2019

# Sem 1: DSC-1 (ECOGCOR01T)

## Sem 1: GE Course-1 (ECOHGEC01T)

#### **Introductory Microeconomics**

After completion of this course the students will be able to understand

- The factors that determine the demand for a product by a consumer and how consumer maximises utility subject to budget constraint
- How a business firm decides its output production in short run and long run by considering various costs of production to maximise profit
- The characteristic features of different types of output market structure where buyers and sellers interact
- The determination of prices of different factors of production in factor market

#### Sem 2: DSC-2 (ECOGCOR02T) Sem 2: GE Course-2 (ECOHGEC02T) Introductory Macroeconomics

- The three key macroeconomic concepts for a closed economy, namely, economic growth (and how it is measured in terms of GDP and National Income), Inflation (its different types and how it is influenced by money supply) and unemployment (how it can be present in Classical and Keynesian macroeconomic system)
- The idea of two important component of GDP, namely, Consumption and Investment
- The money and banking system of an economy

#### Sem 3: DSC-3 (ECOGCOR03T) Sem 3: GE Course-3 (ECOHGEC03T) Development Economics

After completion of this course the students will be able to understand

- The distinction between Economic growth and Economic development and how economic development is influenced by population growth, gender aspects and foreign capital
- The alternative strategies of economic development and the complementary role of agriculture and industry in economic development
- Role of different international institutions like IMF, World Bank and WTO in economic development of developing nations

#### Sem 4: DSC-4 (ECOGCOR04T) Sem 4: GE Course-4 (ECOHGEC04T) Indian Economy

- The structure of Indian economy as an underdeveloped economy with special reference to the sectoral distribution of its national income, the problem of income inequality, poverty, unemployment and population growth
- Sector-specific trends in key indicators and their implications in post-independence period
- The use of various fiscal and monetary instruments used by the Union and State Governments and the Reserve Bank of India

#### WEST BENGAL STATE UNIVERSITY Course Outcome or Learning Outcome Three year B.A. /B.Sc. degree course Under I+I+I system GENERAL COURSE IN ECONOMICS Paper I: Microeconomics (100)

After completion of this course the students will be able to understand

- The factors that determine the demand for a product by a consumer and how consumer maximises utility subject to budget constraint
- How a business firm decides its output production in short run and long run by considering various costs of production to maximise profit
- The characteristic features of different types of output market structure where buyers and sellers interact
- The determination of prices of different factors of production in factor market

# Paper II: Macroeconomics (100)

After completion of this course the students will be able to understand

- The three key macroeconomic concepts for a closed economy, namely, economic growth (and how it is measured in terms of GDP and National Income), Inflation (its different types and how it is influenced by money supply) and unemployment (how it can be present in Classical and Keynesian macroeconomic system)
- The idea of two important component of GDP, namely, Consumption and Investment
- The money and banking system of an economy
- Different principles of taxation, government budget and how public debt imposes burden on a society
- Basis of international trade in terms of classical theory of Adam Smith and David Ricardo

# Paper III: Problems of Indian Economy (100)

- The structure of Indian economy as an underdeveloped economy with special reference to the composition of its national income, the problem of poverty, unemployment and income inequality
- Some key issues related to Indian agriculture and industry, banking system, foreign trade and fiscal situation of Government of India
- Achievements and Failures of India's Five year plans

## Paper IV: Development Economics and Elementary Statistics (100)

# Group: A [Development Economics] (50)

After completion of this course the students will be able to understand

- The distinction between Economic growth and Economic development and how economic development is influenced by population growth, gender aspects and foreign capital
- The alternative strategies of economic development and the complementary role of agriculture and industry in economic development
- Role of different international institutions like IMF, World Bank and WTO in economic development of developing nations

## Group: B [Statistics] (50)

- The basic concept and definitions of various statistical terms along with various statistical techniques which, in turn, helps the students to quantify the various micro and macro economic variables.
- The quantitative measurement of different development indices in economic theory.

#### WEST BENGAL STATE UNIVERSITY Course Outcome or Learning Outcome Three year B.A. /B.Sc. degree course Under CBCS semester system HONOURS COURSE IN ECONOMICS With effect from the session: 2018 – 2019

## Core Course-1: Introductory Microeconomics; ECOACOR01T Learning Outcome:

After successful completion of this course students will be able to:

- Understand the fundamental problems of an economy and optimal allocation of resources to meet the needs of the society.
- Learn the market clearing mechanism for setting up equilibrium price and quantity depending on the demand and supply structures from aggregate to disaggregate unit level.
- Learn how various economic agents such as, consumers; firms etc. behave rationally to optimize their goals given the economic resources.
- Understand the short run and long run behaviour of firms in a given demand condition under perfectly competitive set up.

# Core Course-2: Mathematical Methods for Economics-I; ECOACOR02T Learning Outcome:

After successful completion of this course students will be able to:

- Understand the transmission of basic mathematics that enables the creation of economic theory in general.
- Understand the application of mathematical techniques to economic theory in general.
- Understand the process of optimization techniques in economic theory in general.
- In this course, particular economic models are not the ends and the material is to be taught is indicated by the contents of the prescribed textbook.

# Core Course-3: Introductory Macroeconomics; ECOACOR03T Learning Outcome:

After successful completion of this course students will be able to:

- Understand nature, construction and measurement of key macroeconomic variables.
- Understand the measurement of different components of national income and its importance as an indicator of human wellbeing.
- Gets an idea regarding the determination of income in short run and long run with essential impacts of fiscal and monetary policy variables in different macroeconomic set up (Classical and Simple Keynesian and Complete Keynesian).

# Core Course-4: Statistical Methods for Economics-I; ECOACOR04T Learning Outcome:

After successful completion of this course students will be able to:

- Perceive the characteristics of sample data using various methods of statistical measurements.
- Understand the comparability, consistency, spreadness /concentration among different sets of sample data.
- Understand the degree and the direction of association in bivariate setup.

## Core Course- 5: Intermediate Microeconomics-I; ECOACOR05T Learning Outcome:

Since students are already familiar with the basic concepts of behaviour of the consumer and the producer and also covers the behaviour of a competitive firm, after successful completion of this course students will be able to:

- Acquire knowledge regarding the short run and long run behaviour of firms in a given demand condition under different imperfectly competitive market set up.
- Understand how to determine optimal price and employment of an input in different market structures and the role of the labour union in determining wage rates.
- Check whether the independent action by each economic agent is consistent while there is interdependence among the economic agents.
- Know how choice in the face of risk differs from choice in the absence of risk, how to measure and reduce risk.

# Core Course-6: Intermediate Macroeconomics-I; ECOACOR06T Learning Outcome:

This course is a sequel to Macroeconomics I. After successful completion of this course students will be able to:

- various alternative theories of output and employment determination in a closed economy in the short run as well as medium run, and the role of policy in this context.
- Understand the microeconomic foundation of various aggregative concepts used in the previous course.
- Understand the causes and effects of different types of inflation and inflationunemployment tradeoff in an economy.

• Recent development in macroeconomic concepts with special reference to Real Business Cycle and New Keynesian Economics.

#### Core Course- 7: Mathematical Methods for Economics-II; ECOACOR07T Learning Outcome

After going through the course, the students will be able to

- Understand the basic mathematics that enables the creation of economic theory in general.
- Understand the application of mathematical techniques to economic theory specifically the courses on microeconomic theory, macroeconomic theory, statistics and econometrics set out in this Syllabus.
- Understand the application of linear Programming Problems, interdependence industry relation and game theory.
- In this course, particular economic models are not the ends, but the means for illustrating the specific methods of applying mathematical techniques to economic theory.

#### Core Course-8: Intermediate Microeconomics-II; ECOACOR08T Learning Outcome:

This course is a sequel to Intermediate Microeconomics I, After successful completion of this course students will be able to:

- Have conceptual clarity to the student coupled with the use of mathematical tools and reasoning.
- Know the strategic behavior oligopolistic firms
- Understand market failure
- Learn about general equilibrium and welfare, imperfect markets and topics under information economics.

## Core Course-9: Intermediate Macroeconomics-II; ECOACOR09T Learning Outcome:

This course is a sequel to Intermediate Macroeconomics I and after successful completion of this course students will be able to:

- Have an idea about the long run dynamic issues like growth and technical progress.
- also gather knowledge about the micro-foundations to the various aggregative concepts used in the previous course.

#### Core Course-10: Statistical Methods for Economics-II; ECOACOR10T Learning Outcome:

After successful completion of this course students will be able to:

- Learn conception and definitions of various statistical terms, rules and theorems along with the application of various univariate probability distribution functions.
- Learn about probability distributions of discrete and continuous random variables and of joint distributions.
- Gather experience how to select samples from a population and discussion on sampling techniques used to collect survey data.
- Learn basic concepts and terminology that are fundamental to statistical analysis and inference.
- Learn how to draw inferences about an unknown population with the help of sample observations.

#### Core Course-11: Introductory Econometrics; ECOACOR11T Learning Outcome:

After successful completion of this course students will be able to:

- know about comprehensive introduction to basic econometric concepts and techniques.
- Have idea on statistical concepts of hypothesis testing,
- know about estimation and diagnostic testing of simple and multiple regression models.
- alsos the consequences of and tests for misspecification of regression models.

## Core Course-12: Development Economics; ECOACOR12T Learning Outcome:

After successful completion of this course students will be able to:

- Understand alternative conception of development and their justification.
- Learn about various stages of growth along with various theories and models and strategy of growth.
- Understand the basic demographic concepts and their evolution during the process of development along with various theories and model explaining the problems of a labour surplus economy
- Learn different measures of poverty and inequality and explore the connection between growth and inequality.

- Link the issues and strategies related with economic development and the question of sustainable development.
- Understand how trade causes economic development for Less Developed Countries (LDCs), particularly with reference to the issues of Balance of Payment, economic dependency of LDC in terms of different theories.
- Understand the arguments in favour of protection and how different types of trade protectionist measures affect social welfare of LDCs.
- Interpret how inflow of foreign capital in terms of Multi National Corporations (MNCs) affects the economic development of host LDCs.
- Explore the debate between state and market in solving the fundamental economic problems of an economy and how they address the issue of social welfare.
- Understand the development of different International Financial Institutions like IMF, World Bank, WTO etc. and their functioning with special reference to LDCs.

#### Core Course-13: Indian Economy; ECOACOR13T Learning Outcome

After going through the course, the students will be able to

- Basic characteristics of Indian economy with Growth and distribution, sustainability and regional contrasts; structural change, savings and investment.
- Evaluate how the structure of Indian economy has changed in the planning era.
- Understand the key economic issues related to Indian agriculture, industry, unemployment and poverty in both pre and post reform periods and their policy relevance.
- Understand the rational and major objectives of India's Five Year Plans, how the emphasis of these objectives has changed over time and recent developments.
- Examine the changes in the policies of the Government in pre and post reform periods in the fields of money and capita market, public economics and external sectors.
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## Core Course-14: International Economics; ECOACOR14T Learning Outcome:

On successful completion of this course students will be able to:

- Understand the basis of trade between nations of the world, the notion of terms of trade and how free trade can be mutually beneficial for the trading nations in terms of the Classical and Neo-Classical theories of trade by exploring the idea of comparative cost advantage,
- Evaluate the relationship between country size and gains from trade and how trade affects distribution of factor income among the trading nations

- Be familiar with, and be able to critically analyze the main arguments for protection and be able to critically evaluate the relevance and realism of arguments for free trade, taking into account the costs and benefits of different trade policy measures like tariff, quota, voluntary export restraints, export subsidy etc. on economic welfare of the nation
- Explain how international flow of goods, services and capital affects foreign exchange reserve as well as foreign exchange rate of a nation and how expenditure adjustment and expenditure switching trade policies help a nation to achieve both internal and external balance.

# DSE Course-1: Any one from the given options (Sem-5)

#### a) Applied Econometrics: UG/ECOA/DSE 5.1.1 Learning Outcome:

On successful completion of this course students will be able to:

- have hands on experience in data collection and data entry, analysis of data in terms of charts, diagrams both for primary and secondary data
- statistical measures through computers using statistical software
- prepare students to handle data and project reporting using different tools of computers (excel, word, powerpoint)

#### b) Economics of Health & Education: UG/ECOA/DSE 5.1.2 Learning Outcome:

On successful completion of this course students will be able to:

- Understand the importance of education and health in improving well-being (as per the Millennium Development Goals, other goals),
- Have idea on status of primary education, child mortality, maternal health and combating diseases.
- Have idea on microeconomic framework to analyze, among other things, individual choice in the demand for health and education,
- Have idea on government intervention and aspects of inequity and discrimination in both sectors
- Have an overview of health and education in India.

#### c) History of Economic Thought: UG/ECOA/DSE 5.1.3

#### **Learning Outcome:**

On successful completion of this course students will be able to:

- Understand key models and concepts of the history of economic thought
- Understand scholarly articles concerned the history of economic thought
- Produce simple appreciations of the history of economic thought texts
- Have a historical consciousness of economic ideas

#### DSE Course-2: Any one from the given options (Sem-5)

#### a) Public Economics: UG/ECOA/DSE 5.2.1 Learning Outcome:

On successful completion of this course students will be able to:

- Understand the role of state in a mixed economy
- Be familiar with different principles of taxation of the government and its impact on saving, risk bearing and work effort of economic agents
- Distinguish between different concepts of deficit in government budget and how public debt can impose burden on a society

# *b)* Money and Financial Markets: UG/ECOA/DSE 5.2.2

#### **Learning Outcome:**

On successful completion of this course students will be able to

- exposes students to the theory and functioning of the monetary and financial sectors of the economy.
- Understand highlights the organization, structure and role of financial markets and institutions.
- Know about interest rates, monetary management and instruments of monetary control.
- Have idea on Financial and banking sector reforms and monetary policy with special reference to India are also covered.

#### c) Topics in Microeconomics: UG/ECOA/DSE 5.2.3

#### **Learning Outcome:**

On successful completion of this course students will be able to

- Understand the students to elementary game theory under complete information.
- the basic concepts of game theory in a way that allows students to use them in solving simple problems.
- deal with the solution concepts for normal form and extensive form games along with a variety of economic applications.
- deal with the solution concepts in presence moral hazard.

#### DSE Course-3: Any one from the given options (Sem-6)

#### a) Contemporary Development Economics: UG/ECOA/DSE 6.3.1 Learning Outcome:

On successful completion of this course students will be able to

- know diverse trajectories and patterns of growth to achieve their industrial transition followed clearly by set of countries
- have ideacompares the outcomes of these diverse trajectories on sectoral change, inter-sectoral relations,
- understand about labour processes and industrial relations and also compares the role of the state in facilitating the respective trajectories.

#### b) Environmental Economics: UG/ECOA/DSE 6.3.2 Learning Outcome:

On successful completion of this course students will be able to

- know the economic causes of environmental problems,
- know about economic principles are applied to environmental questions and their management through various economic institutions, economic incentives and other instruments and policies.
- Have idea about Economic implications of environmental policy are also addressed as well as valuation of environmental quality, quantification of environmental damages, tools for evaluation of environmental projects such as cost-benefit analysis and environmental impact assessments.
- Understand on the international environmental problems are also discussed.

# c) Financial Economics: UG/ECOA/DSE 6.3.3

#### **Learning Outcome:**

On successful completion of this course students will be able to

- understand the economics of finance.
- Have idea on some of the basic models used to benchmark valuation of assets and derivatives are studied in detail;
- Know the Option Pricing models and brief idea to corporate finance

# DSE Course-4: Project/Dissertation: UG/ECOA/DSE 6.4; (Sem-6) Learning Outcome:

On successful completion of this course students will have idea on

- presenting small research work on a specified manner
- different contemporary socio-economic issues by applying research methodology,
- process of data presentation and economic analysis, preparation of dissertation using statistical and simple econometric tools,
- prepare the students for concise form of presentation in their future academic and job assignments.

#### WEST BENGAL STATE UNIVERSITY Course Outcome or Learning Outcome Three year B.A. /B.Sc. degree course Under I+I+I system HONOURS COURSE IN ECONOMICS

#### Paper I Economic Theory I Group: A [Microeconomics I]

#### **Learning Outcome:**

After successful completion of this course students will be able to:

- Understand the fundamental problems of an economy and optimal allocation of resources to meet the needs of the society.
- Learn the market clearing mechanism for setting up equilibrium price and quantity depending on the demand and supply structures from aggregate to disaggregate unit level.
- Learn how various economic agents such as, consumers; firms etc. behave rationally to optimize their goals given the economic resources.
- Understand the short run and long run behaviour of firms in a given demand condition under perfectly competitive set up.

### Group: B [Macroeconomics I]

#### **Learning Outcome:**

After successful completion of this course students will be able to:

- Understand nature, construction and measurement of key macroeconomic variables.
- Understand the measurement of different components of national income and its importance as an indicator of human wellbeing.
- Gets an idea regarding the determination of income in short run and long run with essential impacts of fiscal and monetary policy variables in different macroeconomic set up (Classical and Simple Keynesian and Complete Keynesian).

#### Paper II Quantitative Techniques for Economics I Group: A [Statistics I]

#### **Learning Outcome:**

After successful completion of this course students will be able to:

- Perceive the characteristics of sample data using various methods of statistical measurements.
- Understand the comparability, consistency, spreadness/concentration among different sets of sample data.
- Understand the degree and the direction of association in bivariate setup.

# Group: B

# [Mathematical Economics I]

#### **Learning Outcome:**

After successful completion of this course students will be able to:

- Understand the transmission of basic mathematics that enables the creation of economic theory in general.
- Understand the application of mathematical techniques to economic theory in general.

#### Paper III Economic Theory II Group: A [Microeconomics II]

#### **Learning Outcome:**

After successful completion of this course students will be able to:

- Acquire knowledge regarding the short run and long run behaviour of firms in a given demand condition under different imperfectly competitive market set up.
- Understand how to determine optimal price and employment of an input in different market structures and the role of the labour union in determining wage rates.
- Check whether the independent action by each economic agent is consistent while there is interdependence among the economic agents.
- Know how choice in the face of risk differs from choice in the absence of risk, how to measure and reduce risk.

#### Group: B

## [Macroeconomics II]

#### **Learning Outcome:**

This course is a sequel to Macroeconomics I. After successful completion of this course students will be able to:

- Understand the microeconomic foundation of various aggregative concepts used in the previous course.
- Understand the causes and effects of different types of inflation and inflationunemployment tradeoff in an economy.
- Recent development in macroeconomic concepts with special reference to Real Business Cycle and New Keynesian Economics.

#### Paper IV Development Economics and Issues on Economic Development Group: A [Development Economics]

#### **Learning Outcome:**

After successful completion of this course students will be able to:

- Understand alternative conception of development and their justification.
- Learn about various stages of growth along with various theories and models and strategy of growth.
- Understand the basic demographic concepts and their evolution during the process of development along with various theories and model explaining the problems of a labour surplus economy
- Learn different measures of poverty and inequality and explore the connection between growth and inequality.
- Link the environment issues related with economic development and the question of sustainable development.

#### Group: B [Issues on Economic Development]

#### **Learning Outcome:**

After successful completion of this course students will be able to:

- Understand how trade causes economic development for Less Developed Countries (LDCs), particularly with reference to the issues of Balance of Payment, economic dependency of LDC in terms of different theories.
- Understand the arguments in favour of protection and how different types of trade protectionist measures affect social welfare of LDCs.
- Interpret how inflow of foreign capital in terms of Multi National Corporations (MNCs) affects the economic development of host LDCs.
- Explore the debate between state and market in solving the fundamental economic problems of an economy and how they address the issue of social welfare.
- Understand the development of different International Financial Institutions like IMF, World Bank, WTO etc. and their functioning with special reference to LDCs.

#### Paper V International Economics & Public Finance Group: A [International Economics]

#### **Learning Outcome:**

On successful completion of this course students will be able to:

- Understand the basis of trade between nations of the world, the notion of terms of trade and how free trade can be mutually beneficial for the trading nations in terms of the Classical and Neo-Classical theories of trade by exploring the idea of comparative cost advantage,
- Evaluate the relationship between country size and gains from trade and how trade affects distribution of factor income among the trading nations
- Be familiar with, and be able to critically analyze the main arguments for protection and be able to critically evaluate the relevance and realism of arguments for free trade, taking into account the costs and benefits of different trade policy measures like tariff, quota, voluntary export restraints, export subsidy etc. on economic welfare of the nation
- Explain how international flow of goods, services and capital affects foreign exchange reserve as well as foreign exchange rate of a nation and how expenditure adjustment and expenditure switching trade policies help a nation to achieve both internal and external balance.

#### Group: B [Public Finance]

#### **Learning Outcome:**

On successful completion of this course students will be able to:

- Understand the role of state in a mixed economy
- Be familiar with different principles of taxation of the government and its impact on saving, risk bearing and work effort of economic agents
- Distinguish between different concepts of deficit in government budget and how public debt can impose burden on a society

## Paper VI Indian Economic Problems and Planning

#### Learning Outcome

After going through the course, the students will be able to

• Evaluate how the structure of Indian economy has changed in the planning era.

- Understand the key economic issues related to Indian agriculture, industry, unemployment and poverty in both pre and post reform periods and their policy relevance.
- Understand the rational and major objectives of India's Five Year Plans, how the emphasis of these objectives has changed over time and recent developments.
- Examine the changes in the policies of the Government in pre and post reform periods in the fields of money and capita market, public economics and external sectors.

#### Paper VII Quantitative Techniques for Economics II Group: A [Statistics II]

#### Learning Outcome

After going through the course, the students will be able to

- Learn conception and definitions of various statistical terms, rules and theorems along with the application of various univariate probability distribution functions.
- Gather experience how to select samples from a population.
- Learn how to draw inferences about an unknown population with the help of sample observations.

#### Group: B

#### [Mathematical Economics II]

#### Learning Outcome

After going through the course, the students will be able to

- Know the application of the mathematical tools such as: integration, differential equation, difference equation, Cramer' rule, matrix inversion to the economic analysis.
- Understand the economic interpretation of duality theorem.
- Evaluate how economic agents optimize their goals while they are interdependent.

## Paper VIII Indian Economic History, Computer Application & Project Work Group: A [Indian Economic History & Computer Application]

#### **Learning Outcome:**

#### **Group:** A – I Indian Economic History:

On successful completion of this course students will be able to understand the impact of British rule and the British imperial policy in India in the pre-independence period with special reference to the issues of deindustrialization, commercialization of agriculture, drain of economic wealth, land revenue policy, development of railways and irrigation and foreign trade.

It will also enable the students to understand the comparative structural changes of Indian economy.

## **Group: A – II Computer Application:**

On successful completion of this course students will have hands on experience in data entry, analysis of data in terms of charts, diagrams and statistical measures through computers using statistical soft-wares both for primary and secondary data that will prepare students to handle data and project reporting.

#### Group: B [Project Work]

On successful completion of this course students will have idea on presenting small research work on a specified manner on different contemporary socio-economic issues by applying research methodology, process of data presentation and economic analysis, preparation of dissertation. It will prepare the students for concise form of presentation in their future academic and job assignments.

#### WEST BENGAL STATE UNIVERSITY

#### Course Outcome/Learning Outcome

Three year B.A Degree course

#### Under CBCS Semester system, Education

With effect from Session 2018-19

## Core Course 1: Educational Philosophy (EDCACOR01T)

#### **Learning Outcome**

After successful completion of this course the students will be able to:

- Understand the foundation of Education and disciplinary relationship between Education & Philosophy.
- Get an idea of the Philosophical bases in Education.
- Acquire knowledge of the Western & Indian Schools of Philosophy and their impact on Education.
- Perceive the values enshrined and educational provisions in the Indian Constitution.
- Understand contributions of some great educators and their Philosophies of Education.

#### Core Course 2: Educational Psychology (EDCACOR02T) Learning Outcome

- Develop a concept of Psychology, and its relationship with Education.
- Get an idea of Educational Psychology.
- Understand the different aspects of child development and relate that with Education.
- Learn about Psychology of Intelligence and Creativity and relate that with Education.
- Understand different aspects of Learning Psychology in the context of Education.

#### Core Course 3: Educational Sociology (EDCACOR03T)

#### **Learning Outcome**

- 1. Understand the meaning of Sociology and its different perspectives related to Education.
- 2. Realize the relationship between Education and Sociology;
- 3. Acquaintance with the concept of Culture and its relationship with Education
- 4. Understand about National Integration & International Understanding
- 5. Get an idea of social development and role of Education
- 6. Connect with some social issues in education

#### Core Course 4: Pedagogy (EDCACOR04T)

#### **Learning Outcome**

- Get an idea of Pedagogy as an academic discipline
- Understand about different bases of Pedagogy.

- Develop an understanding of philosophical, sociological and psychological bases of Pedagogy
- Learn about Pedagogy as a science of teaching and Pedagogy of teaching learning
- Get acquainted with some contemporary issues of Pedagogy and its application in class room situation.

#### **Core Course 5: Education in Pre independence India (EDCACOR05T)**

#### **Learning Outcome**

- Develop an idea of education in ancient and medieval India
- Know about the education under East India Company
- Perceive the development of education under British rule
- Develop a concept of education from 1917-1947.

## **Core Course 6: Education in Post-independence India (EDCACOR06T)**

## **Learning Outcome**

- Understand about the development of education from 1947-1953
- Develop a concept of education from 1964-1968
- Know about the education from 1986-1992
- Learn about the development of education from 1993 onwards

#### **Core Course 7: Contemporary Issues in Indian education (EDCACOR07T)**

#### Learning Outcome

• Explore the Traditional issues, Social issues and Educational issues of Indian educational system.

#### Core Course 7: Field tour & Report writing (EDCACOR07P)

#### **Learning Outcome**

- Gather experience regarding places of Philosophical, Psychological &Historical importance
- Field study includes proper planning, execution of journey and report writing.
- Students will able to link their learning with experience.

#### Core Course 8: Educational Management (EDCACOR08T)

#### **Learning Outcome**

- Develop the concept, nature, types and need of educational management.
- Understand the importance of leadership in management.

- Know the agencies of educational management in Indian context.
- Understand the importance of planning and management in Education

# Core Course 9: Basics of Educational Research and Evaluation (EDCACOR09T)

#### Learning Outcome

- Have preliminary concepts on research methodology
- Learn about Sampling and hypothesis
- Know about Evaluation and Measurement
- Explore the steps in standardization of a test

# **Core Course 10: Statistics in Education (EDCACOR010T)**

#### **Learning Outcome**

- Develop the basic concept of Statistics
- Organize and tabulate data
- Learn about descriptive statistics
- Learn the calculation of Inferential Statistics

#### **Core Course 10: Statistics in Education (EDCACOR010P)**

#### Learning Outcome

- Learn about data Collection
- Explore the method of data Analyses by any excel/ software and manual both
- Gather experience about statistical report writing

# Core Course 11: Guidance and Counseling (EDCACOR011T) Learning Outcome

• Develop the basic concept of Guidance and Counseling.

- Understand the concepts of adjustment and maladjustment.
- Get acquainted with the basic data necessary for guidance, process of testing and diagnosis in Guidance and Counseling.

#### **Core Course 12: Educational Technology (EDCACOR012T)**

#### **Learning Outcome**

- Acquire knowledge about the concept and approaches of educational technology.
- Understand the concepts, components and basic models of communication used in Education.
- Know the techniques of instructional technology used in Education.

#### Core Course 12: Basic ICT (EDCACOR012P)

#### **Learning Outcome**

- Learn about computer and its components
- Know how to operate DTP & Excel
- Oral Presentation with PPT along with report writing

#### Core Course 13: Curriculum Studies (EDCACOR013T)

#### Learning Outcome

- Develop a concept of Curriculum
- Understand the aims and objectives of Curriculum.
- Get acquainted with the development of Curriculum.
- Learn about the evaluation of Curriculum.

#### Core Course 14: Special Education (EDCACOR014T)

#### **Learning Outcome**

- Acquire knowledge about basic concept of Special Education.
- Understand the development and organization of Special Education.
- Learn about Gifted and Slow Learners.
- Gather experiences about the different types of exceptionality.

#### DSC 1A (EDCGCOR01T)/GE-1 (EDCHG01T) Philosophical Foundation of Education. Course Outcomes:

- The meaning nature and scope of education;
- The aims, forms and factors of education;
- The meaning and importance of value and the relation between value and education; and
- The life And contributions of great educators in the field of education;

# DSC 1B (EDCGCOR01T)/GE-2 (EDCHG02T) Psychological Foundations of Education. Course Outcomes:

After completion of this course the students will be able to understand the followings;

- The relationship between education and psychology;
- The meaning and nature of educational psychology and the contribution of educational psychology to education;
- The meaning, principles, types and stages of human development and their educational significance;
- The meaning, nature and types of attention and memory and the causes of forgetting and the role of education good memorisation; and
- The meaning, characteristics, types and measurement of personality and its importance in education.

# DSC 1C (EDCGCOR03T)/GE-3 (EDCHG03T) Development of educational policies since Independence

#### **Course Outcomes:**

After completion of this course the students will be able to understand the followings;

- The educational scenario of India from 1813 AD to 2016 AD;
- The educational provisions under the British Rule;
- The recommendations of various Committees and commissions on education in India;
- Various policies on education and educational schemes on education in India like SSM, RUSA and NPE etc.

## DSC 1D (EDCGCOR04T)/GE-4 (EDCHG04T) Evaluation in education. Course Outcomes:

- The meaning, principles, types and importance of evaluation in education;
- Tools and techniques of evaluation, their advantages and disadvantages in education;
- The meaning, types and characteristics of tests such as educational tests and psychological tests; and
- The meaning and utility of statistics and calculate central tendency and variability of a distribution.

#### DSE 1A (EDCGDSE01T) Sociological Foundations of Education. Course Outcomes:

After completion of this course the students will be able to understand the followings;

- The meaning nature and scope of sociology and educational sociology and their inter relationship;
- The meaning and types and social groups and their role in socialization process;
- The meaning, nature and types of social agencies and their role as agencies of education; and
- Various social issues and their causes and impact on social life.

#### DSE 1A (EDCGDSE02T) Psychology of Learning. Course Outcomes:

After completion of this course the students will be able to understand the followings;

- The meaning, scope, theories and measurement of Intelligence.
- The meaning, characteristics and type of learning and what are the factors influencing learning
- Various theories of learning and their educational implications;
- The meaning, scope and characteristics of creativity and its measurement techniques; and
- The relationship between creativity and intelligence.

# DSE 1B (EDCGDSE03T) Ancient Indian Education and contemporary Issues in Indian Education.

#### **Course Outcomes:**

After completion of this course the students will be able to understand the followings;

- The system , aims, curriculum, methods of teaching and women education in Brahmanic and Budhhistic period;
- The problems of equality in education and structure and functions of various controlling and policy making agencies i. e. UGC, NCERT, and NCTE etc.;
- The problems of Backward sections of the society and problems of vocational education in India; and
- Understand the current educational Acts such as PWD, SSA and RTE.

## DSE 1A (EDCGDSE01T) Guidance and Counselling in Education. Course Outcomes:

- The meaning, scope and need for adjustment and causes and remedies for maladjustment;
- Meaning, scope, types and importance of guidance and its need in secondary and higher secondary schools;
- The meaning, nature, scope, types and importance of Counselling;
- The techniques of data collection for guidance and counselling; and the students may use this knowledge in their own life situation.

# SSEC-1 (B.A. EDCA and EDCG Students) Developmental skill for Social Awareness (EDCSSEC01M)

#### **Project outcome:**

After completion of this course the students will be able to understand the followings;

- The meaning and nature of Social awareness and its need;
- How to plan and execute a social awareness programme; and
- The student will develop the skill to organise various social awareness programmes.

# SSEC-2 (B.A. EDCA and EDCG Students) Development of Observational Skill (EDCSSEC02M)

#### **Project outcome:**

- The meaning, nature and characteristics of observation;
- The types of observation ways to plan and execute an observation programme; and
- The student will develop the skill to observe an event, record the event and report on the event meticulously.

#### WEST BENGAL STATE UNIVERSITY Course Outcome/Learning Outcome 3Year B.A Degree Course Under 1+1+1 System Honours course in Education

#### (EDCA 01): Philosophical and Sociological Foundations of Education

#### After the completion of the course the learners will be able to:

#### **Group A: Educational Philosophy**

#### Learning Outcome

- 1. Understand the nature of Educational Philosophy, relationships between Education and Philosophy.
- 2. Understand the roles of Philosophical bases in Education;
- 3. Acquaintance with the Western and Indian Schools of Philosophy and their impacts on Education.
- 4. Acquaintance with the values enshrined and educational provisions in the Indian Constitution;
- 5. Understand contributions of some great educators and their Philosophies of Education.

#### **Group B: Educational Sociology**

#### Learning Outcome

1. Understand the meaning of Sociology and its different perspectives related to Education;

2. Understand the relationship between Education and Sociology, nature of Educational Sociology.

4. Understand Culture, its relationship with Education.

5. Understand of social development and role of Education and some social issues in education.

# Course (EDCA 02): Educational Psychology and Pedagogy

# After the completion of the course the learners will be able to:

# **Group-A: Educational Psychology**

#### Learning Outcome

1. Understand the meaning of Psychology, and be acquainted with its different perspectives.

- 2. Realize the relationship between Psychology and Education.
- 3. Understand the concept of Educational Psychology.

4. Understand different aspects of child developments and relate that with Education.

5. Acquaintance with the Psychology of Intelligence and Creativity and relate that with Education.

6. Understand different aspects of Learning Psychology in the context of Education.

# **Group-B: Pedagogy**

#### **Learning Outcome**

- 1. Learn the importance of Pedagogy as an academic discipline.
- 2. Understand the concept of Pedagogy and its different perspectives
- 3. Learn the philosophical, sociological and psychological bases of
- 4. Pedagogy;
- 5. Understand the relationship between Pedagogy and Education;
- 6. Acquaintance with some contemporary issues of Pedagogy.

#### (EDCA 03): Development of Educational Policies and Contemporary Issues in Indian Education

#### After the completion of the course the learners will be able to:

## **Group A: Development of Educational Policies**

#### Learning Outcome

- 1. Understand the development of educational policies in ancient and medieval period.
- 2. Understand the development of educational policies for the period 1813 to 1947.
- 3. Understand the development of educational policies for the period 1947 to 1970.
- 4. Understand the development of educational policies for the period 1970 to 2010.

# Group B: Contemporary Issues in Indian Education: Probable Causes and Solutions[NPE 1986 onwards]

#### Learning Outcome

- **1.** Understand the significance of traditional issues in education.
- 2. Understand the significance of social issues in education.
- 3. Understand the significance of educational issues.
- 4. Understand the significance of current issues in education.

# **Course (EDCA 04): Educational Technology and Educational Management**

#### After the completion of the course the learners will be able to:

#### **Group A: Educational Technology**

#### **Learning Outcome**

- 1. Understand the concept and approaches of educational technology.
- 2. Understand the concepts, components and basic models of communication used in Education.
- 3. Understand and apply the techniques of instructional technology used in Education.
- 4. Understand the emerging issues of educational technology.

# Group B: Educational Management

# Learning Outcome

- 1. Understand the concept, nature and need of educational management.
- 2. Understand the importance of leadership in management.
- 3. Learning about the agencies of educational management in Indian context.
- 4. Understand the importance of planning and management in Education.

#### (EDCA 05): Comparative Education and Curriculum Studies

# **Group A: Comparative Education**

- 1. Understand the foundations of Comparative Education.
- 2. Acquaintance with the system of Comparative Education.
- 3. Understand the structure of Comparative Education.
- 4. Understand various issues related with Comparative Education.

## **Group B: Curriculum Studies**

- 1. Understand the concept of Curriculum Studies.
- 2. Acquaintance with the aims and objectives of Curriculum.
- 3. Understand with the development of Curriculum.
- 4. Understand the evaluation of Curriculum.

# Course (EDCA 06): EDUCATIONAL GUIDANCE AND COUNSELLING AND SPECIAL EDUCATION

## Group A: Educational Guidance and Counselling

- 1. Understand the basic concept of Guidance and Counselling.
- 2. Understand the concepts of adjustment and maladjustment.
- 3. Acquaintance with the process of testing and diagnosis in Guidance and Counselling.
- 4. Acquaintance with the special areas and skills of Guidance and Counselling.

# **Group – B Special Education**

- 1. Understand the basic concept of Special Education.
- 2. Acquaintance with the history and development of Special Education.
- 3. Learn about Gifted and Slow Learners.
- 4. Acquaintance with the different types of exceptionality.

#### Course (EDCA 07): EVALUATION AND STATISTICS IN EDUCATION Group A: EVALUATION WITH BASIC RESEARCH CONCEPT

- 1. Understand the basic concept of Evaluation and Measurement.
- 2. Acquaintance with the basic tools of evaluation.
- 3. Learn the procedure of standardisation of a test.
- 4. Acquaintance with preliminary concept of Research Methodology.

# **GROUP – B. STATISTICS IN EDUCATION**

- 1. Understand the basic concept of Statistics.
- 2. Understand Descriptive Statistics.
- 3. Understand Inferential Statistics.
- 4. Learn about Derived Scores and its uses.

#### Course (EDCA 08): Practicum

# **Group A: ICT based Statistics Practical**

# Part-1. Basic ICT Practical

- 1. Acquaintance with computer and its different parts.
- 2. Understand DTP Operation & its application.
- 3. Understand Excel Operation & its application.

- 4. Understand PPT Operation & its application.
- 5. Learn to write a report with the above application.

#### **Part-II. Statistics Practical**

- 1. Learn data collection.
- 2. Understand analysis of data through excel/ Software & manually.
- 3. Learn how to write a report with help of one & two.

# Group B: Project Work

### Part-1. Field Study

- 1. Understand the aims, objectives, need & significance of field study.
- 2. Learn the importance of group activity.
- 3. Learning documentation with photo session.
- 4. Understand how toprepare a report on field work.

# Part-II. Oral Presentation with PPT

- 1. Understand the relevance of PPT
- 2. Learn how to prepare a PPT & make a presentation on it.

# WEST BENGAL STATE UNIVERSITY



# **Department of Physical Education** <u>DRAFT OF THE SEMESTER-WISE COURSE STRUCTURES</u>

# Final Draft Syllabus B.A. (General) Course in Physical Education

# UNDER THE CHOICE BASED CREDIT SYSTEM ( CBCS ) Recommended by the University Grants Commission (UGC)

[To be implemented from the Academic Session 2018-19]

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#### **Introduction**

The University Grants Commission (UGC) has taken various measures by means of formulating regulations and guidelines and updating them, in order to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions in India. The various steps that the UGC has initiated are all targeted towards bringing equity, efficiency and excellence in the Higher Education System of country. These steps include introduction of innovation and improvements in curriculum structure and content, the teaching-learning process, the examination and evaluation systems, along with governance and other matters. The introduction of Choice Based Credit System is one such attempt towards improvement and bringing in uniformity of system with diversity of courses across all higher education institutes in the country. The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising of core, elective, skill enhancement or ability enhancement courses. The courses shall be evaluated following the grading system, is considered to be better than conventional marks system. This will make it possible for the students to move across institutions within India to begin with and across countries for studying courses of their choice. The uniform grading system shall also prove to be helpful in assessment of the performance of the candidates in the context of employment.

#### **Outline of the Choice Based Credit System being introduced**

**1.** Core Course (CC): A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

**2. Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the student's proficiency/skill is termed as an Elective Course.

**Discipline Specific Elective Course (DSEC):** Elective courses that are offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

**Generic Elective Course (GEC):** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

#### 3. Ability Enhancement Courses/ Skill Enhancement Courses

**Ability Enhancement Compulsory Course (AECC):** Ability enhancement courses are the courses based upon the content that leads to Knowledge enhancement. They (i) Environmental Science, (ii) English Communication) are mandatory for all disciplines.

**Skill Enhancement Course (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

#### Three year B.A. General Course in Physical Education Structure of Syllabus under Semester System with CBCS to be effective from the Academic Session 2018-19

#### Year1:Semester1

COURSE CODE	COURSE TITLE	COURSE TYPE	CREDIT (L -T- P )	L-T-P HOURS	TOTAL MARKS	INTERNAL MARKS	EXTERNAL MARKS
PEDGCOR01P	Part-A: Foundation & History of Physical Education	Core Course	L = 4	4X15=60	50	0	50
	Part-B: Marching, Callisthenics, Aerobics	Core Course	P= 2	2X30=60	25	15	10
PEDGCOR02T	Discipline-2 (core- 1) other than Physical Education	Core Course	6		75		
ENGLCoRo1T	English – 1	Core Course	6		75		
ENVSAEC01T	Environmental Studies	AECC-1	2		25		
SEMESTER TOTAL			20		250		

#### Year 1: Semester 2

COURSE CODE	COURSE TITLE	COURSE TYPE	CREDIT (L -T- P )	L-T-P HOURS	TOTAL MARKS	INTERNAL MARKS	EXTERNAL MARKS
PEDGCORo3P	Part-A: Management of Physical Education	Core Course	L = 4	4X15=60	50	0	50
	Part-B: Layout of Play Fields	Core Course	P= 2	2X30=60	25	15	10
PEDGCOR04T	Discipline-2 (core- 2) other than Physical Education	Core Course	6		75		
ENGLCoRo2T	English – 1	Core Course	6		75		
ENGSAEC01M	English / Modern Indian Language	AECC-2	2		25		
SEMESTER TOTAL			20		250		

#### Year 2: Semester 3

COURSE CODE	COURSE TITLE	COURSE TYPE	CREDIT (L -T- P )	L-T-P HOURS	TOTAL MARKS	INTERNAL MARKS	EXTERNAL MARKS
PEDGCORo5P	Part-A: Anatomy, Physiology &Exercise Physiology	Core Course	L = 4	4X15=60	50	0	50
	Part-B: Laboratory Practical	Core Course	P= 2	2X30=60	25	15	10
PEDGCORo6T	Discipline-2 (Core- 3) other than Physical Education	Core Course	6		75		
	To be selected from other Arts Departments	Core Course	6		75		
PEDSSEC01M	Track & Field or Kasrate	SEC	P=2	2X30=60	25	25	0
S	EMESTER TOTAL		20		250		

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3

#### Year 2: Semester 4

COURSE CODE	COURSE TITLE	COURSE TYPE	CREDIT (L -T- P )	L-T-P HOURS	TOTAL MARKS	INTERNAL MARKS	EXTERNAL MARKS
PEDGCOR07P	Part-A: Health Education, Test, Measurement & Evaluation in Physical Education	Core Course	L = 4	4X15=60	50	0	50
	Part-B: Fitness Test	Core Course	P= 2	2X30=60	25	15	10
PEDGCOR08T	Discipline-2 (core-4) other than Physical Education	Core Course	6		75		
	To be selected from other Arts Departments	Core Course	6		75		
PEDSSEC02M	Gymnastics & Yoga	SEC	P=2	2X30=60	25	25	0
	SEMESTER TOTAL		20		250		

#### Year 3: Semester 5

COURSE CODE	<b>COURSE TITLE</b>	COURSE TYPE	CREDIT (L -T- P )	L-T-P HOURS	TOTAL MARKS	INTERNAL MARKS	EXTERNAL MARKS
PEDGDSE01T	Any One- 1. Sports Training & Mechanics 2. Therapeutic Aspect of Physical Activities & Lifestyle	DSE	6		75		
	Any One- 1. Other than Physical Education 2. Other than Physical Education	DSE	6		75		
		GE	6		75	25	50
		SEC	2		25		
		20		250			

#### Year 3: Semester 6

COURSE	COURSE TITLE	COURSE	CREDIT	L-T-P	TOTAL	INTERNAL	EXTERNAL
CODE		TYPE	(L -T-P)	HOURS	MARKS	MARKS	MARKS
	Any One- 1. Psychology in Physical Education & Sports 2. Project Work	DSE	6		75		
	Any One- 1. Other than Physical Education 2. Other than Physical Education	DSE	6		75		
		GE	6		75	25	50
		SEC	2		25	25	0
	SEMESTER TOTAL		20		250		

#### Year 1: Semester 1 FOUNDATION AND HISTORY OF PHYSICAL EDUCATION Paper 1: Semester 1 Subject Code : PEDGCOR01P Full Marks: 75 [Internal assessment – 25 Marks ; Semester-end Examination – 50 Marks] Total Credits : 6 [120 Hours] TOTAL CLASS HOURS : 120 [LECTURE HOURS 60 & PRACTICAL HOURS 60]

#### PART – A [THEORY]

#### **Unit- 1: Introduction**

[15 L]\* Meaning and definition of Physical Education, Aim and objectives of Physical Education, Modern concept and changing concepts of Physical Education, Importance, Nature and scope of Physical Education.

#### Unit- 2: Biological, Sociological and Philosophical Foundations of Physical Education

Biological Foundation- Meaning and definition of growth and development. Factors affecting growth and development. Differences of growth and development. Principles of growth and development, Age- Chronological age, anatomical age, physiological age and mental age. Sociological Foundation-Meaning and definition of Sociology, Society and Socialization. Role of games and sports in National and International integration, Introduction of philosophies – naturalism, pragmatism, realism, idealism.

#### **Unit- 3: History of Physical Education**

Historical development of Physical Education and Sports in India- Pre-Independence period and Post-Independence period, Olympic Movement- Ancient Olympic Games and Modern Olympic Games, Brief historical background of Asian Games and Commonwealth Games, Modern and Ancient Historical perspectives: USA, UK, Greece, Rome, and India.

#### **Unit- 4: Yoga Education**

Meaning and definition of the term Yoga, types, aim, objectives and important of Yoga, History of Yoga, Astanga Yoga, Hatha Yoga.

#### PART – B [PRACTICAL] MARCHING, CALLISTHENICS, AEROBICS

1.	Development	of	physical	fitness	throu	gh Marching		[25 L]
2.	Callisthenics							[ <b>15</b> L]
3.	Development	of	physical	fitness	and	co-ordination through	Aerobics.	[20 L]

#### **Suggested Readings**

- Graham, G. (2001) Teaching Children Physical Education: Becoming a Master Teacher. Human Kinetics, Champaign, Illinois, USA.
- Kamlesh, M.L. & Singh, M.K. (2006) Physical Education (Naveen Publication). \*
- ٠ Lau, S.K. (1999) Great Indian Players, New Delhi, Sports.
- Lumpkin, A. (2007) Introduction to Physical Education, Exercise Science and Sports Studies, McGraw Hill, ٠ New York, USA.
- \* Siedentop, D. (2004) Introduction to Physical Education, Fitness and Sport, McGraw Hill Companies Inc., New York, USA.
- $\Leftrightarrow$ Shaffer, D.R. (2002) Development Psychology: Childhood and Adolescence. Thomson, Sydney, Australia.
- Shukla, (2000) Mother on Education, National Council of Teacher Education, New Delhi.  $\dot{\mathbf{v}}$
- \* Singh, A. et al. (2000) Essential of Physical Education, Kalyani Publishers, Ludhiana, Punjab.
- Wuest, D.A. & C.A. Bucher (2006) Foundation of Physical Education, Exercise Science, and Sports. ٠ McGraw Hill Companies Inc.; New York, USA.

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#### [20L]

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#### [10 L]

[15 L]

6

#### Vide Resolutions taken at U.G.BOS Meeting, Ph.Ed. WBSU dt. 3.5.2018. and in concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

#### \* L = 1 Hour.

## Year 1: Semester 2

# MANAGEMENT OF PHYSICAL EDUCATION AND SPORTS

#### Paper 1: Semester 2 Subject Code : PEDGCOR03P

#### Full Marks: 75

[Internal assessment - 25 Marks; Semester-end Examination - 50 Marks] Total Credits : 6 [120 Hours] TOTAL CLASS HOURS : 120 [LECTURE HOURS 60 & PRACTICAL HOURS 60]

#### PART – A [THEORY]

#### **Unit- 1: Introduction**

[10 L]\* Concept and definition of Sports Management, Important of Sports Management, Purpose of Sports Management, Principles of Sports Management.

#### **Unit- 2: Tournaments**

Tournaments: Meaning and definition and types of tournaments (Knock-out, League, Combination, Challenge), Procedure of drawing fixture (Knock-out, League, Combination), Method of organising Annual Athletic Meet and Play Day, Method of organising of Intramural and Extramural competition.

#### **Unit- 3: Facilities and Equipment's**

Method of calculation of Standard Athletic Track and Field marking, Care and maintenance of Playground and gymnasium, Importance, care and maintenance of sports equipment, Lay- out of Play-Field and Basic Rules: Football, Kabaddi, Kho-Kho, Badminton and Volleyball.

#### **Unit- 4: Leadership**

Meaning and definition of leadership, Qualities of good leader in Physical Education, Principles of leadership activities, Hierarchy of Leadership in School, College and University level, Time Table: Meaning, importance and factors affecting Time Table.

# PART – B [PRACTICAL] LAY OUT KNOWLEDGE AND OFFICIATING ABILITY

1. Track and Field events.

2. Games: Football, Kabaddi, Kho-Kho, Badminton and Volleyball (any two).

#### **Suggested Readings**

- Broyles, F. J. & Rober, H. D. (1979). Administration of sports, Athletic programme: A Managerial Approach. ••• New York: Prentice hall Inc.
- ••• Bucher, C. A. (1983). Administration of Physical Education and Athletic programme, St. Lolis: The C.V. Hosby Co.
- Kozman, H.C. Cassidly, R. & Jackson, C. (1960). Methods in Physical Education. London: W.B. Saunders \*\* Co
- \* Pandy, L.K. (1977). Methods in Physical Education, Delhe: Metropolitan Book Depo.
- Sharma, V.M. & Tiwari, R.H.: (1979). Teaching Methods in Physical Education. Amaravati: Shakti Publication.
- \* Thomas, J. P. (1967). Organization & administration of Physical Education. Madras: Gyanodayal Press.
- \* Tirunarayanan, C. & Hariharan, S. (1969). Methods in Physical Education, Karaikudi: South India Press. ♦ 8. Voltmer, E. F. & Esslinger, A. A. (1979). The organization and administration of Physical Education. New
- York: Prentice Hall Inc.
- ♦ 9. Singh, A. et al. (2010) Essential of Physical Education. Kalyayani Publishers.

#### \* L = 1 Hour.

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#### [10 L]

[30 L]

[30L]

[20 L]

[20 L]
7

# ANATOMY, PHYSIOLOGY AND EXERCISE PHYSIOLOGY

Vide Resolutions taken at U.G.BOS Meeting, Ph.Ed. WBSU dt. 3.5.2018. and in concurrence with

CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

Paper 1: Semester 3

Subject Code : PEDGCORo5P

Year 2: Semester 3

Full Marks: 75

[Internal assessment - 25 Marks ; Semester-end Examination - 50 Marks] Total Credits : 6 [120 Hours] TOTAL CLASS HOURS : 120 [LECTURE HOURS 60 & PRACTICAL HOURS 60]

#### PART – A [THEORY]

#### Unit- 1: Introduction

Meaning and definition of Anatomy, Physiology and Exercise Physiology, Importance of Anatomy, Physiology and Exercise Physiology in Physical Education, Human Cell- Structure and function, Tissue- Types and functions.

#### Unit- 2: Musculo-skeletal System

Skeletal System- Structure of Skeletal System. Classification and location of bones and joints. Anatomical differences between male and female, Muscular System- Type, location, function and structure of muscle, Types of muscular contraction, Effect of exercise on muscular system.

#### **Unit-3: Circulatory and Respiratory System**

Blood- Composition and function, Heart- Structure and functions. Mechanism of blood circulation through heart. Blood Pressure, Athletic Heart and Bradycardia, Effect of exercise on circulatory system, Structure and function of Respiratory organs, Mechanism of Respiration, Vital Capacity, O2 Debt and Second Wind, Effect of exercise on respiratory system.

#### **Unit- 4: Nervous and Endocrine System**

Meaning of Nervous System, Parts of Nervous System, system-structure of brain, spinal cord, Neuron, reflex action, Reciprocal Innervations. Meaning of Endocrine Gland, Function and Location of pituitary, Thyroid and Adrenal Glands.

#### PART – B [LABORATORY PRACTICAL]

- 1. Assessment of, BMI, Heart rate, Blood Pressure, Respiratory Rate, Pick Flow Rate and Vital Capacity. [30 L]
- 2. Anthropometric measurement (Length, wide and circumference of bones), Body fat%.

[30 L]

#### **Suggested Readings**

- Amrit Kumar, R, Moses. (1995). Introduction to Exercise Physiology. Madras: Poompugar Pathipagam.
- Clarke, D.H. (1975). Exercise Physiology. New Jersey: Prentice Hall Inc., Englewood Cliffs. ٠
- $\dot{\mathbf{v}}$ David, L Costill. (2004). Physiology of Sports and Exercise, Human Kinetics.
- ••• Fox, E.L., and Mathews, D.K. (1981). The Physiological Basis of Physical Education and Athletics. Philadelphia: Sanders College Publishing.
- Guyton, A.C. (1976). Textbook of Medical Physiology. Philadelphia: W.B. Sanders co. Richard, W. Bowers. ••• (1989). Sports Physiology, WMC: Brown Publishers.
- ••• SandhyaTiwaji. (1999). Exercise Physiology, Sports Publishers.
- Shaver, L. (1981). Essentials of Exercise Physiology. New Delhi: Subject Publications. •••
- Vincent, T. Murche. (2007). Elementary Physiology. Hyderabad: Sports Publication. •••
- William, D. McAradle. (1996). Exercise Physiology, Energy, Nutrition and Human Performance. Philadelphia: Lippincott Williams and Wilkins Company

#### \* L = 1 Hour.

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[**16** L]

[24 L]

[10 L]

[10 L]\*

# TRACK & FIELD Paper 2: Semester 3 Subject Code : PEDSSEC01M Full Marks: 25 [Internal assessment/Practical – 15 Marks] Total Credits : 2 [60 Hours] TOTAL CLASS HOURS : 60 [PRACTICAL HOURS 60]

Unit-1 : Track Events

L]\*

Starting Techniques: Standing start and Crouch start (its variations) use of Block, Acceleration with proper running techniques, Finishing technique: Run Through, Forward Lunging and Shoulder Shrug, Relay Race: Starting, Baton Holding, Carrying, Baton Exchange in between zone, and Finishing.

#### Unit-2 : Field events (any two)

L]

- 1. Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing.
- 2. High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing.
- 3. Shot put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique).
- 4. Discus Throw: Holding the Discus, Initial Stance, Primary Swing, Turn, Release and Recovery (Rotation in the circle).
- 5. Javelin Throw: Grip, Carry, Release and Recovery (3/5 Impulse stride).

\* L = 1 Hour.

# KARATE (MARSHAL ART)

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Paper 2: Semester 3 Subject Code : PEDSSEC01M or

#### Full Marks: 25 [Internal assessment/Practical – 15 Marks] Total Credits : 2 [60 Hours] TOTAL CLASS HOURS : 60 [PRACTICAL HOURS 60]

<u>Unit-1 : Fundamental Skills</u>

**1. Arm Techniques (any ten):** Punch, Strike, Rising punch, Hook punch, Mountain punch, Two handed punch, Parallel punch, Scissors punch, Flowing punch, Bent wrist strike, Eagle hand, Open hand, Straight punch, Upper punch, Back fist strike, Round hook punch, Jab punch, Reverse punch.

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# [15

[45

[15 L]\*

- 2. Foot Techniques (any five): Front kick (snap & thrust), Stomping joint kick, Knee kick, Double front kick, Jump kick, Swing kick, Side kick (snap & thrust), Round kick, Back kick, Foot sweep, Heel drop, Stomp (strike).
- **3. Foot Movements (any five):** Sliding step, Shuffling step, Natural stepping, Dragging step, Kicking foot, Moving, Landing, One foot length.
- **4. Stances (any five):** Closed foot stance, Parallel stance, Natural stance, straddle leg stance, horse riding stance, Hourglass stance, Front stance, Half front stance, Free stance, Back stance, Cat stance, "L" stance, Dide facing straddle stance, Squat stance.
- **5. Blocking Techniques (any ten):** Block, Rising block (Head), Inside circular block, Sweeping block, Side block, Two hand scoop block, Palm heel sweeping block, Palm heel descending block, Bow & Arrow block, Back hand circling press block, Circular elbow block, Back-hand hook block, Middle level inward pulling block, Cross block, Hook block, Arm wedge, Downward block, Grasping block, Knife hand block, Palm heel block, inside forearm block, Wrist block, Back hand block, Elbow block, Knee block, Double handed block.
- **6.** Game practice with application of Rules and Regulations.

# A. Rules and their interpretation and duties of officials. (45L)

\*L = 1 Hour.

# <u>Year 2: Semester 4</u> HEALTH EDUCATION, TEST, MEASUREMENT & EVALUATION IN PHYSICAL EDUCATION Paper 1:

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# Semester 4 Subject Code : PEDGCOR07P

Full Marks: 75 [Internal assessment – 25 Marks ; Semester-end Examination – 50 Marks] Total Credits : 6 [120 Hours] TOTAL CLASS HOURS : 120 [LECTURE HOURS 60 & PRACTICAL HOURS 60]

# PART – A [THEORY]

#### Unit- 1: Introduction

L]\*

Concept, definition and dimension of Health, Definition, aim, objectives and principles of Health Education, School Health Program- Health Service, Health Instruction, Health Supervision, Health appraisal and Health Record, Communicable Diseases& Non-communicable Diseases (Malaria, Cholera, Influenza and Chicken Pox, Obesity, Diabetes), Basic Nutrients: - Protein, Carbohydrates, Fat, Vitamins, Minerals and Water, Balance Diet, Athletic Diet, Standard Diet

<u>Unit- 2: Health and First-aid Management</u> © Department of Physical Education, West Bengal State University. [18

[**18** L] First aid- M 9

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School, College, Play-ground, Streets, Postural deformities- Causes and corrective exercise of Kyphosis, Lordosis, Scoliosis, Knock Knees and Flat Foot.

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#### Unit-3: Introduction Test, measurement & Evaluation

Concept of test, measurement & Evaluation, Criteria of good test, Principles of Evaluation, Importance of Test, Measurement and Evaluation in Physical Education and Sports.

#### Unit- 4: Measurements of Body Compositions and Somatotype Assessment

Body Mass Index (BMI)- Concept and method of measurement, Body Fat- Concept and method of measurement, Lean Body Mass (LBM)- Concept and method of measurement, Somatotype- Concept and method of measurement.

#### <u>PART – B [ PRACTICAL]</u> FITNESS TEST

#### **Unit-1: Fitness Test**

- 1 Kraus-Weber Muscular Strength Test
- 2 AAHPER Youth Fitness Test
- 3 Queens College Step Test
- 4 Harvard Step Test
- 5 Assessment of% body fat

#### **Sports Skill Test**

- 1 4.1 Lockhart and McPherson Badminton Skill Test
- 2 4.2 Johnson Basketball Test Battery
- 3 4.3 McDonald Soccer Test
- 4 4.4 Brady Volleyball Test

#### Suggested Readings

- \* Bucher, Charles A. "Administration of Health and Physical Education Programme".
- Delbert, Oberteuffer, et. al." The School Health Education".
- ✤ Ghosh, B.N. "Treaties of Hygiene and Public Health".
- Hanlon, John J. "Principles of Public Health Administration" 2003.
- ◆ Turner, C.E. "The School Health and Health Education".
- Moss et. al. "Health Education" (National Education Association of U.T.A.).
- \* Nemir A. 'The School Health Education" (Harber and Brothers, New York).
- Nutrition Encyclopedia, edited by Delores C.S. James, The Gale Group, Inc.
- Boyd-Eaton S. et al (1989) The Stone Age Health Programme: Diet and Exercise as Nature Intended. Angus and Rober
- tson.
- Terras S. (1994) Stress, How Your Diet can Help: The Practical Guide to Positive Health Using Diet, Vitamins, Minerals, Herbs and Amino Acids, Thorons .
- Authors Guide (2013) ACSM's Health Related Physical Fitness Assessment Manual, USA: ACSM Publications.
- Collins, R.D., & Hodges P.B. (2001) A Comprehensive Guide to Sports Skills Tests and Measurement (2nd edition) Lanham: Scarecrow Press.
- ◆ 3. Cure ton T.K. (1947) Physical Fitness Appraisal and Guidance, St. Louis: The C. Mosby Company.
- ♦ 4. Getchell B (1979) Physical Fitness A Way of Life, 2nd Edition New York.
- 5. John Wiley and Sons, Inc Jenson, Clayne R and Cynt ha, C. Hirst (1980) Measurement in Physical Education and Athletics, New York, Macmillan Publising Co. Inc.
- 6. Kansal D.K. (1996), "Test and Measurement in Sports and Physical Education, New Delhi: DVS Publications.
- \* 7. Krishnamurthy (2007) Evaluation in Physical Education and Sports, New Delhi; Ajay Verma Publication.
- 8. Vivian H. Heyward (2005) Advance Fitness Assessment and Exercise Prescription, 3rd Edition, Dallas TX: The Cooper Institute for Aerobics Research.
- 9. Wilmore JH and Costill DL. (2005) Physiology of Sport and Exercise: 3rd Edition. Champaigm IL: Human Kinetics.
- 10. Yobu, A (2010), Test, Measurement and Evaluation in Physical Education in Physical Education and Sports. New Delhi; Friends Publications

#### \* L = 1 Hour.

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[**18** L]

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GYMNASTICS AND YOGA Paper 2: Semester 4 Subject Code : PEDSSECo2M Full Marks: 25 [Internal assessment/Practical – 15 Marks] Total Credits : 2 [60 Hours] TOTAL CLASS HOURS : 60 [PRACTICAL HOURS 60]

#### Unit-1: GYMNASTICS

#### 1. Compulsory

- Forward Roll
- ✤ T-Balance
- Forward Roll with Split leg
- Backward Roll
- Cart-Wheel

#### 2. Optional (any two)

- Dive and Forward Roll
- Hand Spring
- ✤ Head Spring
- Neck Spring
- Hand Stand and Forward Roll
- ✤ Summersault

#### Unit-2: YOGA

- 3. Asanas
- Standing Position (Ardhachandrasana, Brikshasana, Padahastasana)
- Sitting Position( Ardhakurmasana , Paschimottanasana , Gomukhasana )
- Supine Position (Setubandhasana , Halasana , Matsyasana)
- Prone Position (Bhujangasana, Salvasana , Dhanurasana)
- \* Inverted Position (Sarbangasana , Shirsasana, Bhagrasana )
- 4. Pranayama (any two) [Kapalbhati, Bhramri, Anulam, Vilom].

\* L = 1 Hour.

# Year 3 : Semester 5

#### SPORTS TRAINING & MECHANICS Paper 1: Semester 5

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Subject Code : PEDGDSE01T Full Marks: 75 [Internal assessment – 25 Marks ; Semester-end Examination – 50 Marks] Total Credits : 6 [90 Hours] TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit- 1: Introduction**

[20 L]\*

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[20 L]\*

[40 L]

Meaning, definition, Aim and characteristics of Sports Training. Principles and Importance of Sports Training, Warming up, cooling down and Conditioning -Meaning, types, methods and principles, Training Methods- Circuit Training, Interval Training, Weight Training, Fartlek Training

#### **Unit- 2: Training Techniques**

Strength- Means and methods of strength development, Speed- Means and methods of speed development, Endurance- Means and methods of endurance development, Flexibility- Means and methods of flexibility development.

#### **Unit-3: Training Load and Adaptation**

Training Load- Meaning, definition, types and factors of training load, Over Load- Meaning, causes, symptoms and tackling of over load, Adaptation- Meaning and conditions of adaptation, Components of training load, 3.4 Periodization- Meaning, types, aim and contents of different periods.

#### **Unit- 4: Mechanical Principles Applied to Sports**

Law of Motion, Equilibrium - its type and Law, Centre of Gravity, Force and its types, Lever and its Types.

#### **Suggested Readings**

- Baechle T R & Earle R W (2000). Essentials of strength training and conditioning. Human Kinetics. USA.
- \* Bompa. T.O. (1994). Theory and Methods of Training-A Key to Athletic Performance (3rd Ed.). Kandwall Hunt Publication Co.
- Bompa. T.O. and G. Gregory Hett. (2009) Periodizzzation: Theory and Methodology of Training. •••
- $\Leftrightarrow$ Dick FW (1999). Sport training Principles. A and C Black. London.
- Knopf K (2008). Total Sports Conditioning for Athletes 50 + Ulyssesl Press. Berkeley. California. USA.  $\Rightarrow$
- Newton H (2006). Explosive lifting for sports. Human Kinetics. US. \*
- Philipp A Joan and Wilkerson Jerry D (Joan A. Philipp & Jerry D. Wilkerson.  $\dot{\mathbf{v}}$
- Singh Hardayal (1991). Science of Sport Training. D.V.S Pub. Delhi. ٠
- Thomas R. Baechle and Roger W. Earle, (2000). \*
- Singh MK (2008). Comprehensive Badminton (Scientific Training). Friends Publication. •••
- $\dot{\mathbf{v}}$ Beer, Johnson and Dewolf, Mechanics of Materials, Tata McGraw-Hill Education
- ••• H.J.Shah and S.B. Junnarkar, Mechanics of Structures Vol.1, Charotar Publishing House Pvt Limited
- $\dot{\mathbf{v}}$ Brendan Burket, Sport Mechanics for Coaches-3rd Edition, ISBN-13: 9780736083591

\* L = 1 Hour.

# OR

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# THERAPEUTIC ASPECT OF PHYSICAL ACTIVITIES AND LIFESTYLE

# Paper 1: Semester 5

Subject Code : PEDGDSE01T

# Full Marks: 75

[Internal assessment - 25 Marks ; Semester-end Examination - 50 Marks] Total Credits : 6 [90 Hours]

# TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit- 1: Introduction**

Meaning, definition, Aim and Scope of Therapy. Types of Therapy, Definition and Terms of Physiotherapy- Electrotherapy, Exercise-therapy, Massage-therapy, Ergonomics, Rehabilitation, Physical modalities used in Physiotherapy, Exercise Therapy: Corrective, Isotonic, Isometric and Resistance Exercise,

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#### **Unit-2: Therapeutic Aspects of Physical Activities**

Exercise of chronic diseases: Osteoporosis, Obesity, Hypertension, Diabetes, Cardiovascular diseases, Basic Principal of Rehabilitation- modalities and Relaxation Techniques, Definition of Massage, Aim and Types of Massage, Physiological effects of Massage, Therapeutic uses of Massage, Rules & direction of Massage, Concept of Yoga Therapy, Principles of Yoga Therapy, Qualities of Yoga Therapist, Yoga Therapy For chronic diseases (Obesity, Hypertension and Diabetes).

#### **Unit-3: Methods of Physiotherapy**

Electro Therapy: meaning, use, principles and Technique and Safety precautions in Electrotherapy, Hydrotherapy: meaning, use, Type, Technique and Safety precautions in Hydrotherapy, Cry Therapy: meaning, use, Type, Physiological effects, Methods of application, and Safety precautions Cry Therapy, Thermo Therapy: meaning, use, Benefits, Methods of application, and Safety precautions Thermo Therapy.

#### **Unit-4: Physical Activities and Lifestyle**

Physical Activities, Health and Wellness- Meaning, definition and Importance of Physical Fitness, Relationship between Physical activities and Wellness, Health and Fitness Active Lifestyle. Health and Performance related Physical Fitness, Physical Activity for different age and Women- Puberty, Adolescent, Post- Adolescent periods, Ageing, Pregnancy, House Wife, Limitation of Female in Athletics, Physical activity for the Disable: Types of Disability, Programme for the disabled.

#### **Suggested Readings**

- Jeffreys. Bland "The Disease Delusion: Conquering the Causes of Chronic Illness for a Healthier, Longer, and Happier Life", Published May 6th 2014 by Harper Wave (first published April 22nd 2014)
- \* Wilding, C. (2010). Teach Yourself Cognitive Behavioural Therapy. Teach Yourself Books: London.
- Branch, R., Wilson, R. (2010). Cognitive Behavioural Therapy For Dummies. John Wiley and Sons: New York.
- \* Magee DJ. Orthopedic physical assessment, Philadelphia, W.B. Saunders, 5th edition, 2007
- Srukner P and Sydney KK. Clinical sports medicine, McGraw-Hill Co., 2011
- Warwick DJ, Solomon L and Nayagam S. Apley's System of Orthopedics and Fractures, Arnold, 9th edition, 2010.
- Hoppenfeld S. and VasanthaL.M. Treatment and rehabilitation of fractures, 1st edition, Philadelphia, Lippincott Williams & Wilkins, 2000.
- Petty NJ and Moore AP. Neuromusculoskeletal examination and assessment: a handbook for therapies. Foreword by GD Maitland Edinburgh, Churchill Livingstone, 4th edition 2011.
- \* Kauffman TL. The geriatric rehabilitation manual, Churchill-Livingstone Elsevier, PA, USA, 2007
- ✤ Fox J and Sharp T. Practical Electrotherapy: A Guide to Safe Application. Churchill Livingstone, 2007.

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\* L = 1 Hour.

# MODERN TRENDS AND PRACTICES IN PHYSICAL EDUCATION EXERCISE SCIENCES (FOR THE STUDENTS OTHER THAN PHYSICAL EDUCATION) Paper 2: Semester 5 Subject Code : PEDGGECo1T Full Marks: 75 [Internal assessment – 25 Marks ; Semester-end Examination – 50 Marks] Total Credits : 6 [90 Hours] TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit- 1: Introduction**

[12 L]

Meaning, definition and importance of physical Education and Sports, Aims, objectives and scope of Physical Education, Types of sports and their utility in physical education, Meaning, definition and importance of Physical fitness and Motor fitness. Difference between physical fitness and motor fitness. Components of Physical fitness.

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#### Unit- 2: Biological, Psychological and Sociological Foundations of Physical Education

Biological Foundation- Meaning and definition of growth and development. Factors affecting growth and development, Differences of growth and development, Principles of growth and development, Meaning and definition of Psychology. Importance of Psychology in Physical Education, Qualities of good leader in Physical Education, Principles of leadership activities, Sociological Foundation-Meaning and definition of Sociology. Social values and their Importance. Socialization through Sports, Role of games and sports in National and International integration. [18 L]

#### **Unit- 3: History of Physical Education**

Historical development of Physical Education and Sports in India- Pre-Independence period and Post-Independence period, Ancient Olympic Games, Modern Olympic Games, Asian Games.

#### **Unit- 4: Exercise Sciences**

Meaning, definition and importance Exercise and Exercise Physiology, Effects of short and long term exercise on Muscular systems, Effects of short and long term exercise on Circulatory System, Effects of short and long term exercise on Respiratory System.

#### Suggested Readings

- Kamlesh, M.L. & Singh, M.K. (2006) Physical Education (Naveen Publication).
- Lumpkin, A. (2007) Introduction to Physical Education, Exercise Science and Sports Studies, McGraw Hill, New York, USA.
- Siedentop, D. (2004) Introduction to Physical Education, Fitness and Sport, McGraw Hill Companies Inc., New York, USA.
- Shaffer, D.R. (2002) Development Psychology: Childhood and Adolescence. Thomson, Sydney, Australia.
- Shukla, (2000) Mother on Education, National Council of Teacher Education, New Delhi.
- Singh, A. et al. (2000) Essential of Physical Education, Kalyani Publishers, Ludhiana, Punjab.
- Wuest, D.A. & C.A. Bucher (2006) Foundation of Physical Education, Exercise Science, and Sports. McGraw Hill Companies Inc.; New York, USA.
- Fahey, T.D., M.P. Insel and W.T. Rath (2006) Fit & Well: Core Concepts and Labs in Physical Fitness, McGraw Hill, New York.
- Kansal, D.K. (2012) A Practical Approach to Test Measurement and Evaluation Sports and Spiritual Science Publication, New Delhi.
- Clarke, D.H. (1975). Exercise Physiology. New Jersey: Prentice Hall Inc., Englewood Cliffs.
- David, L Costill. (2004). Physiology of Sports and Exercise. Human Kinetics.
- Fox, E.L., and Mathews, D.K. (1981). The Physiological Basis of Physical Education and Athletics. Philadelphia: Sanders College Publishing.

\* L = 1 Hour.

#### INDIAN GAMES AND RACKET SPORTS Paper 3: Semester 5 Subject Code : PEDSSECo3M Full Marks: 25 [Internal assessment/Practical – 15 Marks] Total Credits : 2 [60 Hours] TOTAL CLASS HOURS : 60 [PRACTICAL HOURS 60]

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#### Unit-1: KABADDI

#### A. Fundamental skills

- 1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.
- 2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.
- 3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defence.

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4. Game practice with application of Rules and Regulations.

B. Rules and their interpretations and duties of the officials.

#### OR

<u>KHO-KHO</u>

#### A. Fundamental skills

- 1. Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distyal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul.
- 2. Skills in running: Chain Play, Ring play and Chain & Ring mixed play.
- 3. Game practice with application of Rules and Regulations.
- B. Rules and their interpretations and duties of the officials.

#### **Unit-2: BADMINTON**

#### A. Fundamental skills

- 1. Basic Knowledge: Various parts of the Racket and Grip.
- 2. Service: Short service, Long service, Long-high service.
- 3. Shots: Overhead shot, Defensive clear shot, Attacking clear shot, Drop shot, Net shot, Smash.

OR

- 4. Game practice with application of Rules and Regulations.
- B. Rules and their interpretations and duties of the officials.

#### TABLE TENNIS

#### A. Fundamental skills

- 1. Basic Knowledge: Various parts of the Racket and Grip (Shake Hand & Pen Hold Grip).
- 2. Stance: Alternate & Parallel.
- 3. Push and Service: Backhand & Forehand.
- 4. Chop: Backhand & Forehand.
- 5. Receive: Push and Chop with both Backhand & Forehand.
- 6. Game practice with application of Rules and Regulations.
- B. Rules and their interpretations and duties of the officials.

#### \* L = 1 Hour.

# <u>Year 3 : Semester 6</u> PSYCHOLOGY IN PHYSICAL EDUCATION AND SPORTS Paper 1: Semester 6 Subject Code : PEDGDSE03T Full Marks: 75 [Internal assessment – 25 Marks ; Semester-end Examination – 50 Marks] Total Credits : 6 [90 Hours]

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#### TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit- 1: Introduction**

Meaning and definition Psychology, Importance and scope of Psychology, Meaning and definition Sports Psychology, Need for knowledge of Sports Psychology in the field of Physical Education.

#### Unit- 2: Learning

Meaning and definition of learning, Theories of learning and Laws of learning, Learning curve: Meaning and Types, Transfer of learning- Meaning, definition type and factors affecting transfer of learning.

#### **Unit-3: Psychological Factors**

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Motivation- Meaning, definition, type and importance of Motivation in Physical Education and Sports, Emotion- Meaning, definition, type and importance of Emotion in Physical Education and Sports. Personality- Meaning, definition and type Personality traits, Role of physical activities in the development of personality.

#### **Unit- 4: Stress and Anxiety**

[20 L] Stress- Meaning, definition and types of Stress, Causes of Stress. Effect of Stress on Sports Performance, Anxiety- Meaning, definition and types of Anxiety. . Effect of Anxiety on Sports Performance, Management of Stress and Anxiety through physical activity and sports.

#### **Suggested Readings**

- Authors Guide (2013) National Library of Educational and Psychological Test (NLEPT) Catalogue of Tests, New Delhi: National Council of Educational Research and Training Publication.
- ••• Jain. (2002), Sports Sociology, Heal Sahety Kendre Publishers.
- Jay Coakley. (2001) Sports in Society Issues and Controversies in International Education, Mc-Craw Seventh Ed. ٠
- $\dot{\bullet}$ John D Lauther (2000) Psychology of Coaching. NerJersy: Prenticce Hall Inc.
- ••• John D. Lauther (1998) Sports Psychology. Englewood, Prentice Hall Inc.
- ٠ Miroslaw Vauks & Bryant Cratty (1999). Psychology and the Superior Athlete. London: The Macmillan Co.
- $\div$ Richard, J. Crisp. (2000). Essential Social Psychology. Sage Publications.
- \* Robert N. Singer (2001). Motor Learning and Human Performance. New York: The Macmillan Co.
- \* Robert N. Singer. (1989) The Psychology Domain Movement Behaviour. Philadelphia: Lea and Febiger.
- \* Thelma Horn. (2002). Advances in Sports Psychology. Human Kinetic.
- Whiting, K, Karman., Hendry L.B& Jones M.G. (1999) Personality and Performance in Physical Education and Sports. London: Hendry Kimpton Publishers.

#### \* L = 1 Hour.

# OR

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# **PROJECTWORK**

#### Paper 1: Semester 6 Subject Code : PEDGDSE03T Full Marks: 75 [Internal assessment – 25 Marks ; Semester-end Examination – 50 Marks] Total Credits : 6 [90 Hours] TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

Unit-1: Record Book: Physical Fitness Components, Body composition and Somatotype, Rules of Games and Sports, Non-communicable diseases, First-aid Management

#### **Unit-2: Dissertation / Project Report**

The candidate is required to select a topic of his/her choice for the Dissertation and project. The Steps for Dissertation/Project Report that should be followed are given below

- 1. Analysing the problem or topic.
- 2. Conducting extensive research.
- 3. Summarizing findings from the research investigation.
- 4. Recommending additional research on the topic.
- 5. Drawing conclusions and making recommendations.
- 6. Documenting the results of the research.
- 7. Defending conclusions and recommendations.

#### THE ORIGINAL AND COPIES OF THE THESIS MUST INCLUDE THE FOLLOWING ITEMS IN THE ORDER LISTED:

- 1. Title Page.
- 2. Acknowledgment

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3. Abstract

- 4. Table of Contents.
- 5. Introduction
- 6. Review of Related Literature
- 7. Procedure and methodology
- 8. Results and findings
- 9. Discussions, summary and conclusions.

# **HEALTH EDUCATION AND TESTS & MEASUREMENTS IN** PHYSICAL EDUCATION (FOR THE STUDENTS OTHER THAN PHYSICAL EDUCATION) Paper 2: Semester 6 Subject Code : PEDGGEC02T Full Marks: 75 [Internal assessment - 25 Marks; Semester-end Examination - 50 Marks] Total Credits : 6 [90 Hours]

#### **Unit- 1: Introduction**

Concept, definition and dimension of Health, Definition, aim, objectives and principles of Health Education, Health Agencies- World Health Organization (WHO), United Nations Educational Scientific and Cultural Organization (UNESCO), Nutrition- Nutritional requirements for daily living. Balance Diet. Health disorders due to deficiencies of Vitamins and Minerals.

#### **Unit- 2: Health and First-aid Managements**

First aid- Meaning, definition, importance and golden rules of First-aid, Concept of sports injuries-Sprain, Strain, Facture and Dislocation, Postural deformities- Causes and corrective exercise of Kyphosis, Lordosis, Scoliosis, Knock Knees and Flat Foot, Hypo-kinetic Diseases and Physical Activities- Obesity and Diabetes.

#### Unit- 3: Mesasurement of Body Compositions and Somatotype Assessmen [20 L]

Body Mass Index (BMI)- Concept and method of measurement, Body Fat- Concept and method of measurement, Lean Body Mass (LBM)- Concept and method of measurement, Somatotype- Concept and method of Assessment.

#### Unit- IV: Fitness Test

Kraus-Weber Muscular Strength Test, AAHPER Youth Fitness Test, Queens College Step Test, Harvard Step Test.

#### **Suggested Readings**

- Bucher, Charles A. "Administration of Health and Physical Education Programme".
- ••• Hanlon, John J. "Principles of Public Health Administration" 2003.
- Turner, C.E. "The School Health and Health Education". \*
- \* Nutrition Encyclopaedia, edited by Delores C.S. James, The Gale Group, Inc.
- $\div$ Boyd-Eaton S. et al (1989) The Stone Age Health Programme: Diet and Exercise as Nature Intended. Angus and Robertson.
- $\dot{\mathbf{v}}$ Terras S. (1994) Stress, How Your Diet can Help: The Practical Guide to Positive Health Using Diet, Vitamins, Minerals, Herbs and Amino Acids, Thorons.
- ••• Collins, R.D., & Hodges P.B. (2001) A Comprehensive Guide to Sports Skills Tests and Measurement (2nd edition) Lanham: Scarecrow Press.
- John Wiley and Sons, Inc Jenson, Clayne R and Cynt ha, C. Hirst (1980) Measurement in Physical ••• Education and Athletics, New York, Macmillan Publising Co. Inc.
- KansalD.K. (1996), "Test and Measurement in Sports and Physical Education, New Delhi: DVS ٠ Publications.
- Krishnamurthy (2007) Evaluation in Physical Education and Sports, New Delhi; Ajay Verma Publication. \*\*
- Vivian H. Heyward (2005) Advance Fitness Assessment and Exercise Prescription, 3rd Edition, Dallas TX: ٠ The Cooper Institute for Aerobics Research.

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#### Vide Resolutions taken at U.G.BOS Meeting, Ph.Ed. WBSU dt. 3.5.2018. and in concurrence with 17 CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

- Wilmore JH and Costill DL. (2005) Physiology of Sport and Exercise: 3rd Edition. Champaigm IL: Human Kinetics.
- Yobu, A (2010), Test, Measurement and Evaluation in Physical Education in Physical Education and Sports. New Delhi; Friends Publications

\* L = 1 Hour.

# BALL GAMES (Any two)

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#### Paper 3: Semester 6 Subject Code : PEDSSEC04M Full Marks: 25 [Internal assessment/Practical – 15 Marks] Total Credits : 2 [60 Hours] TOTAL CLASS HOURS : 60 [PRACTICAL HOURS 60]

#### **FOOTBALL**

A. Fundamental Skills

- 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.
- 2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot.
- 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.
- 4. Heading: In standing, running and jumping condition.
- 5. Throw-in: Standing throw-in and Running throw-in.
- 6. Feinting: With the lower limb and upper part of the body.
- 7. Tackling: Simple Tackling, Slide Tackling.
- 8. Goal Keeping: Collection of Ball, Ball clearance- kicking, throwing and deflecting.
- 9. Game practice with application of Rules and Regulations.
- B. Rules and their interpretation and duties of officials.

#### HANDBALL

- A. Fundamental Skills
- 1. Catching, Throwing and Ball control,
- 2. Goal Throws: Jump shot, Center shot, Dive shot, Reverse shot.
- 3. Dribbling: High and low.
- 4. Attack and counter attack, simple counter attack, counter attack from two wings and center.
- 5. Blocking, GoalKeeping and Defensive skills.
- 6. Game practice with application of Rules and Regulations.
- B. Rules and their interpretation and duties of officials.

#### **CRICKET**

- **A.** Fundamental Skills
- 1. Batting Skill: Block, Cut, Drive, Hook, Leg Glance, Paddle Sweep, Pull, Sweep
- 2. Bowling Skill: Seam Bowling, Swing Bowling, Bouncer, In swinger, Leg Cutter, Off Cutter, Reverse.
- 3. Fielding Skill:
- B. Rules and their interpretation and duties of officials.

#### **VOLLEYBALL**

- A. Fundamental skills
- 1. Service: Under arm service, Side arm service, Tennis service, Floating service.
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- 2. Pass: Under arm pass, Overheadpass.
- 3. Spiking and Blocking.
- 4. Game practice with application of Rules and Regulations.
- B. Rules and their interpretation and duties of officials.

#### **NETBALL**

- A. Fundamental skills
- 1. Catching: one handed, two handed, with feet grounded and in flight.
- 2. Throwing (Different passes and their uses): One hand passes (shoulder, high shoulder, underarm, bounce, lob), two hand passes (Push, overhead and bounce).
- 3. Footwork: Landing on one foot, landing on two feet, Pivot, Running pass.
- 4. Shooting: One hand, forward step shot, and backward step shot.
- 5. Techniques of free dodge and sprint, sudden sprint, sprint and stop, sprinting with change at speed.
- 6. Defending: Marking the player, marking the ball, blocking, inside the circle, outside the Intercepting: Pass and shot.
- 7. Game practice with application of Rules and Regulations.
- B. Rules and their interpretation and duties of officials.

#### THROW BALL

A. Fundamental skills

Overhand service, Side arm service, two hand catching, one hand overhead return, side arm return. **B. Rules and their interpretations and duties of officials.** 

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Recommended by UG BOS in Commerce & Management At its meeting held on 03.05.2018..

> Sd/-Dr. Pranam Dhar Chairperson.

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#### **B.A. POLITICAL SCIENCE GENERAL(Discipline Specific Core)**

#### (For pure General students)

#### (The Syllabus for Semester 2 to Semester 6 may be slightly modified later)

#### LIST OF PAPERS AND COURSES

#### A) PLSGDSC- DISCIPLINE SPECIFIC CORE COURSE (4)

Semester – 1

1. PLSGCOR01T - Paper I - Introduction to Political Theory

Semester - 2

- PLSGCOR02T Paper-II Indian Government and Politics
   Semester 3
- 3. PLSGCOR03T Paper-III- Comparative Government and Politics

Semester - 4

- 4. PLSGCOR04T Paper-IV- Introduction to International Relations
- B) CORE/ FOUNDATION (Compulsory) (4) ENGLISH (2) MIL (2)

#### C) ABILITY ENHANCEMENT (COMPULSORY) (2)

ENGLISH/MIL (Communication) ENVIRONMENTAL SCIENCE

- C) PLSGDSE DISCIPLINE SPECIFIC ELECTIVE 2 (any two) Semester 5 and 6 (For General Students)
   Semester 5 College will offer both but a student will select any one
- 1. PLSGDSE01T Reading Gandhi
- 2. PLSGDSE02T Women, Power and Politics

Semester 6

# College will offer both but a student will select any one

- 3. **PLSGDSE03T** Understanding Global Politics
- 4.PLSGDSE04T Public Policy in India

# E) PLSSSEC - SKILL ENHANCEMENT COURSE (Skill Based)

Semester -- odd (Same as Honours)

1. PLSSSEC01M - Democratic Awareness with Legal Literacy

Semester - even (Same as Honours)

PLSSSEC02M - Public Opinion and Survey Research

#### F)PLSGEC - GENERIC ELECTIVE -

Semester 5

#### **PLSGGECO1T - Human Rights in a Comparative Perspective**

Semester 6

2. PLSGGECO1T - Governance: Issues and Challenges

# **DISCIPLINE SPECIFIC CORE COURSE(4)**

# **BA POLITICAL SCIENCE**

PLSGCOR	Semester I			
Course Code	Paper – I Introduction to Political Theory	Lectures	Credits (Theory+T utorial) X 15 weeks	Marks
PLSGCOR01T	<ul><li>Module I. Introducing the subject</li><li>a. What is Politics?</li><li>b. What is Political Theory and what is its relevance?</li></ul>	10	5+1	75
	<ul> <li>Module II. Concepts: Democracy, Liberty, Equality, Justice, Rights, Gender, Citizenship, Civil Society and State</li> <li>Module III. Debates in Political Theory:</li> <li>a. Is democracy compatible with economic</li> </ul>	30		
	<ul><li>growth?</li><li>b. On what grounds is censorship justified and what are its limits?</li><li>c. Does protective discrimination violate principles of fairness?</li><li>d. Should the State intervene in the institution of the family?</li></ul>	35		

	Semester – 2		5+1	75
PLSGCOR02T	Paper - II			
	Indian Government and Politics			
	Structure, Process, Behaviour.			
	1.Evolution:	20		
	Making of the Constitution by the Constitutional Advisor, the Drafting Committee and finally the Constituent assembly	20		
	2.Constituion of India(Article-wise)			
	a)Preamble b)Fundamental Rights c)Directive Principles of State Policy d)Federalism	20		
	3.Constitution of India			
	a)Union Government: Executive(total as it is in the constitution)Legislature(total, according to the Constitution) Judiciary(total, following the articles of the constitution with two additional dimensions: landmark decisions and PIL b)State Government: Executive, Legislature, Judiciary (In the same way as the Union government is to	35		
	be studied) c)Public Services: Union Service, State service, All India Services(total that includes recruitment, training, service conditions) c)Public service Commission(UPSC and PSC)			

	Semester III			
PLSGCOR				
Course Code	Paper – III Comparative Government and Politics	Lectures	Credits (Theo +Tutorial)X 15 weeks	Marks
	I. Understanding Comparative Politics a. Nature and scope b. Going beyond Eurocentrism	15	5+1	75
PLSGCOR03T	<ul> <li>II. Historical context of modern government         <ul> <li>a. Capitalism: meaning and development: globalization</li> <li>b. Socialism: meaning, growth and development</li> <li>c. Colonialism and decolonization:</li> </ul> </li> </ul>	35		
	<ul> <li>meaning, context, forms of colonialism; anti-colonialism struggles and process of decolonization</li> <li>III. Themes for comparative analysis <ul> <li>A comparative study of constitutional</li> <li>developments and political economy in the following countries: Britain, Brazil and China.</li> </ul> </li> </ul>	25		

PLSGCOR	Semester IV			
Course Code	Paper – IV Introduction to International Relations	Lectures	Credits (Theo +Tutorial )X 15 weeks	Marks
	I. Studying International Relations			
	<ul> <li>a. How do you understand International Relations: Levels of Analysis</li> <li>b. History and IR: Emergence of the International State System</li> </ul>	15	5+1	75
	II. Theoretical Perspectives			
	<ul> <li>a. Classical Realism &amp; Neo-Realism</li> <li>b. Liberalism &amp; Neo-liberalism</li> <li>c. Marxist Approaches</li> <li>d. Feminist Perspectives</li> </ul>	20		
PLSGCOR04T	<ul> <li>III. An Overview of Twentieth Century IR History <ul> <li>a. World War I: Causes and Consequences</li> <li>b. Significance of the Bolshevik Revolution</li> <li>c. Rise of Fascism / Nazism</li> <li>d. World War II : Causes and Consequences</li> <li>e. Cold War: Different Phases</li> <li>f. Emergence of the Third World</li> <li>g. Collapse of the USSR and the End of the Cold War</li> <li>h. Post Cold War Developments and Emergence of Other Power Centers of Power</li> <li>i. Indian as an Emerging Power</li> <li>Indian Foreign Policy</li> </ul> </li> </ul>	35		

### **READING LIST**

# PLSGC0R01T - Paper I- Introduction to Political Theory

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Bhargava, R. (2008) 'Why Do We Need Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 18-37.

Sriranjani, V. (2008) 'Liberty', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 40-57.

Acharya, A. (2008) 'Equality', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 58-73.

Menon, K. (2008) Justice', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 74-82.

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Srinivasan, J. (2008) 'Democracy', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 106-128.

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Das, S. (2008) 'State', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi:Pearson Longman, pp. 170-187. Singh, M. (2008) 'Civil Society', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 188-205.

Menon, N. (2008) 'Gender', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 224-235.

Sen, A. (2003) 'Freedom Favours Development,' in Dahl, R., Shapiro, I. and Cheibub, A. J. (eds.) *TheDemocracy Sourcebook*. Cambridge, Massachusetts: MIT Press, pp. 444-446.

Prezowrski, A., et al. (2003) 'Political Regimes and Economic Growth,' in Dahl, R., Shapiro, I. and Cheibub, A. J. (eds.) *The Democracy Sourcebook*. Cambridge, Massachusetts: MIT Press, pp. 447-454.

Sethi, A. (2008) 'Freedom of Speech and the Question of Censorship', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 308-319.

Acharya, A. (2008) 'Affirmative Action', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 298-307.

Jha, M. (2001) 'Ramabai: Gender and Caste', in Singh, M.P. and Roy, H. (eds.) *Indian Political Thought: Themes and Thinkers*, New Delhi: Pearson

# PLSGC0R02T - Paper-II - Indian Government and Politics

Abbas, H., Kumar, R. & Alam, M. A. (2011) *Indian Government and Politics*. New Delhi: Pearson, 2011.

Chandhoke, N. & Priyadarshi, P. (eds.) (2009) *Contemporary India: Economy, Society, Politics*.New Delhi: Pearson.

Chakravarty, B. & Pandey, K. P. (2006) Indian Government and Politics. New Delhi: Sage.

Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) *India After Independence*. New Delhi: Penguin.

Singh, M.P. &Saxena, R. (2008) Indian Politics: Contemporary Issues and Concerns. New Delhi: PHI Learning.

Vanaik, A. & Bhargava, R. (eds.) (2010) Understanding Contemporary India: Critical Perspectives.New Delhi: Orient Blackswan.

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Austin, G. (2004) *Working of a Democratic Constitution of India*.New Delhi: Oxford University Press.

Jayal, N. G. & Maheta, P. B. (eds.) (2010) *Oxford Companion to Indian Politics*. New Delhi: Oxford University Press.

# PLSGC0R03T - Paper-III- Comparative Government and Politics

Bara, J & Pennington, M. (eds.). (2009) Comparative Politics.New Delhi: Sage.

Caramani, D. (ed.). (2008) Comparative Politics. Oxford: Oxford University Press.

Hague, R. and Harrop, M. (2010) *Comparative Government and Politics: An Introduction*. (Eight Edition). London: Palgrave McMillan.

Ishiyama, J.T. and Breuning, M. (eds.). (2011) 21st Century Political Science: A Reference Book.Los Angeles: Sage.

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# PLSGC0R04T - Paper-IV- Introduction to International Relations

William, P., Goldstein, D. M. and Shafritz, J. M. (eds.) (1999) *Classic Readings of International Relations*. Belmont: Wadsworth Publishing Co, pp. 30-58; 92-126.

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Goldstein, J. and Pevehouse, J.C. (2009) *International Relations*. New Delhi: Pearson, pp. 81-111.

Tickner, J. A. (2001) *Gendering World Politics: Issues and Approaches in the Post-Cold War Era*. Columbia University Press.

Baylis, J. and Smith, S. (eds.) (2011) *The Globalization of World Politics: An Introduction to International Relations*. Fifth Edition. Oxford: Oxford University Press, pp. 90-123; 142-159; 262-277.

Wenger, A. and Zimmermann, D. (eds.) (2003) *International Relations: From the Cold World War to the Globalized World*.London: Lynne Rienner, pp. 54-89.

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Indian Foreign Service Institute. (1997, 1998) *India's Foreign Policy: An Agenda for the 21st Century* Vols. 1 & 2, New Delhi: Konark Publishers, pp. 3-41; 102-119.

Ganguly, S. (ed.) (2009) *India's Foreign Policy: Retrospect and Prospect*. New Delhi: Oxford University Press.

Vanaik, A. (1995) *India in a Changing World: Problems, Limits and Successes of Its Foreign Policy*. New Delhi: Orient Longman. pp. 19-41; 63-67; 102-114; 118-124; 132-134.

Basu, Rumki (ed)(2012) International Politics: Concepts theories and Issues, New Delhi, Sage Publications India Pvt Ltd.

# **DISCIPLINE SPECIFIC ELECTIVE – 1(For General Students)**

# Any Two[Any one in semester V]

# **DISCIPLINE SPECIFIC ELECTIVE – 1**

PLSGDSE	Semester V			
Course Code	Reading Gandhi	Lectures	Credits (Theo +Tutorial) X <b>15</b> weeks	Marks
	<b>Module 1</b> . Gandhi on Modern Civilization and Modern Industrialisation based on Large and Heavy Industries and Alternative Modernity ; critique of development	25	5+1	75
PLSGDSE01T	<ul> <li>Module 2. Gandhian Thought: Theory and Action:</li> <li>a. Theory of Satyagraha</li> <li>b. Satyagraha in Action : Peasant Satyagraha: Kheda and the Idea of Trusteeship</li> <li>c. Gandhi on all-inclusive Development- Sarvodaya – on Untouchability and Dalit emancipation</li> </ul>	30		
	<ul><li>Module 3.</li><li>a. Gandhi on Women's Development and on</li></ul>	20		
	<ul><li>Women's Movement</li><li>Gandhi on peace and Preservation of Nature</li></ul>			

# **DISCIPLINE SPECIFIC ELECTIVE – 2**

PLSGDSE	Semester V			
Course Code	Women, Power and Politics	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	Module 1. Approaches to understanding Patriarchy	25	5+1	75
	• Feminist theorising of the sex/gender distinction. Biologism versus social constructivism			
	Understanding Patriarchy and Feminism			
	<b>Module 2.</b> Liberal, Socialist, Marxist, Radical feminism, New Feminist Schools/Traditions	30		
PLSGDSE02T	Module 3. The Indian Experience			
	<ul> <li>Traditional Historiography and Feminist critiques. Social Reforms Movement and position of women in India. History of Women's struggle in India</li> <li>Family in contemporary India - patrilineal and matrilineal practices. Gender Relations in the Family, Patterns of Consumption: Intra Household Divisions, entitlements and bargaining, Property Rights</li> </ul>	20		
	• Understanding Woman's Work and Labour			

# **DISCIPLINE SPECIFIC ELECTIVE – 3**

# Any Two[Any one in semester VI]

PLSGDSE	Semester VI			
Course Code	Understanding Global Politics	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	<ul> <li>I. Globalization: Conceptions and Perspectives</li> <li>a. Understanding Globalization and its Alternative Perspectives</li> <li>b. Political: Debates on Sovereignty and Territoriality</li> <li>c. Global Economy: Its Significance and Anchors of Global Political Economy:</li> </ul>	25	5+1	75
PLSGDSE03T	<ul> <li>IMF, World Bank, WTO, TNCs</li> <li>II. Identity and Culture</li> <li>III. What Drives the World Apart?</li> <li>a. Global Inequalities</li> <li>b. Violence: Conflict, War and Terrorism</li> </ul>	10 15		
	<ul> <li>IV. Why We Need to Bring the World Together?</li> <li>a. Global Environment : Ecological Issues: Historical Overview of International Environmental Agreements, Climate Change, Global Commons Debate</li> <li>b. Global Civil Society : Proliferation of Nuclear Weapons ; International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments ; Migration ; Human Security</li> </ul>	25		

PLSADSE	Semester VI			
Course Code	Paper - IV Public Policy in India	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
PLSADSE04T	<ul> <li>Module . I. Introduction to Policy Analysis         <ul> <li>a. The Analysis of Policy in the Context of Theories of State</li> <li>b. Political Economy and Policy: Interest Groups and Social Movements.</li> </ul> </li> <li>Module II.Models of Policy Decision-Making     <ul> <li>Module III. Ideology and Policy: Nehruvian Vision, Economic Liberalisation and recentdevelopments</li> </ul> </li> </ul>	30 20 25	5+1	75

PLSGGEC	Semester			
Course Code	Human Rights in a Comparative Perspective	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
<b>PLSGGEC01T</b>	<ul> <li>I. Human Rights: Theory and Institutionalization <ul> <li>a. Understanding Human Rights: Three</li> <li>Generations of Rights</li> <li>b. Institutionalization: Universal Declaration of</li> <li>Human Rights</li> <li>c. Rights in National Constitutions: South Africa and India</li> </ul> </li> <li>II. Issues <ul> <li>a. Torture: USA and India</li> <li>b. Surveillance and Censorship: China and India</li> </ul> </li> <li>III. Structural Violence <ul> <li>a. Caste and Race: South Africa and India</li> <li>b. Gender and Violence: India and Pakistan</li> <li>c. Adivasis/Aboriginals and the Land Question: Australia and India</li> </ul> </li> </ul>	25 25 25	5+1	75

# **GENERIC ELECTIVE 1(FOR General students)**

# **GENERIC ELECTIVE 2(FOR General students)**

PLSGGEC	Semester IV			
Course Code	Governance: Issues and Challenges	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	Module 1. GOVERNMENT AND GOVERNANCE: CONCEPTS Role of State In the era Of Globalisation State, Market and Civil Society	20	5+1	75
PLSGGEC02T	Module 2. ENVIRONMENTAL GOVERNANCE Human-Environment Interaction Green Governance: Sustainable Human Development	20		
	Module -3. GOOD GOVERNANCE INITIATIVES IN INDIA: BEST PRACTICES Public Service Guarantee Acts Electronic Governance Citizens Charter & Right to Information Corporate Social Responsibility			

# (D) PLSSSEC - Skill Enhancement Courses - Two

Semester – 3 Credit – 2 Class – 2Hours/week

# PLSSSEC01M - Democratic Awareness with Legal Literacy

**Course Objective:** The Proposed course aims to acquaint student with the structure andmanner of functioning of the legal system in India.

# Course Content: Unit I

□ Outline of the Legal system in India

□ System of courts/tribunals and their jurisdiction in India - criminal and civil courts,Writ jurisdiction, specialized courts such as juvenile courts, Mahila courts andTribunals.

□ Role of the police and executive in criminal law administration.

□ Alternate dispute mechanisms such as LokAdalats, non- formal mechanisms.

# Unit II

□ Brief understanding of the laws applicable in India

 $\Box$  Constitution - fundamental rights, fundamental duties, other constitutional rights and their manner of enforcement, with emphasis on public interest litigation and the expansion of certain rights under Article 21 of the Constitution.

 $\Box$  Laws relating to criminal jurisdiction - provision relating to filing an FIR, arrest, bailsearch and seizure and some understanding of the questions of evidence and procedure in Cr. P.C. and related laws, important offences under the IndianPenalCode, offences against women, juvenile justice, prevention of atrocities onScheduled Castes and Scheduled Tribes.

□ Concepts like Burden of Proof, Presumption of Innocence, Principles of Natural Justice, Fair comment under Contempt laws.

□ Personal laws in India : Pluralism and Democracy

□ Laws relating to contract, property and tenancy laws.

□ Laws relating to dowry, sexual harassment and violence against women

- □ Laws relating to consumer rights
- □ Laws relating to cyber crimes
- □ Antiterrorist laws: implications for security and human rights

□ Practical application: Visit to either a (I) court or (ii) a legal aid centre set up by the

□ Legal Services Authority or an NGO or (iii) a LokAdalat, and to interview a litigant or person being counselled. Preparation of a case history.

# Unit III

#### Access to courts and enforcement of rights

□ Critical Understanding of the Functioning of the Legal System

□ Legal Services Authorities Act and right to legal aid, ADR systems

#### **Practical application :**

What to do if you are arrested ; if you are a consumer with a grievance; if you are avictim of sexual harassment; domestic violence, child abuse, caste, ethnic andreligious discrimination; filing a public interest litigation. How can you challenge administrative orders that violate rights, judicial and administrative remedies

Using a hypothetical case of (for example) child abuse or sexual harassment or anyother violation of a right, preparation of an FIR or writing a complaint addressed to the appropriate authority.

#### □ Suggested exercises for students

1. Discuss the debates around any recent Ordinance, Bill or Act in Parliament.

2. How to file an FIR? In case there has been a theft in the neighbourhood, how wouldyou file the first Hand Information Report?

3. Under what circumstances can detention and arrest become illegal?

4. Discuss any contemporary practice or event that violates the equality and protectionagainst discrimination laws.

5.. Your friend has shared with you an incident of unwelcome verbal remarks on her by aperson of higher authority in your college, what would you do?

6. You have seen a lady in your neighbourhood being beaten up by her husband. Identifythe concerned Protection Officer in case you want to provide information about this incident.

7.Read the Vishakha Guidelines as laid down by the Supreme Court and the Act against

sexual harassment at the workplace. Discuss what constitutes sexual harassment and the mechanisms available for its redressal in your institution. Use and Abuse of the mechanism.

8. What is the procedure to file an RTI? Use and Abuse of RTI. Exemptions to RTI10. You bought a product from a nearby shop which was expired, the shop keeperrefused to return it. Use your knowledge of Consumer Protection Act to decide what youdo next?11. What must you keep in mind as a consumer while making a purchase that may laterhelp you make use of Consumer Protection Act? (Hint- Should you ask for a Bill?)

12. In your surroundings have you witnessed any incident that would be considered offensive under the SC and ST Act? Make a class- room presentation on it.

# (D) PLSSSEC - Skill Enhancement Courses - Two

Semester – 4 Credit – 2 Class – 2Hours/week

# PLSSSEC02M - Public Opinion and Survey Research

**Course Objective:** this course will introduce the students to the debates, principles and practices of public opinion polling in the context of democracies, with special reference toIndia. It will familiarize the students with how to conceptualize and measure public opinionusing quantitative methods, with particular attention being paid to developing basic skillspertaining to the collection, analysis and utilization of quantitative data.

#### I. Introduction to the course

Definition and characteristics of public opinion, conceptions and characteristics, debates about its role in a democratic political system, uses for opinion poll

#### II. Measuring Public Opinion with Surveys: Representation and sampling

a. What is sampling? Why do we need to sample? Sample design.

b. Sampling error and non-response

c. Types of sampling: Non random sampling (quota, purposive and snowball sampling); random sampling: simple and stratified

d. Interviewing: Interview techniques pitfalls, different types of and forms of interview

e. Questionnaire: Question wording; fairness and clarity.

#### **III. Quantitative Data Analysis**

a. Introduction to quantitative data analysis

b. Basic concepts: correlational research, causation and prediction, descriptive andInferential Statistics

# WEST BENGAL STATE UNIVERSITY

# CHOICE BASED CREDIT SYSTEM

# LIST OF PAPERS AND COURSES

# **B.A (HONOURS) POLITICAL SCIENCE**

# (The Syllabus for Semester 2 to Semester 6 may be slightly modified later)

# <u>CODES</u>

- > **PLSACOR** denotes Political Science HONOURS(CORE)
- > **PLSHGEC** denotes Political Science GENERIC ELECTIVE (For Honours in other subjects)
- PLSADSE denotes Political Science DISCIPLINE SPECIFIC ELECTIVE(For Honours in Political Science)
- PLSSSEC denotes Political Science SKILL ENHANCEMENT COURSE (For Honours/general in Political Science)
- ✓ **PLSGCOR** denotes Political Science GENERAL(CORE)
- ✓ PLSGDSE denotes Political Science DISCIPLINE SPECIFIC ELECTIVE((For pure General students with Political Science as one of the subjects)
- ✓ PLSGGEC denotes Political Science GENERIC ELECTIVE((For General students not having Political Science as one of the core subjects)
- PLSA /PLSG SUBJECT ABBREVIATIONS MADE BY THE UNIVERSITY

# CREDIT/MARKS DISTRIBUTION

Core course - CC - 14 Core courses - 6 Credits/Paper

Generic Elective – GE – 4 courses - 6 Credits/Paper

Discipline Specific Elective – DSE -4 courses - 6 Credits/Paper

Ability Enhancement Compulsory Course – AECC – 2 courses – 2 Credits/paper

Skill Enhancement Courses - SEC - 2 Courses - 2 Credits/paper

*Total : CC 84 + GE 24 + DSE 24 + AECC 4 + SEC 4 = 140 CREDITS* 

#### A) CORE COURSE (14) – COURSE TITLES

Semester - I

- PLSACOR01T CC1.1- Paper I- Understanding Political Theory
- PLSACOR02T CC1.2 -Paper II- Constitutional Government and Democracy in India

Semester - II

PLSACOR03T - CC2.1 Paper III - Political Theory-Concepts and Debates

PLSACOR04T - CC 2.2 Paper IV- Political Process in India

Semester - III

- PLSACOR05T CC3.1 Paper V- Introduction to Comparative Government and Politics
- PLSACOR06T CC3.2 Paper VI Perspectives on Public Administration
- PLSACOR07T CC3.3 Paper VII- Perspectives on International Relations and World History

Semester - IV

- PLSACOR08T CC4.1 Paper VIII- Political Processes and Institutions in Comparative Perspective
- PLSACOR09T CC4.2 Paper IX- Public Policy and Administration in India
- PLSACOR10T CC4.3 Paper X- Global Politics

Semester - V

PLSACOR11T - CC5.1 Paper XI- Classical Political Philosophy

PLSACOR12T - CC5.2 Paper XII- Indian Political Thought-I

Semester - VI

- PLSACOR13T CC6.1 Paper XIII- Modern Political Philosophy
- PLSACORT4T CC6.2 Paper XIV- Indian Political Thought-II
## B) GENERIC ELECTIVE-(GE-Interdisciplinary): (Sem. I, II, III, IV)

## [For the Honours students with subjects other than Political Science]

- 1. PLSHGEC01T GE Paper I Introduction to Political Theory Semester 1
- 2. **PLSHGEC02T** GE Paper-II Indian Government and Politics Semester -2
- 3. PLSHGEC03T GE Paper-III- Comparative Government and Politics Semester- 3
- 4. **PLSHGEC04T** GE Paper-IV- Introduction to International Relations Semester 4

## C) PLSSSEC - SKILL ENHANCEMENT COURSE: Any Two (Sem.-3 & 4)

Semester – III

1. PLSSSEC01M Democratic Awareness with Legal Literacy

Semester – IV

2. PLSSSEC02M Public Opinion and Survey Research

# D) PLSADSE - DISCIPLINE SPECIFIC ELECTIVE(DSE): Any Four (Sem.-V and VI)

Semester – V(Any two)

- 1. PLSADSE01T Reading Gandhi
- 2. PLSADSE02T Women, Power and Politics
- 3. PLSADSE03T Understanding Global Politics

Semester - VI (Any two)

- 4. PLSADSE04T Public Policy in India
- 5. PLSADSE05T Human Rights in a Comparative Perspective
- 6. PLSADSE06T Governance: Issues and Challenges

# E) ABILITY ENHANCEMENT COURSE (COMPULSORY) :ANY TWO

- 1. Language-MIL/ENGLISH
- 2. Environmental Science

## COURSE OBJECTIVES(HONOURS/CORE COURSE - 14)

## Paper – 1 Understanding Political Theory

This course introduces the students to the idea of political theory, its history and approaches, and an assessment of its critical and contemporary trends and is designed to reconcile political theory and practice through reflections on the ideas and practices related to democracy.

## Paper – 2 Constitutional Government and Democracy in India

This course acquaints students with the constitutional design of state structures and institutions, and their actual working over time. It further encourages a study of state institutions in their mutual interaction, and in interaction with the larger extra-constitutional environment.

## Paper – 3 Political Theory-Concepts and Debates

This course helps the student familiarize with the basic normative concepts of political theory. Each concept is related to a crucial political issue that requires analysis with the aid of our conceptual understanding. This exercise is designed to encourage critical and reflective analysis and interpretation of social practices through the relevant conceptual toolkit. It further introduces the students to the important debates in the subject.

## Paper – 4 Political Process in India

This course maps the working of 'modern' institutions, premised on the existence of an individuated society, in a context marked by communitarian solidarities, and their mutual transformation thereby. It also familiarizes students with the working of the Indian state, paying attention to the contradictory dynamics of modern state power.

#### Paper 5 Introduction to Comparative Government and Politics

This is a foundational course in comparative politics. The purpose is to familiarize students with the basic concepts and approaches to the study of comparative politics. More specifically the course will focus on examining politics in a historical framework while engaging with various themes of comparative analysis in developed and developing countries.

#### Paper 6 Perspectives on Public Administration

The course provides an introduction to the discipline of public administration. This paper encompasses public administration in its historical context with an emphasis on the various classical and contemporary administrative theories. The course also explores some of the recent trends, including feminism and ecological conservation and how the call for greater democratization is restructuring public administration.

The course will also attempt to provide the students a comprehensive understanding on contemporary administrative developments.

## Paper 7 Perspectives on International Relations and World History

This paper seeks to equip students with the basic intellectual tools for understanding International Relations. It introduces students to some of the most important theoretical approaches for studying international relations. The course begins by historically contextualizing the evolution of the international state system; then the students are introduced to different theories in International Relations. It provides a fairly comprehensive overview of the major political developments and events starting from the twentieth century. Students are expected to learn about the key milestones in world history and equip them with the tools to understand and analyze the same from different perspectives. A key objective of the course is to make students aware of the implicit Euro - centricism of International Relations by highlighting certain specific perspectives from the Global South.

## Paper 8 Political Processes and Institutions in Comparative Perspective

In this course students will be trained in the application of comparative methods to the study of politics. The course is comparative in both what we study and how we study. In the process the course aims to introduce undergraduate students to some of the range of issues, literature, and methods that cover comparative political arena

## Paper-9 Public Policy and Administration in India

The paper seeks to provide an introduction to the interface between public policy and administration in India. The essence of public policy lies in its effectiveness in translating the governing philosophy into programs and policies and making it a part of the community living. It deals with issues of decentralization, financial management, citizens and administration and social welfare from a non-western perspective.

#### Paper 10 Global Politics

This course introduces students to the key debates on the meaning and nature of globalization by addressing its political, economic, social, cultural and technological dimensions. It imparts an understanding of the working of the world economy, while analyzing the changing nature of relationship between the state and trans-national actors and networks. The course also offers insights into key contemporary global issues.

#### Paper 11 Indian Political Thought-I

This course introduces the specific elements of Indian Political Thought spanning over two millennia. The basic focus of study is on individual thinkers whose ideas are however framed by specific themes. The course as a whole is meant to provide a sense of the broad streams of Indian thought while encouraging a specific knowledge of individual thinkers and texts. Selected extracts from some original texts are also given to discuss in class.

## Paper 12 Modern Political Philosophy

Philosophy and politics are closely intertwined. We explore this convergence by identifying four main tendencies here. Students will be exposed to the manner in which the questions of politics have been posed in terms that have implications for larger questions of thought and existence.

## Paper 13 Modern Political Philosophy

Philosophy and politics are closely intertwined. We explore this convergence by identifying four main tendencies here. Students will be exposed to the manner in which the questions of politics have been posed in terms that have implications for larger questions of thought and existence.

## Paper 14 Indian Political Thought-II

Based on the study of individual thinkers, the course introduces a wide span of thinkers and themes that defines the modernity of Indian political thought. The objective is to study general themes that have been produced by thinkers from varied social and temporal contexts. Selected extracts from original texts are also given to discuss in the class. The list of essential readings are meant for teachers as well as the more interested students.

PLSACOR	Semester I			
Course Code	Paper – I Course Title –Understanding Political Theory	Lectures	Credits (Th+Tut) X15 weeks	Marks
PLSACOR01T	Introducing the subject Module 1. What is Political and what is political Science	10	5+1	75
	Module 2.Approaches to the study: a)Traditional b) Marxist c)Behavioral d)Post Behavioral	20		
	<ul> <li>Module 3. Models of studying Political Theory <ul> <li>a) Authority Models(Weber)</li> <li>b) Systems Analysis</li> <li>c) Structural functional Model</li> <li>d) Post Modernism(to be studied at the backdrop of the current debates)</li> </ul> </li> </ul>	45		
PLSACOR02T	<u>Paper - II</u> <u>Constitutional Government and Democracy in India</u>		5+1	75
	Module 1.Constituion of India(Article-wise) a)Preamble b)Fundamental Rights c)Directive Principles of State Policy	30		
	Module 2. Federalism Module 3.Constitution of India: Structure, Process, Behaviour a)Union Government: Executive(total as it is in the constitution)Legislature(total, according to the Constitution)	10		
	Judiciary(total, following the articles of the constitution with two additional dimensions: landmark decisions and PIL b)State Government: Executive, Legislature, Judiciary (In the same way as the Union government is to be studied)	35		

# Semester II

PLSACOR	Paper – III			
Course Code	Course Title -Political Theory-Concepts and Debates	Lect	Credits (Th+Tut) X 15 wks	Marks

	Module – 1. Core political concepts:	20	5+1	75
PLSACOR03T	<ul><li>i. Nationalism and nation state</li><li>ii. Sovereignty: Monism, Pluralism</li></ul>			
	Module – 2. Core Concepts and Debates:	20		
	<ul><li>i. Rights, Liberty, Equality</li><li>ii. Justice: Plato,Rawls</li></ul>			
	Module – 3. Theories of State	35		
	<b>a</b> )Idealist Theory b)Liberal and Neo-liberal Theories			
	Paper – IV Course Title - Political Process in India			
PLSACOR04T	Module – 1. Structure and process of election system a)Party system in India: features and trends; coalition Governments	25		
	b) Electoral process: Election Commission— Composition and Functions	25		
	Module 2.Issues in contemporary politics a) Regionalism in India b) Role of religion ,caste, Dalits, Women			
	<ul><li>Module 3.The concerns</li><li>a) Corruption and politics: Measures to curb corruption in Indian politics</li><li>b) Media and politics</li></ul>	25		

PLSACOR	Semester III			
Course Code	Paper – V Course Title - Introduction to Comparative Government and Politics	Lectures	Credits (Theory +Tutorial)X 15 weeks	Marks

PLSACOR05T	Module – 1. Understanding Comparative Politics a. Nature and scope b. Going beyond Eurocentrism	15	5+1	75
	Module – 2. Historical context of modern government	35		
	<ul> <li>a. Capitalism: meaning and development: globalization</li> <li>b. Socialism: meaning, growth and development</li> <li>c. Colonialism and decolonization: meaning, context, forms of colonialism; anti-colonialism struggles and process of decolonization</li> </ul>	55		
	Module – 3 Themes for comparative analysis A comparative study of constitutional developments and political economy in the following countries: Britain, Brazil and China.	25		

PLSACOR	Semester III			
Course Code		Lectures	Credits	Marks
	Paper – VI		(Theo	
	Course Title - Perspectives on Public Administration		+Tut)X	
			15	

			weeks	
	I. Public Administration as a Discipline		1	
PLSACOR06T			5+1	75
	a. Meaning, Dimensions and Significance of the	15		
	Discipline			
	b. Public and Private Administration			
	c. Evolution of Public Administration			
	II. Theoretical Perspectives	40		
	a. CLASSICAL THEORIES			
	• Scientific management (F.W. Taylor)			
	Administrative Management (Gullick, Urwick			
	and Fayol)			
	• Ideal-type bureaucracy (Max Weber)			
	b. NEO-CLASSICAL THEORIES			
	• Human relations theory (Elton Mayo)			
	• Rational decision-making (Herbert Simon)			
	c. CONTEMPORARY THEORIES			
	• Ecological approach (Fred Riggs)			
	• Innovation and Entrepreneurship			
	(Peter Drucker)			
	III Majan Annuachas In Dublic Administration			
	New Dublic Administration	20		
	New Public Administration			
	New Public Service Approach			
	Good Governance			
	Good Governance     Feminist Perspectives			

PLSACOR	Semester III			
Course Code	Paper – VII Course Title - Perspectives on International Relations and World History	Lectures	Credits (Theo +Tut)X 15 weeks	Marks

PLSACOR07T	<ul> <li>I. Studying International Relations</li> <li>a. How do you understand International Relations: Levels of Analysis</li> </ul>	15	5+1	75
	<ul> <li>b. History and IR: Emergence of the International State System</li> <li>c. Pre-Westphalia and Westphalia</li> <li>d. Post-Westphalia</li> </ul>			
	<ul> <li>II. Theoretical Perspectives</li> <li>a. Classical Realism &amp; Neo-Realism</li> <li>b. Liberalism &amp; Neo-liberalism</li> <li>c. Marxist Approaches</li> <li>d. Feminist Perspectives</li> <li>e. Eurocentricism and Perspectives from the Global South</li> </ul>	25		
	<ul> <li>III. An Overview of Twentieth Century IR History</li> <li>a. World War I: Causes and Consequences</li> <li>b. Significance of the Bolshevik Revolution</li> <li>c. Rise of Fascism / Nazism</li> <li>d. World War II : Causes and Consequences</li> <li>e. Cold War: Different Phases</li> <li>f. Emergence of the Third World</li> <li>g. Collapse of the USSR and the End of the Cold War</li> <li>h. Post Cold War Developments and Emergence of other Power Centers of Power</li> </ul>	35		

PLSACOR	Semester IV			
Course Code	Paper – VIII	Lectures	Credits	Marks
	Course Title - Political Processes and		(Theo	

	Institutions in Comparative Perspective		+Tut)X 15	
	Module I. Approaches to Studying Comparative Politics		5+1	75
	a. Political Culture b. New Institutionalism	15		
PLSACOR08T	<ul> <li>Module II.</li> <li>a. Nation-state: What is nation-state? Historical evolution in Western Europe and postcolonial contexts 'Nation' and 'State': debates</li> <li>b. Process of democratization in postcolonial, post- authoritarian and post-communist countries</li> </ul>	25		
ILSACOROI	III. Module III			
	a. Federalism: Historical context Federation and Confederation: debates around territorial division of power: USA, CANADA, INDIA	20		
	<b>b.</b> Nature of Party System :			
	<ul><li>i. Historical contexts of emergence of the party system and types of parties</li><li>ii. Nature of party System: USA, UK, China</li></ul>	15		

PLSACOR	Semester IV			
Course Code	Paper – IX	Lectures	Credits	Marks
	Course Title – Public Policy and Administration in		(Theo	
	India		+Tut)X 15	

weeks	
Module I. Public Policy a. Concept, relevance and approaches b. Definition, characteristics and models c. Public Policy Process in India d. Formulation, implementation and evaluation e. Social Welfare Policies: Education: Right To Education, National Education Policy, Kothari Commission. Health: National Health Mission . Food: Right To Food Security35PLSACOR097a. Employment: JNNURM, MNREGA25Module II. a. Decentralization i. Meaning, significance and approaches and types ii. Local Self Governance: Rural and Urban – With Special Reference to West Bengal25b. Citizen and Administration Interface a. Public Service Delivery b. Redressal of Public Grievances: RTI, Lokpal, Citizens' Charter and E-Governance10Module III. Budget Cycle in India c. Various Approaches and Types Of Budgeting, Vote on Account, Zero Base10	75

PLSACOR	Semester IV			
Course Code	Paper X	Lectures	Credits (Theo	Marks
	Global Politics		+Tut)X 15	

			weeks	
PLSACOR10T	<ul> <li>I. Globalization: Conceptions and Perspectives         <ul> <li>a. Understanding Globalization and its Alternative Perspectives</li> <li>b. Political: Debates on Sovereignty and Territoriality</li> <li>c. Global Economy: Its Significance and Anchors of Global Political Economy: IMF, World Bank, WTO, TNCs</li> <li>d. Cultural and Technological Dimension</li> <li>e. Global Resistances (Global Social Movements and NGOs)</li> </ul> </li> <li>II. Contemporary Global Issues         <ul> <li>a. Ecological Issues: Historical Overview of</li> </ul> </li> </ul>	35	weeks 5+1	75
	<ul> <li>International Environmental Agreements, Climate Change, Global Commons Debate</li> <li>b. Proliferation of Nuclear Weapons</li> <li>c. International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments</li> <li>d. Migration</li> <li>e. Human Security</li> <li>III. Global Shifts: Power and Governance</li> </ul>	10		

PLSACOR	Semester V			
Course Code	Paper XI	Lectures	Credits	Marks

	Classical Political Philosophy		(Theo +Tutorial) X 15 weeks	
			5+1	75
	Module I. Antiquity			
	<b>Plato:</b> Philosophy and Politics, Theory of Forms, Justice, Philosopher King/Queen, Communism; Critique of Democracy; Women and Guardianship, Censorship	15		
PLSACOR11T	<b>Aristotle:</b> Virtue, Citizenship, Justice, State and Household - Classification of governments; man as zoon politikon	15		
	Module II. Interlude: Machiavelli: Virtue, Religion, Republicanism, morality and statecraft; vice and virtue	10		
	Module IV. Hobbes, Locke and Rousseau	15		
	a. <b>Hobbes</b> : Human nature, State of Nature, Social Contract, State; Social Contract; Leviathan; atomistic individuals.			
	<ul> <li>b. Locke : Laws of Nature, Natural Rights, Property, Natural rights; right to dissent; justification of property</li> </ul>	10		
	<b>c. Rousseau:</b> State of Nature, Social Contract, General Will	10		

PLSACOR	Semester V	
		16

Course Code	Paper XII	Lectures	Credits (Theo	Marks
	Indian Political Thought - I		+Tutorial)X 15 weeks	
	Module I. Traditions of Pre-colonial Indian Political Thought a. Brahmanic and Shramanic b. Islamic and Syncretic.	20	5+1	75
	Module II. Outline of ancient Indian Political Thought	30		
PLSACOR12T	<ul> <li>a. Ved Vyasa (Shantiparva): Rajadharma</li> <li>b. Manu: Social Laws</li> <li>c. Kautilya: Theory of State , Saptanga, Danda, Law</li> <li>d. Aggannasutta (Digha Nikaya): Theory of kingship</li> </ul>			
	Module III. Outline of Islamic and Syncretic Thought	25		
	a. Barani: Ideal Polity			
	b. Abul Fazal: Monarchy			
	c. Kabir: Syncretism			

PLSACOR	Semester VI			
Course Code	Paper XIII Modern Political Philosophy	Lectures	Credits (Theory +Tutorial) X 15 weeks	Marks

	Module I Modernity and its discourse(Two essential readings)	25	5+1	75
	<ul><li>a. Kant. (1784) 'What is Enlightenment?,'</li><li>b. George Wilhelm Friedrich Hegel: Civil Society and State</li></ul>			
	Module II. Faminist Discourse	20		
PLSACOR13T	<ul><li>a. Mary Wollstonecraft: 'Vindication of Rights of Women'</li><li>b. Betty Friedan: 'The Faminique Mistique'</li></ul>			
	<ul> <li>Module III. Liberal socialist and Radicals <ul> <li>a. John Stuart Mill: Liberty, suffrage and subjection of women, right of minorities; utility principle</li> <li>b. Karl Marx: Alienation; Dialectical materialism, Historical Materialism, Class and class struggle</li> <li>c. Antonio Gramsci: Civil Society and Hegemony</li> </ul> </li> </ul>	30		

PLSACOR

Course Code		Lectures	Credits	Marks
	Paper XIV		(Theo	
			+Tutorial)	
	Indian Political Thought - II		X 15	
			weeks	
	Module I. Introduction to Modern Indian	05		
	Political Thought		5+1	75
	a. Rammohan Roy: Rights	10		
	b. Pandita Ramabai: Gender	8		
	c. Vivekananda: Ideal Society	10		
	Module - II			
	a. Gandhi: Swaraj	10		
PLSACOR14T	b. Ambedkar: Social Justice	05		
	c. Tagore: Critique of Nationalism	06		
	Module III			
	a. Iqbal: Community	06		
	b. Savarkar: Hindutva	05		
	c. Nehru: Secularism	05		
	<b>d.</b> Lohia: Socialism	05		

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- 1. Constitution of India, Government of India
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- 3. Basu D., (2012) Introduction to the Constitution of India, New Delhi: Lexis Nexis.
- 4. U. Baxi, (2010) 'The Judiciary as a Resource for Indian Democracy', Seminar, Issue 615
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#### **GENERIC ELECTIVE – 1**
# Interdisciplinary

### For Honours students, other than Political Science

PLSHGEC	Semester I			
Course Code	Paper – I Introduction to Political Theory	Lectures	Credits (Theory+ Tutorial) X 15 weeks	Marks
PLSHGEC01T	<ul> <li>Module I. Introducing the subject</li> <li>a. What is Politics?</li> <li>b. What is Political Theory and what is its relevance?</li> <li>Module II. Concepts: Democracy, Liberty, Equality, Justice, Rights, Gender, Citizenship, Civil Society and State</li> <li>Module III. Debates in Political Theory:</li> <li>a. Is democracy compatible with economic growth?</li> <li>b. On what grounds is censorship justified and what are its limits?</li> <li>c. Does protective discrimination violate principles of fairness?</li> <li>d. Should the State intervene in the institution of the family?</li> </ul>	10 30 35	5+1	75

PLSHGEC	Semester II			
Course Code	Paper - II Indian Government and Politics Structure Process Behaviour	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	Structure, 11 occss, Denaviour.			
	Module I Evolution:		5+1	75
	Making of the Constitution by the Constitutional Advisor, the Drafting Committee and finally the Constituent assembly	20		
	Module II.Constituion of India(Article-wise)	20		
	a)Preamble b)Fundamental Rights c)Directive Principles of State Policy d)Federalism			
PLSHGEC02T	Module III. Constitution of India a)Union Government: Executive(total as it is in the constitution)Legislature(total, according to the Constitution) Judiciary(total, following the articles of the constitution with two additional dimensions: landmark decisions and PIL b)State Government: Executive, Legislature, Judiciary (In the same way as the Union government is to be studied) c)Public Services: Union Service, State service, All India Services(total that includes recruitment, training, service conditions) c)Public service Commission(UPSC and PSC)	35		

### **GENERIC ELECTIVE – 3**

PLSHGEC	Semester III			
Course Code	Paper – III Comparative Government and Politics	Lectures	Credits (Theo +Tutorial )X 15 weeks	Marks
	Module I. Understanding Comparative Politics	15	<b>F</b> . 1	
	a. Nature and scope b. Going beyond Eurocentrism		5+1	75
	Module II. Historical context of Modern Government	35		
PLSHGEC03T	<ul> <li>a. Capitalism: meaning and development: globalization</li> <li>b. Socialism: meaning, growth and development</li> <li>c. Colonialism and decolonization: meaning, context, forms of colonialism; anti-colonialism struggles and process of decolonization</li> </ul>			
	<b>Module III. Themes for comparative analysis</b> A comparative study of constitutional developments and political economy in the following countries: Britain, Brazil and China.	25		

### **GENERIC ELECTIVE – 4**

PLSHGEC	Semester IV			
Course Code	Paper – IV Introduction to International Relations	Lectures	Credits (Theo +Tutorial )X 15 weeks	Marks
	<ul> <li>I. Studying International Relations         <ul> <li>a. How do you understand International Relations: Levels of Analysis</li> <li>b. History and IR: Emergence of the International State System</li> </ul> </li> </ul>	15	5+1	75
	<ul> <li>II. Theoretical Perspectives</li> <li>a. Classical Realism &amp; Neo-Realism</li> <li>b. Liberalism &amp; Neo-liberalism</li> <li>c. Marxist Approaches</li> <li>d. Feminist Perspectives</li> </ul>	25		
PLSHGEC04T	<ul> <li>III. An Overview of Twentieth Century IR History <ul> <li>a. World War I: Causes and Consequences</li> <li>b. Significance of the Bolshevik Revolution</li> <li>c. Rise of Fascism / Nazism</li> <li>d. World War II : Causes and Consequences</li> <li>e. Cold War: Different Phases</li> <li>f. Emergence of the Third World</li> <li>g. Collapse of the USSR and the End of the Cold War</li> <li>h. Post Cold War Developments and Emergence of Other Power Centers of Power</li> <li>i. Indian as an Emerging Power Indian Foreign Policy</li> </ul> </li> </ul>	35		

#### **PLSHGEC01T - Paper I- Introduction to Political Theory**

Bhargava, R. (2008) 'What is Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 2-17.

Bhargava, R. (2008) 'Why Do We Need Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 18-37.

Sriranjani, V. (2008) 'Liberty', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 40-57.

Acharya, A. (2008) 'Equality', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 58-73.

Menon, K. (2008) Justice', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 74-82.

Talukdar, P.S. (2008) 'Rights', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 88-105.

Srinivasan, J. (2008) 'Democracy', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 106-128.

Roy, A. 'Citizenship', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 130-147.

Das, S. (2008) 'State', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi:Pearson Longman, pp. 170-187. Singh, M. (2008) 'Civil Society', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*.New Delhi: Pearson Longman, pp. 188-205.

Menon, N. (2008) 'Gender', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 224-235.

Sen, A. (2003) 'Freedom Favours Development,' in Dahl, R., Shapiro, I. and Cheibub, A. J. (eds.) *TheDemocracy Sourcebook*. Cambridge, Massachusetts: MIT Press, pp. 444-446.

Prezowrski, A., et al. (2003) 'Political Regimes and Economic Growth,' in Dahl, R., Shapiro, I. and Cheibub, A. J. (eds.) *The Democracy Sourcebook*. Cambridge, Massachusetts: MIT Press, pp. 447-454.

Sethi, A. (2008) 'Freedom of Speech and the Question of Censorship', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 308-319.

Acharya, A. (2008) 'Affirmative Action', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction*. New Delhi: Pearson Longman, pp. 298-307.

Jha, M. (2001) 'Ramabai: Gender and Caste', in Singh, M.P. and Roy, H. (eds.) *Indian Political Thought: Themes and Thinkers*, New Delhi: Pearson

#### PLSHGEC02T - Paper-II - Indian Government and Politics

Abbas, H., Kumar, R. & Alam, M. A. (2011) *Indian Government and Politics*. New Delhi: Pearson, 2011.

Chandhoke, N. & Priyadarshi, P. (eds.) (2009) *Contemporary India: Economy, Society, Politics.* New Delhi: Pearson.

Chakravarty, B. & Pandey, K. P. (2006) Indian Government and Politics. New Delhi: Sage.

Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) *India After Independence*. New Delhi: Penguin.

Singh, M.P. & Saxena, R. (2008) *Indian Politics: Contemporary Issues and Concerns*. New Delhi: PHI Learning.

Vanaik, A. & Bhargava, R. (eds.) (2010) Understanding Contemporary India: Critical Perspectives. New Delhi: Orient Blackswan.

Menon, N. and Nigam, A. (2007) *Power and Contestation: India Since 1989.* London: Zed Book.

Austin, G. (1999) *Indian Constitution: Corner Stone of a Nation*. New Delhi: Oxford University Press.

Austin, G. (2004) *Working of a Democratic Constitution of India*. New Delhi: Oxford University Press.

Jayal, N. G. & Maheta, P. B. (eds.) (2010) *Oxford Companion to Indian Politics*. New Delhi: Oxford University Press.

#### PLSHGEC03T - Paper-III- Comparative Government and Politics

Bara, J & Pennington, M. (eds.). (2009) Comparative Politics. New Delhi: Sage.

Caramani, D. (ed.). (2008) Comparative Politics. Oxford: Oxford University Press.

Hague, R. and Harrop, M. (2010) *Comparative Government and Politics: An Introduction*. (Eight Edition). London: Palgrave McMillan.

Ishiyama, J.T. and Breuning, M. (eds.). (2011) 21st Century Political Science: A Reference Book. Los Angeles: Sage.

Newton, K. and Deth, Jan W. V. (2010) *Foundations of Comparative Politics: Democracies of The Modern World*. Cambridge: Cambridge University Press. O'Neil, P. (2009) *Essentials of Comparative Politics*. (Third Edition). New York: WW. Norton & Company, Inc.

Palekar, S.A. (2009) Comparative Government and Politics. New Delhi: PHI Learning Pvt. Ltd

Blondel, J. (1996) 'Then and Now: Comparative Politics', *Political Studies. Vol. 47, Issue 1*, pp. 152-160

Chandhoke, N. (1996) 'Limits of Comparative Political Analysis', *Economic and Political Weekly*. vol. 31, No. 4, (January 27), pp. PE 2-PE8.

#### **PLSHGEC04T - Paper-IV- Introduction to International Relations**

William, P., Goldstein, D. M. and Shafritz, J. M. (eds.) (1999) *Classic Readings of International Relations*. Belmont: Wadsworth Publishing Co, pp. 30-58; 92-126.

Art, R. J. and Jervis, R. (eds.) (1999) *International Political Enduring: Concepts and Contemporary Issues*.5th Edition. New York: Longman, pp. 7-14; 29-49; 119-126.

Jackson, R. and Sorenson, G. (2008) *Introduction to International Relations: Theories and Approaches*. New York: Oxford University Press, pp. 59-96.

Goldstein, J. and Pevehouse, J.C. (2009) *International Relations*. New Delhi: Pearson, pp. 81-111.

Tickner, J. A. (2001) *Gendering World Politics: Issues and Approaches in the Post-Cold War Era.* Columbia University Press.

Baylis, J. and Smith, S. (eds.) (2011) *The Globalization of World Politics: An Introduction to International Relations*. Fifth Edition. Oxford: Oxford University Press, pp. 90-123; 142-159; 262-277.

Wenger, A. and Zimmermann, D. (eds.) (2003) *International Relations: From the Cold World War to the Globalized World*. London: Lynne Rienner, pp. 54-89.

Appadorai and Rajan, M. S. (eds.) (1985) India's Foreign Policy and Relations. New Delhi:

South Asian Publishers.

Mewmillians, W.C. and Piotrowski, H. (2001) *The World Since 1945: A History of International Relations*. Fifth edition. London: Lynne Rienner Publishers.

Smith, M., Little, R. and Shackleton, M. (eds.) (1981) *Perspectives on World Politics*. London: Croom Helm.

Indian Foreign Service Institute. (1997, 1998) *India's Foreign Policy: An Agenda for the 21st Century* Vols. 1 & 2, New Delhi: Konark Publishers, pp. 3-41; 102-119.

Ganguly, S. (ed.) (2009) *India's Foreign Policy: Retrospect and Prospect*. New Delhi: Oxford University Press.

Vanaik, A. (1995) *India in a Changing World: Problems, Limits and Successes of Its Foreign Policy.* New Delhi: Orient Longman. pp. 19-41; 63-67; 102-114; 118-124; 132-134.

Basu, Rumki (ed)(2012) International Politics: Concepts theories and Issues, New Delhi, Sage Publications India Pvt Ltd.

**DISCIPLINE SPECIFIC ELECTIVE – 1(Interdisciplinary) for Honours students** 

(Any two in Semester - V)

PLSADSE	Semester V			
Course Code	Paper I Reading Gandhi	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	<ul> <li>Module I. Gandhi on Modern Civilization and Modern Industrialisation based on Large and Heavy Industries and Alternative Modernity ; critique of development</li> <li>Module II. Gandhian Thought: Theory and Action: a. Theory of Satyagraha b. Satyagraha in Action : Peasant Satyagraha: Khada and the Idaa of Trustagehin</li> </ul>	25 30	5+1	75
PLSADSE01T	<ul> <li>c. Gandhi on all-inclusive Development Sarvodaya – on Untouchability and Dalit emancipation</li> <li>Module III.</li> <li>a. Gandhi on Women's Development and on Women's Movement</li> <li>b. Gandhi on peace and Preservation of Nature</li> </ul>	20		

- B. Parekh, (1997) 'The Critique of Modernity', in Gandhi: A Brief Insight, Delhi: Sterling Publishing Company, pp. 63-74.
- **2.** K. Ishii, (2001) 'The Socio-economic Thoughts of Mahatma Gandhi: As an Origin of Alternative Development', Review of Social Economy. Vol. 59 (3), pp. 297-312.
- **3.** R Iyer, (ed) (1993) 'Chapter 4' in The Essential Writings of Mahatma Gandhi, New Delhi: Oxford University Press.
- **4.** R. Iyer, (1993) The Essential Writings of Mahatma Gandhi, New Delhi: Oxford University Press, pp. 299-344; 347-373.
- **5.** R. Ramashray, (1984) 'Liberty Versus Liberation', in Self and Society: A Study in Gandhian Thought, New Delhi: Sage Publication.
- **6.** P. Chatterjee, (1986) 'The Moment of Maneuver', in Nationalist Thought and the Colonial World: A derivative discourse?, Delhi: Zed Books.
- 7. S. Sarkar, (1982) Modern India 1885-1947, New Delhi: Macmillan, pp. 432-39.
- **8.** R. Iyer, (2001) The Moral and Political Thought of Mahatma Gandhi, New Delhi: Oxford University Press. pp. 344-358.
- 9. R. Mukharjee, (ed) (1995), The Penguin Gandhi Reader, New Delhi: Penguin.
- Reading of primary texts:- M K Gandhi Chapter VI and XIII "Hind Swaraj" Navjeevan Trust, Ahmedabad, 1910

# **DISCIPLINE SPECIFIC ELECTIVE – 2(Any two in Semester - V)**

PLSADSE	Semester V			
Course Code	Paper II Women, Power and Politics	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	Module 1. Approaches to understanding Patriarchy• Feminist theorising of the sex/gender distinction. Biologism versus social constructivism• Understanding Patriarchy and Feminism	25	5+1	75
PLSADSE02T	Module 2. Schools of Feminism Liberal, Socialist, Marxist, Radical feminism, New Feminist Schools/Traditions	30		
	<ul> <li>Module 3. The Indian Experience</li> <li>Traditional Historiography and Feminist critiques. Social Reforms Movement and position of women in India. History of Women's struggle in India</li> <li>Family in contemporary India - patrilineal and matrilineal practices. Gender Relations in the Family, Patterns of Consumption: Intra Household Divisions, entitlements and bargaining, Property Rights</li> <li>Understanding Woman's Work and Labour</li> </ul>	20		

### **READING LIST**

#### **PLSADSE02T - Women, Power and Politics**

- T. Shinde, (1993) 'Stree Purusha Tulna', in K. Lalitha and Susie Tharu (eds), Women Writing in India, New Delhi, Oxford University Press, pp. 221-234
- U. Chakravarti, (2001) 'Pitrasatta Par ek Note', in S. Arya, N. Menon & J. Lokneeta (eds.) Naarivaadi Rajneeti: Sangharsh evam Muddey, University of Delhi: Hindi Medium Implementation Board, pp.1-7
- 3. V Geetha, (2002) Gender, Kolkata, Stree, pp. 1-20
- 4. M. Kosambi, (2007) Crossing the Threshold, New Delhi, Permanent Black, pp. 3-10; 40-46
- 5. N. Menon, (2008) 'Power', in R. Bhargava and A. Acharya (eds), *Political Theory: An Introduction*, Delhi: Pearson, pp.148-157
- 6. B. Hooks, (2010) 'Feminism: A Movement to End Sexism', in C. Mc Cann and S. Kim (eds), *The Feminist Reader: Local and Global Perspectives*, New York: Routledge
- 7. K.
   Millet,
   (1968)
   Sexual
   Politics,
   Available
   at

   http://www.marxists.org/subject/women/authors/millett-kate/sexual-politics.htm
   Available
   at
- 8. S. de Beauvoir (1997) Second Sex, London: Vintage
- Agnihotri and V. Mazumdar, (1997) 'Changing the Terms of Political Discourse: Women's Movement in India, 1970s-1990s', *Economic and Political Weekly*, 30 (29), pp. 1869-1878.
- R. Kapur, (2012) 'Hecklers to Power? The Waning of Liberal Rights and Challenges to Feminism in India', in A. Loomba *South Asian Feminisms*, Durham and London: Duke University Press, pp. 333-355
- 11. P. Swaminathan, (2012) 'Introduction', in Women and Work, Hyderabad: Orient Blackswan, pp.1-17

#### **DISCIPLINE SPECIFIC ELECTIVE – 3 (Any two in Semester - V)**

PLSADSE	Semester V			
Course Code	Paper III Understanding Global Politics	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	Module I. Globalization: Conceptions and Perspectives a. Understanding Globalization and its Alternative Perspectives b. Political: Debates on Sovereignty and	25	5+1	75
	Territoriality c. Global Economy: Its Significance and Anchors of Global Political Economy: IMF, World Bank, WTO, TNCs Module II. Identity and Culture : Crisis of	25		
PLSADSE03T	a. Global Inequalities b. Violence: Conflict, War and Terrorism c. Global Civil Society : Proliferation of Nuclear Weapons ; International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments ; Migration ; Human Security			
	Module III. Global Environment Ecological Issues: Historical Overview of International Environmental Agreements, Climate Change, Global Commons Debate	25		

#### **PLSADSE03T** - Understanding Global Politics

- S. Elden, (2009) 'Why Is The World Divided Territorially?', in J. Edkins and M. Zehfuss (eds.) Global Politics: A New Introduction, New York: Routledge, pp. 192-219.
- M. Shapiro, (2009) 'How Does The Nation- State Work?', in J. Edkins and M. Zehfuss (eds.) Global Politics: A New Introduction, New York: Routledge, pp. 220-243.
- **3.** A. Narlikar, (2005) The World Trade Organization: A Very Short Introduction, New Delhi: Oxford University Press.
- **4.** J. Goldstein, (2006) International Relations, New Delhi: Pearson, pp. 327-368.
- Y. Isar, (2012) 'Global Culture', in B. Chimni and S. Mallavarapu (ed.) International Relations: Perspectives For the Global South, New Delhi: Pearson, pp. 272-285.
- **6.** M. Duffield, (2011) Development and Security the Unending War: Governing the World of Peoples, Cambridge: Polity Press.
- N. Adams, (1993) World Apart: The North-South Divide and the International System, London: Zed.
- M. Dillon, (2009) 'What Makes The World Dangerous?' in J. Edkins And M. Zehfuss (eds.) Global Politics: A New Introduction, New York: Routledge, pp. 397-426.
- **9.** A. Heywood, (2011) 'Global Environmental Issues', in Global Politics, London: Palgrave, 2011, pp. 383-411.
- **10.**N. Carter, (2007) The Politics of Environment: Ideas, Activism, Policy, 2nd edition, Cambridge: Cambridge University Press, pp 13-81
- **11.**N. Chandhoke, (2011) 'The Limits of Global Civil Society,' Available at www.gcsknowledgebase.org/wp-content/uploads/2002chapter2.pdf
- **12.**G. Lexter and S. Halperin (eds.), (2003) Global Civil Society And Its Limits, New York: Palgrave, pp. 1-21.

PLSADSE	Semester VI			
Course Code	Paper - IV Public Policy in India	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
PLSADSE04T	<ul> <li>Module . I. Introduction to Policy Analysis</li> <li>a. The Analysis of Policy in the Context of Theories of State</li> <li>b. Political Economy and Policy: Interest</li> </ul>	30	5+1	75
	Groups and Social Movements. Module II. Models of Policy Decision-Making Module III. Ideology and Policy: Nehruvian Vision, Economic Liberalisation and recent developments	20 25		

# **DISCIPLINE SPECIFIC ELECTIVE 4(Any two in Semester - VI)**

#### PLSADSE04T- PUBLIC POLICY IN INDIA

- 1. Jenkins, B. (1997) 'Policy Analysis: Models and Approaches' in Hill, M. (1997) *The Policy Process: A Reader* (2nd Edition). London: Prentice Hall, pp. 30-40.
- 2. Dye, T.R. (2002) Understanding Public Policy. Tenth Edition. Delhi: Pearson, pp.1-9, 32-56 and 312-329.
- 3. Sapru, R.K.(1996) *Public Policy : Formulation, Implementation and Evaluation.* New Delhi: Sterling Publishers, pp. 26-46.
- 4. Dunleavy, P. and O'Leary, B. (1987) *Theories of the State*. London: Routledge.McClennan, G. (1997) 'The Evolution of Pluralist Theory' in Hill, M. (ed.) *The Policy Process: A Reader*. 2nd Edition. London: Prentice Hall, pp. 53-61.
- 5. Dye, T.R. (2002) Understanding Public Policy. 10th Edition. Delhi: Pearson, pp.11-31.
- 6. Lukes, S. (1986) Power. Basil: Oxford , pp. 28-36.
- 7. Lukes, S. (1997) 'Three Distinctive Views of Power Compared', in Hill, M. (ed.), *The PolicyProcess: A Reader*. 2nd Edition. London: Prentice Hall, pp. 45-52.
- 8. Giddens, A. (1998) *The Third Way: The Renewal of Social Democracy*. Cambridge: Polity Press, pp. 27-64 and 99-118.
- 9. Hogwood, B. & Gunn, L. (1984) *Policy Analysis for the Real World*. U.K: Oxford University Press, pp. 42-62.
- 10. Sabatier, P.L. & Mazmanian, D. (1979) 'The Conditions of Effective Policy Implementation', in *Policy Analysis*, vol. 5, pp. 481-504.
- 11. Basu Rumki (2015) Public Administration in India Handates, Performance and Future Perspectives, New Delhi, Sterling Publishers
- 12. Self, P. (1993) *Government by the Market? The Politics of Public Choice*. Basingstoke: MacMillan, pp. 1-20,70-105,113-146,198-231 and 262-277.
- 13. Girden, E.J. (1987) 'Economic Liberalisation in India: The New Electronics Policy' in *Asian Survey*. California University Press. Volume 27, No.11. Available at www.jstor.org/stable/2644722.

# DISCIPLINE SPECIFIC ELECTIVE 5(Any two in Semester - VI)

PLSADSE	Semester VI			
Course Code	Paper - V Human Rights in a Comparative Perspective	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
PLSADSE05T	<ul> <li>I. Human Rights: Theory and Institutionalization <ul> <li>a. Understanding Human Rights: Three</li> <li>Generations of Rights</li> <li>b. Institutionalization: Universal Declaration of</li> <li>Human Rights <ul> <li>c. Rights in National Constitutions: South Africa</li> <li>and India</li> </ul> </li> <li>II. Issues <ul> <li>a. Torture: USA and India</li> <li>b. Surveillance and Censorship: China and India</li> </ul> </li> <li>C. Terrorism and Insecurity of Minorities: USA and India</li> <li>III. Structural Violence <ul> <li>a. Caste and Race: South Africa and India</li> <li>b. Gender and Violence: India and Pakistan</li> <li>c. Adivasis/Aboriginals and the Land Question: Australia and India</li> </ul> </li> </ul></li></ul>	25 25 25	5+1	75

#### PLSADSE05T - HUMAN RIGHTS IN A COMPARATIVE PERSPECTIVE

- 1. J. Hoffman and P. Graham, (2006) 'Human Rights', *Introduction to Political Theory*, Delhi,Pearson, pp. 436-458.
- SAHRDC (2006) 'Introduction to Human Rights'; 'Classification of Human Rights: An Overview of the First, Second, and Third Generational Rights', in *Introducing Human Rights*, New Delhi: Oxford University Press.
- 3. The Constitution of the Republic of South Africa, Chapter 2: Bill of Rights.
- 4. The Constitution of India, Chapter 3: Fundamental Rights
- 5. M. Lippman, (1979) 'The Protection of Universal Human Rights: The Problem of Torture' *Universal Human Rights*, Vol. 1(4), pp. 25-55
- J. Lokaneeta, (2011) 'Torture in the TV Show 24: Circulation of Meanings'; 'Jurisprudence on Torture and Interrogations in India', in *Transnational Torture Law, Violence, and State Power in the United States and India*, Delhi: Orient Blackswan,
- 7. D. O'Byrne, (2007) 'Torture', in Human Rights: An Introduction, Delhi: Pearson, pp. 164-197.
- 8. E. Scarry, (2010) 'Resolving to Resist', in *Rule of Law, Misrule of Men*, Cambridge: Boston Review Books, MIT, pp.1-53.
- U. Singh, (2007) 'The Unfolding of Extraordinariness: POTA and the Construction of Suspect Communities', in *The State, Democracy and Anti-terror Laws in India*, Delhi: Sage Publications, pp.165-219
- A. Pinto, (2001) 'UN Conference against Racism: Is Caste Race?', in *Economic and Political Weekly*, Vol. 36(30)
- 11. A. Khan and R. Hussain, (2008), 'Violence Against Women in Pakistan: Perceptions and Experiences of Domestic Violence', *Asian Studies Review*, Vol. 32, pp. 239 253
- K. Kannabiran (2012) 'Rethinking the Constitutional Category of Sex', in *Tools of Justice: Non-Discrimination and the Indian Constitution*, New Delhi, Routledge, pp.425-443
- 13. N. Menon (2012) 'Desire', Seeing Like a Feminist, New Delhi: Zubaan/Penguin, pp. 91-146
- 14. M. Ishay, (2004) *The History of Human Rights: From Ancient Times to the Globalization Era*, Delhi: Orient Blackswan.
- 15. Text of UDHR available at http://www.un.org/en/documents/udhr/index.shtml

16. U. Baxi, (1989) 'From Human Rights to the Right to be Human: Some Heresies', in S. Kothari and H. Sethi (eds.), *Rethinking Human Rights*, Delhi: Lokayan, pp.181-166

#### DISCIPLINE SPECIFIC ELECTIVE 6 (Any two in Semester - Vi)

PLSADSE	Semester VI			
Course Code	Paper VI Governance: Issues and Challenges	Lectures	Credits (Theo +Tutorial) X 15 weeks	Marks
	Module 1. GOVERNMENT AND GOVERNANCE: CONCEPTS Role of State In the era of Globalisation State, Market and Civil Society	20	5+1	75
PLSADSE06T	Module 2. ENVIRONMENTAL GOVERNANCE Human-Environment Interaction Green Governance: Sustainable Human Development	20		
	Module -3. GOOD GOVERNANCE INITIATIVES IN INDIA: BEST PRACTICES Public Service Guarantee Acts Electronic Governance Citizens Charter & Right to Information Corporate Social Responsibility	35		

#### PLSADSE06T - GOVERNANCE: ISSUES AND CHALLENGES

1. B. Chakrabarty and M. Bhattacharya, (eds.) *The Governance Discourse*. New Delhi: Oxford University Press, 1998

- 2. Surendra Munshi and Biju Paul Abraham [eds.], *Good Governance, Democratic Societies And Globalisation*, Sage Publishers, 2004
- 3. United Nation Development Programme, Reconceptualising Governance, New York, 1997
- 4. Carlos Santiso, *Good Governance and Aid Effectiveness: The World Bank and Conditionality* Johns Hopkins University, The Georgetown Public Policy Review ,Volume VII, No.1, 2001
- 5. Vasudha Chotray and Gery Stroker, Governance Theory: A Cross Disciplinary Approach, Palgrave Macmillan, 2008
- 6. J. Rosenau, 'Governance, Order, and Change in World Politics', in J. Rosenau, and E. Czempiel (eds.) *Governance without Government: Order and Change in World Politics*, Cambridge: Cambridge University Press, 1992
- 7. B. Nayar (ed.), *Globalization and Politics in India*. Delhi: Oxford University Press, 2007 pp. 218-240.
- 8. P. Bardhan, 'Epilogue on the Political Economy of Reform in India', in *The Political Economy of Development in India*. 6th edition, Delhi: Oxford University Press, 2005
- 9. J. Dreze and A. Sen, *India: Economic Development and Social Opportunity*. New Delhi: Oxford University Press, 1995
- 10. Niraja Gopal Jayal[ed.], *Democracy in India*, Oxford University Press, 2007
- 11. Ramachandra Guha, *Environmentalism: A Global History*, Longman Publishers, 1999 J.P. Evans, *Environmental Governance*, Routledge, 2012
- 12. Emilio F. Moran, Environmental Social Science: Human Environment interactions and Sustainability, Wiley-Blackwell, 2010
- 13. Burns H Weston and David Bollier, Green Governance: Ecological Survival, Human Rights, and the Law of the Commons, Cambridge University Press, 2013
- 14. A. Heywood, *Global Politics*, New York: Palgrave, 2011, pp. 383-411.
- 15. N. Carter, *The Politics of Environment: Ideas, Activism, Policy*, Cambridge: Cambridge University Press, 2007, pp. 13-81.

- 16. Pranab Bardhan and Dilip Mookherjee, *Decentralization And Local Governance In Developing Countries: A Comparative Perspective*, MIT Press, 2006
- 17. Niraja Gopal Jayal, *Democracy and the State: Welfare, Secularism, and Development in Contemporary India*, Oxford University Press, 1999
- 18. K. Vijaya Kumar, Right to Education Act 2009: Its Implementation as to Social Development in India, Akansha Publishers, 2012
- 19. Amartya Sen and Jean Dreze, Omnibus: Poverty and Famines, Hunger and Public Action, India-Economic Development and Social Opportunity, Oxford University Press, 1998
- 20. Jean Dreze and Amartya Sen, An Uncertain Glory: India And Its Contradictions, Princeton University Press, 2013

#### (D) PLSSSEC - Skill Enhancement Courses - Two

Semester – 3 Credit – 2 Class – 2Hours/week

#### 1. PLSSSEC01M Democratic Awareness with Legal Literacy

**Course Objective:** The Proposed course aims to acquaint student with the structure and manner of functioning of the legal system in India.

#### Course Content: Unit I

□ Outline of the Legal system in India

□ System of courts/tribunals and their jurisdiction in India - criminal and civil courts,Writ jurisdiction, specialized courts such as juvenile courts, Mahila courts and Tribunals.

□ Role of the police and executive in criminal law administration.

□ Alternate dispute mechanisms such as Lok Adalats, non- formal mechanisms.

#### Unit II

□ Brief understanding of the laws applicable in India

 $\Box$  Constitution - fundamental rights, fundamental duties, other constitutional rights and their manner of enforcement, with emphasis on public interest litigation and the expansion of certain rights under Article 21 of the Constitution.

 $\Box$  Laws relating to criminal jurisdiction- provision relating to filing an FIR, arrest, bail search and seizure and some understanding of the questions of evidence and procedure in Cr. P.C. and related laws, important offences under the Indian PenalCode, offences against women, juvenile justice, prevention of atrocities on Scheduled Castes and Scheduled Tribes.

□ Concepts like Burden of Proof, Presumption of Innocence, Principles of Natural Justice, Fair comment under Contempt laws.

- □ Personal laws in India : Pluralism and Democracy
- □ Laws relating to contract, property and tenancy laws.
- □ Laws relating to dowry, sexual harassment and violence against women
- □ Laws relating to consumer rights
- □ Laws relating to cyber crimes
- □ Antiterrorist laws: implications for security and human rights
- □ Practical application: Visit to either a (I) court or (ii) a legal aid centre set up by the

 $\Box$  Legal Services Authority or an NGO or (iii) a Lok Adalat, and to interview a litigant or person being counselled. Preparation of a case history.

#### Unit III

#### Access to courts and enforcement of rights

- □ Critical Understanding of the Functioning of the Legal System
- □ Legal Services Authorities Act and right to legal aid, ADR systems

#### **Practical application :**

What to do if you are arrested ; if you are a consumer with a grievance; if you are a victim of sexual harassment; domestic violence, child abuse, caste, ethnic and religious discrimination; filing a public interest litigation. How can you challenge administrative orders that violate rights, judicial and administrative remedies

Using a hypothetical case of (for example) child abuse or sexual harassment or any other violation of a right, preparation of an FIR or writing a complaint addressed to the appropriate authority.

#### □ Suggested exercises for students

1. Discuss the debates around any recent Ordinance, Bill or Act in Parliament.

2. How to file an FIR? In case there has been a theft in the neighbourhood how would you file the first Hand Information Report?

3. Under what circumstances can detention and arrest become illegal?

4. Discuss any contemporary practice or event that violates the equality and protection

against discrimination laws.

5.. Your friend has shared with you an incident of unwelcome verbal remarks on her by a person of higher authority in your college, what would you do?

6. You have seen a lady in your neighbourhood being beaten up by her husband. Identify the concerned Protection Officer in case you want to provide information about this incident.

7.Read the Vishakha Guidelines as laid down by the Supreme Court and the Act against sexual harassment at the workplace. Discuss what constitutes sexual harassment and the mechanisms available for its redressal in your institution. Use and Abuse of the mechanism.

8. What is the procedure to file an RTI? Use and Abuse of RTI. Exemptions to RTI

10. You bought a product from a nearby shop which was expired, the shop keeper refused to return it. Use your knowledge of Consumer Protection Act to decide what you do next?

11. What must you keep in mind as a consumer while making a purchase that may later help you make use of Consumer Protection Act? (Hint- Should you ask for a Bill?)

12. In your surroundings have you witnessed any incident that would be considered offensive under the SC and ST Act? Make a class- room presentation on it.

Semester – 4 Credit – 2 Class – 2Hours/week

#### PLSSSEC02M - 2. Public Opinion and Survey Research

**Course Objective:** this course will introduce the students to the debates, principles and practices of public opinion polling in the context of democracies, with special reference to India. It will familiarize the students with how to conceptualize and measure public opinion using quantitative methods, with particular attention being paid to developing basic skills pertaining to the collection, analysis and utilization of quantitative data.

#### I. Introduction to the course

Definition and characteristics of public opinion, conceptions and characteristics, debates about its role in a democratic political system, uses for opinion poll

#### II. Measuring Public Opinion with Surveys: Representation and sampling (6 lectures)

a. What is sampling? Why do we need to sample? Sample design.

b. Sampling error and non-response

c. Types of sampling: Non random sampling (quota, purposive and snowball sampling); random sampling: simple and stratified

d. Interviewing: Interview techniques pitfalls, different types of and forms of interview

e. Questionnaire: Question wording; fairness and clarity.

#### **III. Quantitative Data Analysis**

a. Introduction to quantitative data analysis

b. Basic concepts: correlational research, causation and prediction, descriptive and Inferential Statistics



# Syllabus under CBCS

# FOR

# **THREE YEARS B.A.SANSKRIT (HONOURS)**



# WEST BENGAL STATE UNIVERSITY

# BARASAT

## **NORTH 24 PARGANAS**

PIN - 700126



# **DETAILS OF COURSE STRUCTURE**

Distribution of courses in different semesters for B.A. (Honours) Sanskrit

Semester	Core	DSE	GE	AECC	SEC	Total credit
	C1		GF1	Environmental		20
I	C2		011	Science		20
	C3		GE2	English/MIL		20
11	C4		012	Communication		20
	C5					
111	C6		GE3		SEC1	26
	C7					
	C8					
IV	С9		GE4		SEC2	26
	C10					
	C11	DSE1				24
V	C12	DSE2				27
	C13	DSE3				24
VI	C14	DSE4				24
Total number of courses	14	4	4	2	2	140

# West Bengal State University

# Syllabus under CBCS

# FOR

# B.A. Honours in Sanskrit

(6 Semesters Pattern)

There will be six semesters in the three-year B.A. Honours in Sanskrit. The Curriculum consists of 14 Core Courses (C), 2 Ability Enhancement Compulsory Courses (AECC), 2 Skill Enhancement Courses (SEC) and 4 Discipline Specific Elective (DSE) Courses and 4 Generic Elective (GE) courses.

All questions will be set in Sanskrit Language with Devnagari Script.

\* <u>60% of Questions are to be answered compulsorily in Sanskrit with</u> <u>Devanagari script in 1<sup>st</sup> and 2<sup>nd</sup> Semesters.</u>

\* <u>80% of Questions are to be answered compulsorily in Sanskrit with</u> Devanagari script in 3<sup>rd</sup> and 4<sup>th</sup> Semesters.

<u>100% Questions are to be answered compulsorily in Sanskrit with</u>
 <u>Devanagari script in 5<sup>th</sup> and 6<sup>th</sup> Semesters.</u>



	Semester I		Marks				
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total
		Classical Sanskrit Literature (Poetry)	6	5+1	25 (5+20)	50	75
SANACORO1T	Core Course 1	<ul> <li>Section 'A' (10 Classes) Raghuvaṁśam: Canto-I (Verse: 1-25)</li> <li>Section 'B' (18 Classes) Kumārasambhavam: Canto-V (Verse: 1-30)</li> <li>Section 'C' (22 Classes) Kirātārjunīyam - Canto I (1-25 Verses)</li> <li>Section 'D' (15 Classes) Nītiśatakam (1-20 Verses, 1st two Paddhatis)-M. R. Kale Edition.</li> <li>Section 'E' (10 Classes) Origin and Development of Mahākāvya and Gītikāvya</li> </ul>					
SANACORO2T	Core Course 2	Critical Survey of Sanskrit Literature Section 'A' (20 Classes) Vedic Literature Samhitā (Rk, Yajuḥ, Sāma, Atharva) time, subject– matter, religion & Philosophy, social life Brāhmaṇa, Āraṇyaka, Upaniṣad, Vedāṅga (Brief Introduction) Section 'B'(10 Classes) Rāmāyaṇa Rāmāyaṇa as a Source-matter, Rāmāyaṇa as an Ādikāvya. Rāmāyaṇa as a Source Text and its Cultural Importance. Section 'C'(10 Classes) Mahābhārata Mahābhārata Mahābhārata : Encyclopaedic nature, as a Source, Text, Cultural Importance. Section 'D'(10 Classes) Purāṇas Purāṇas : Subject matter, Characteristics Purāṇas : Social, Cultural and Historical Importance	6	5+1	25 (5+20)	50	75

west Bengal State University			CBCS	Syllabus				B.A.(Honours) Sanskrit			
		Section 'E'(25 Cla General Introduc Sāhityaśāstra General Introducti Brief History of Vya General Introducti Major schools of Jaina, Sāṅkhya-yo and Uttara mīmāṁ General Introducti Six major Schools Dhvani,Vakrokti ar	asses) oction to Vyākaraņa; ākaraņašāstra on to Daršana: Indian Philosophy Cā ga, Nyāya-Vaisešika, F isā. on to Poetics: of Indian Poetics-Rasa nd Aucitya	, Darśana and rvāka, Bauddha, Pūrva- mīmāṁsā a, Alaṁkāra, Rīti,							
	Generic Elective Course 1	Interdisciplina	ary(Any Discipline oth than Sanskrit) (75 classes)	er	6	5+1	25 (5+20)	50	75		
ENVSAEC01T	AECC		ENVS		2	2	5	20	25		

		Semester II	Marks				
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total
		Classical Sanskrit Literature (Prose)	6	5 + 1	25 (5+20)	50	75
SANACORO3T	Core Course 3	Section 'A'(30 Classes) Śukanāsopadeśa Section 'B'(23 Classes) Viśrutacaritam (Uchhvāsa VIII) Section 'C'(22 Classes) Origin and development of prose, Important prose romances and fables Origin and development of prose, important prose romances and fables (i) Subandhu, Daņḍin, Bāṇa, Ambikādatta Vyāsa. (ii)Paňcatantra,Hitopadeśa, Vetālapaňcaviṁśatikā, Siṁhāsanadyātriṁśikā, Purusaparīksā, Śukasaptati					
		Self Management in the Gītā	6	5 + 1	25 (5+20)	50	75
SANACORO4T	Core Course 4	Section 'A'(23 Classes)           Gītā: Cognitive and emotive apparatus           III.42; XV. 7, XIII. 5-6; XIV.5-8, 11-13; XIV.17, VII.4           XV.7; XV.9           Section 'B'(30 Classes)           Gītā: Controlling the mind           I.1; IV.16; I.45; II.6.41.60.67, III.36-39, XVI.21, II.3; IV.5, VI.34-35;					

West Bengal State University CBCS Syllabus B.A.(Honours) Sanskrit									
		, VI.11-14, III.8; VI.16-17, XVII. 8-10, XVII. 14-19, VI., III.25, IV.42, XVIII.30-32, XVIII.63, II.59, 64, XVIII .13-16; V.8-9, II.48; II.55, II. 52 ; IV.38-39							
		Section 'C'(22 Classes) Gītā: Self management through devotion XII.11; XII.13-19, II.47, VII.21, IV.11, IX.26, II.7; IX.27; VIII.7; XI.55							
	Generic Elective Course 2	Interdisciplinary(Any Discipline other than Sanskrit) (75 classes)	6	5+1	25 (5+20)	50	75		
SANSAEC01M	AECC/MIL	ENGLISH/ Bengali/ Sanskrit Declension : Nara, Muni, Sādhu, Pitri, Latā, Mati, Madhu, Marut, Nadī, Dhenu, Badū, Phala, Vāri, Asmad, Yusmad, Tat, Yat Conjugation : Pat, Pac, Gam, Kri, Bhū, Ad, As, Han, Hū, Dib, Tan, Tud, Su, Krī, Sev, Chur Kāraka vibhakti Rules, ktva, tumun, Shatri, Shanach, nistha, kritya Comprehension	2	2	5	20	25		



B.A.(Honours) Sanskrit

		Semester III			Marks		
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total
		Classical Sanskrit Literature (Drama)	6	5 + 1	25 (5+20)	50	75
SANACOROST	Core Course 5	Section 'A'(25 Classes) Svapnavāsavadattam— Bhāsa Section 'B'(50 Classes) Abhijňānaśākuntalam					
		Poetics and literary criticism	6	5 + 1	25 (5+20)	50	75
SANACORO6T	Core Course 6	<ul> <li>Section 'A'(10 Classes)</li> <li>Introduction to Sanskrit poetics</li> <li>Introduction to poetics:</li> <li>Origin and development of Sanskrit poetics, its various names- kriyākalpa, alaôkāraśāstra sāhityaśāstra, saundryaśāstra.</li> <li>Definition (lakşaṇa), objectives (prayojana) and causes (hetu) of poetry. (according to kāvyaprakāśa)</li> <li>Section 'B' (15 Classes)</li> <li>Forms of Kāvya-Literature</li> <li>Forms of poetry :</li> <li>drśva, śravya, miśra, (campū)</li> <li>Mahākāvya, khaṇḍakāvya, gadya-kāvya: kathā, ākhyāyikā (according to Sāhityadarpaṇa)</li> <li>Section 'C'(20 Classes)</li> <li>Śabda-śakti (Power of Word) and rasa-sūtra</li> <li>Power/Function of word and meaning (according to kāvyaprakāśa):</li> <li>abhidhā (expression/ denotative meaning), lakṣaṇā (indication/ indicative meaning) and vyañjanā (suggestion/ suggestive meaning).</li> <li>Rasa: rasa-sūtra of Bharata and its prominent expositions: utpattivāda, anumitivāda, bhuktivāda and abhivyaktivāda, alaukikatā (transcendental nature) of rasa (as discussed in kāvyaprakāśa</li> <li>Section 'D'(30 Classes)</li> <li>Alamkāra(figures of speech) — According to Sahityadarpanaand</li> <li>Chandasa (metres) – According to Chandomanjari</li> <li>Figures of speech: anuprāsa, yamaka, śleşa, upamā, rūpaka, sandeha, bhrāntimān, apahnuti, utprekşā, atiśayokti, tulyayogitā, dīpaka, dṛstānta, nidarśanā, vyatireka, samāsokti, svabhāvokti, aprastutapraśamsā, arthāntaranyāsa, kāvyalinğa, vibhāvanā.</li> </ul>					

1 1 / 0+		Matraci					
anus upaj śārd		anustup, āryā, indravajrā, upendravajrā, drutavilambita, upajāti, vasantatilakā, mālinī, mandākrāntā, śikhariņī, śārdūlavikrīdita, sragdharā					
		Indian Social Institutions and Polity	6	5 + 1	25 (5+20)	50	75
Sec Ind India Soci Trer Insti Rām Jain Fore Soci Vār Dha Insti Yājñ Mar in th Tent Four Stru Var Four Mak Divis 4.13 Orig (Ma Soci Syst Bauu Yājñ Brie Soci Syst Bauu Yājñ Posi Brie Soci Soci Situ Soci Situ Soci	Core Course 7	<ul> <li>Section 'A'(15 Classes)</li> <li>Indian Social Institutions : Definition and Scope: Sociological Definition of Social Institutions. Trends of Social Changes, Sources of Indian Social Institutions (Vedic Literature, Sütra Literature, Puräņas, Rāmāyaņa, Mahābhārata, Dharmašāstras, Buddhist and Jain Literature, Literary Works, Inscriptions, Memoirs of Foreign Writers)</li> <li>Social Institutions and Dharmašāstra Literature:</li> <li>Dharmašāstra as a special branch of studies of Social Institutions, sources of Dharma (Manusmrti, 2,12; Yājñavalkyasmrti,1.7).</li> <li>Different kinds of Dharma in the sense of Social Ethics Manusmrti, 10,63; Vişnupurāņa 2.16-17); Six kinds of Dharma in the sense of Duties (Mitākşarāţikā on Yājñavalkyasmrti,1.1).</li> <li>Tenfold Dharma as Ethical Qualities (Manusmrti,6.92); Fourteen-Dharmasthānas (Yājñavalkyasmrti,1.3)</li> <li>Section 'B'(20 Classes)</li> <li>Structure of Society and Value of Life Varņa-System and Caste System :</li> <li>Four-fold division of Varņa System, (Rgveda, 10.90.12), Mahābhārata, Šāntiparva,72.3-8); Division of Varņa according to Guna and Karma (Bhagvadgīta, 4.13, 18.41-44).</li> <li>Origin of Caste-System from Inter-caste Marriages (Mahābhārata, Sāntiparva, 65.13-22).</li> <li>Social rules for up-gradation and down-gradation of Caste System (Apastambadharmasūtra, 1.8.16.13-14, Manusmrti, 10,64, Yājñavalkyasmrti, 1.96)</li> <li>Position of Women in the Society : Brief survey of position of women in different stages of Society.</li> <li>Position of women in Mahābhārata (Anušāsanaparva, 46.5- 11, Sabhāparva, 69.4-13.</li> <li>Praise of women in The Brhatsamhitā of Varāhamihira (Strīprasamšā, chapter-74.1-10)</li> <li>Social Relevance of Indian life style with special reference to Sixteen Samskāras.</li> </ul>			(5+20)		

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		Section 'C' (25 Classes)					
		Indian Polity : Origin and Development					
		initial stage of indian Polity (from Vedic period to Budanist					
		penou).					
		Election of King by the people: 'Viśas' in Vedic					
		priod(Rgveda,10.173;10.174;Atharvaveda,3.4.2;					
		Parliamentary Institutions:'Sabhā,'Samiti' and 'Vidatha' in					
		Vedic period (Atharvaveda,7.12.1;12.1.6; Rgveda,10.85.26);					
		Ring-maker Rajakartaran Council in Atharvaveda(3.5.6- 7) Council of 'Ratnis' in Satanathahrāhmana(5.2.5.1)					
		Satapathabrāhmana (51.1.8-13: 9.4.1.1-5) Republic States in					
		the Buddhist Period (Digghnikāya, Mahāparinibbaṇa					
		Sutta, Anguttaranikāya,1.213;4.252,256) Later Stages of					
		Indian Polity (From Kauțilya to Mahatma Gandhi). Concept of					
		Welfare State in Arthasastra of Kauțilya (Arthasastra,					
		1.13 : Malsydnydyddindnulii lo yo dsindngopdydilii); Essential Qualities of King (Arthaćāstra 6.1.16-18:					
		'sampādavatvasampannah' to 'javatveva na hīvate');					
		. , , ,					
		State Politics 'Rajadharma' Mahābhārata					
		Śāntiparva,120.1-15; Manusmṛti, 7.1-15; Śukranīti,1.1-15);					
		Constituent Elements of Jain Polity in Nitivākyāmrta of					
		Somadeva Suri, (Daņģaniti- samuddesa, 9.1.18 and Jananada- samuddeša 19.1.10)					
		Relevance of GandhianThought in Modern Period with					
		special reference to 'Satyāgraha' Philosophy					
		('Satyāgrahagītā' of Panditā Kṣamārāva and 'Gandhi Gītā', 5.1-					
		25 of Prof. Indra)					
		Section 'D'(15 Classes)					
		Cardinal Theories and Thinkers of Indian Polity					
		Cardinal Theories of Indian Polity:					
		'Saptāṅga' Theory of State:					
		1.Svami, 2. Amatya, 3.Janapada 4. Pura, 5. Kosa, 6. Daņģa and Mitra(Arthaćāstra, 6.1. Mahābhārata, Šāntinarya					
		56.5, Śukranīti, 1.61-62).					
		'Maṇḍala'Theory of Inter-State Relations:					
		1.Ari, 2.Mitra, 3. Ari-mitra,4.Mitra- mitra, 5.Ari-mitra-					
		mitra; (According to Manusamhita)					
		Sādgunya'Policy of War and Peace :					
		1.Sandni, 2. Vigrana, 3. Yana, 4. Asana, Saméraya 6 Dyaidhibhāya (According to Manusamhita)					
		'CaturvidhaUpāva'for Balancing the power					
		1.Sāma 2.Dāma,3.Daņda.4.Bheda; (According to					
		Manusamhita)					
		Ihree Types of State Power: Sakti':					
		Sakii, Z.Mahira-Sakii, S. Olsana-Sakii. Important Thinkers on Indian Polity:					
		Manu, Kautilya, Kāmandaka, Śukrācārya, SomadevaSuri,					
		Mahatma Gandhi.					
	Generic		Ţ		25		
	Course 3	Interdisciplinary (Any Discipline other than	6	5+1	(5+20)	50	75
	course s	Sanskrit) (75 classes)	-				25
		Basic Sanskrit	2	2	5	20	25
SANSSEC01M	SECT (Skill	(20 Classes)					
57.1.435EC011VI	Based)	(20 Classes) Paragraph Writing (5 Classes)					
	,	Letter Writing (5 Classes)					


		Semester IV				Marks	
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total
SANACORO8T	Core Course 8	Indian Epigraphy, Paleography and Chronology Section 'A' (20 Classes) Epigraphy Introduction to Epigraphy and Types of Inscriptions Importance of Indian Inscriptions in the reconstruction of Ancient Indian History and Culture History of Epigraphical Studies in India History of Decipherment of Ancient Indian Scripts (Contribution of Scholars in the field of epigraphy): Fleet, Cunninghum, Princep, Buhler, Ojha, D.C.Sircar Section 'B'(20 Classes) Paleography Antiquity of the Art of Writing Writing Materials, Inscribers and Library Introduction to Ancient Indian Scripts. Section 'C'(25 Classes) Study of selected inscriptions Aśoka's Giranāra Rock Edict-1 , Aśoka's Sāranātha Pillar Edict Girnāra Inscription of Rudradāman, Eran Pillar Inscription of Samudragupta, Mehrauli Iron Pillar Inscription of Candra, Delhi Topra Edict of Bīsaladeva Section 'D'(10 Classes) Chronology General Introduction to Ancient Indian Chronology System of Dating the Inscriptions - Vikrama Era, Śaka Era and Gupta Era	6	5+1	25 (5+20)	50	75
SANACORO9T	Core Course 9	Modern Sanskrit Literature Section 'A'(35 Classes) Survey of Modern Sanskrit Literature in Bengal Section 'B'(40 Classes) GadyaKāvya and Rūpaka Śivarājavijayam, Niśwāsa-I Bharatavivekam – Yatindravimal Choudhury Chipitakacharvanam - Srijiv Nyayatirtha	6	5 + 1	25 (5+20)	50	75

	est Bengal	State University CBCS Syllabus			B.A.(Hoi	nours) Sa	anskrit
		Sanskrit and World Literature   6   5 + 1				50	75
SANACOR10T	Core Course 10	Section 'A' (30 Classes) Sanskrit Studies in West: - William Jones, Charles Wilkins, H.Wilson, Max Muller, J.G.Buhler, Mac donell, Weber, W.T.Whitney Section 'B' (45 Classes) Sanskrit Studies in East: Swami Vivekananda, Sri Aurobindo, DayānandaSarasvatī, HaridāsaSiddhāntavāgīśa, ŚrījīvaNyāyatīrtha, Kshitish Chandra Chatterji, Roma Chaudhuri, PañcānanaTarkaratna &Ramaranjan Mukherji)					
	Generic Elective Course 4	Interdisciplinary (Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75
SANSSEC02M	SEC2 (Skill Based)	Spoken Sanskrit & Computer Awareness for Sanskrit( Basic Computer Awareness, Typing in Unicode for Preservation and Digitalization of Sanskrit Text Web Publishing)	2	2	5	20	25

		Semester V			I	Marks	
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total
		Vedic Literature	6	5 + 1	25 (5+20)	50	75
SANACOR11T	Core Course 11	Section 'A' (30 Classes)Samhitā and BrāhmaņaRgveda- Agni- 1.1, Uşas- 3.61, Akşa10.34, Hiraņyagarbha- 10.121Yajurveda- Śivasamkalpa Sūkta- 34.1-6Atharvaveda- Sāmmanasyam- 3.30, Bhūmi-12.1-12Sunahśepākhyāna of AitereyabrahmanaSection 'B' (20 Classes)Vedic GrammarDeclensions (śabdarūpa),SubjunctiveMood (leţ), Gerunds (ktvārthaka, Tumarthaka),Vedic Accent and PadapāţhaSection 'C' (25 Classes)Muņḍakopanişad					
		Sanskrit Grammar	6	5 + 1	25 (5+20)	50	75
SANACOR12T	Core Course 12	Section 'A' (5 Classes) The Concept of the following Saṃjñās: Sūtra,Vārtika,Bhāşya,Karmapravacanīya,Nipāta,Gati, Upasarga,Guṇa,Vṛddhi,Ṭi,Ghi,Ghu,Nadī,Upadhā and Samprasāraṇa					

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लक्ष्यं विश्वमानम् WE	est Bengal	State University CBCS Syllabus			B.A.(Hono	urs) Sa	anskrit
		Section 'B' (10 Classes) General introduction on Philology: i) Classification of Languages ii) Production and Classification of Sounds iii) Phonetic Laws iv) Vedic and Classical Sanskrit v) Ablaut vi) Phonetic Tendencies vii) Somanties					
		Section 'C'(30 Classes) Karakaprkaranam – Vaiyakaranasiddhantakoumudi Section 'D'(30 Classes) Samasaprakaranam - Vaiyakaranasiddhantakoumudi					
		Choose Any Two from SANADSE01T, SANADSE02T, SANADSE03T					
		Veda & Vyakarana	6	5 + 1	25 (5+20)	50	75
SANADSE01T	Discipline Specific Elective 1	<ul> <li>i) Śuklayajurveda : Rudrādhyāy ii) Manumatsyakathā of Śatapatha Brāhmana iii) Kavirahasyam</li> <li>iv) Taittiriyopanisad Shikshabvalli : (Adhyaya-1st, Anuvaka : 1- 12), v) Aitareya Brāhmana - Nabhānedişţhopākhyānam (22.9)</li> <li>vi) Siddhantakoumudi (Stripratyaya)</li> </ul>					
SANADSE02T	Discipline Specific	Darshana	6	5 + 1	25 (5+20)	50	75
	Elective 2	i) Saptapadarthi ii) Brihadarnnyakopanishad – Ch –IV.4 & 5 Bramhanas.					
	Discipline	Каvya	6	5 + 1	25 (5+20)	50	75
SANADSE03T	Specific Elective 3	i) Sahityadarpana- 1-3 Chapters ii) Śiśupālavadham: Canto-I (Verse: 1-30) iii) Yugajivanam– Roma Chowdhury					

		Semester VI			Marks		
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total
		Ontology and Epistemology	6	5 + 1	25 (5+20)	50	75
SANACOR13T	Core Course 13	Section 'A'(15 Classes) Essentials of Indian Philosophy Meaning and purpose of darśana, general classification of philosophical schools in classical Indian philosophy Realism (yathārthavāda or vastuvāda) and Idealism (pratyayavāda), Monism (ekattvavāda), Dualism (dvaitavavāda) & Pluralism (bahuttvavāda); dharma (property)-dharmi (substratum) Causation (kāryakāraṇavāda) naturalism (svabhāvavāda), doctrine of pre-existence of effect (satkāryavāda),					

	St Benga	doctrine of real transformation (pariņāmavāda),         doctrine of illusory transformation (vivartavāda),         doctrine of non prexistence of effect in cause         (asatkāryavāda and ārambhavāda)         Section 'B'(30 Classes)         Ontology (Based on Tarkasamgraha)         Concept of padārtha, three dharmas of padārthas, definition of Dravya, Sāmānya, Viśeşa, Samavāya, Abhāva.         Definitions of first seven dravyas and their examination;         Ātma and its qualities, manas.         Qualities (other than the qualities of the ātman)         Five types of Karma         Section 'C'(30 Classes)         Epistemology (Based on Tarkasamgraha)         Buddhi(jñāna) – nature of jñāna in Nyāya         vaišeşika; smriti-anubhava; yathārtha and ayathārtha         Karaṇa and kāraṇa, definitions and types of pramā,         kartā-kārana-vyāpāra-phala,			B.A.(r	10110UTS) Se	
		Sanskrit Composition and Communication	6	5 + 1	25 (5+20)	50	75
SANACOR14T	Core Course 14	Section 'A'(25 Classes) Vibhaktyartha, Voice and Krt Section 'B'(25 Classes) Translation and Communication Translation Bengali/English to Sanskrit Section 'C'(25 Classes) Essay					
		Chose Any Two from SANADSE04T, SANADSE05T, SANADSE06T					
		Veda & Vyakarana	6	5 + 1	25 (5+20)	50	75
Dis SANADSE04T Sp Ele	Discipline Specific Elective 4	i)Vedic Culture & Vedic studies in West Bengal ii)Computational linguistics iii)VaidikaVyakhyapaddhati (Indian & Western) iv) Bhattikavyam (2nd Sarga)					
		Darshana	6	5 + 1	25 (5+20)	50	75
SANADSE05T	Discipline Specific Elective 5	i) Bangiyadarshanachinta: Ramakrishna-Vivekananda darshan, GouriyaVaishnabdarshan Shaktadarshan ii) Comparative Studies – Indian & Western logic &Nyaya studies in West Bengal					
SANADSE06T	Discipline Specific	i) Kawalankarasutravritti 1.4 Chantors	6	5 + 1	25 (5+20)	50	75
	Elective 6	ii) Bhattikavyam (2nd Sarga)					

# **Generic Elective Course (Honours)**

- \* <u>All questions will be set in Sanskrit Language with Devnagari Script.</u>
- 20% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 1<sup>st</sup> and 2<sup>nd</sup>Semesters.
- \* 30% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 3<sup>rd</sup> and 4<sup>th</sup> Semesters.
- 40% Questions are to be answered compulsorily in Sanskrit with Devanagari script in 5<sup>th</sup> and 6<sup>th</sup> Semesters.

Semester I						Marks		
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total	
		Sanskrit Poetry	6	5 + 1	25	50	75	
		Section 'A' (20 Classes) Raghuvaṁśam: Canto-I (Verse: 1-25)						
SANHGEC01T	Generic Elective	<b>Section 'B' (18 Classes)</b> Kumārasambhavam: Canto-V (Verse: 1-30)						
	Course	<b>Section 'C' (22 Classes)</b> Nītiśatakam (1-20 Verses, 1st two Paddhatis)-M. R. Kale Edition.						
		Section 'D' (15 Classes) History of Sanskrit Poetry						
		Semester II				Marks		
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total	
		Sanskrit Prose	6	5 + 1	25	50	75	
SANHGEC02T	Generic Elective Course	Section 'A' (15 Classes) Śukanāsopadeśa Section 'B' (30 Classes) Śivarājavijayam, Niśwāsa-I Section 'C' (30 Classes) Survey of Sanskrit Literature- Prose						

Semester III					Marks			
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total	
		Sanskrit Drama	6	5 + 1	25	50	75	
SANHGEC03T	Generic Elective Course	Section 'A' (25 Classes) Svapnavāsavadattam— Bhāsa Section 'B' (50 Classes) Abhijānašākuntalam						
Semester IV					Marks			
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total	
	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Sanskrit Grammar	6	5 + 1	25	50	75	
SANHGEC04T	Generic Elective Course	Section 'A' (25 Classes) Laghusiddhāntakaumudī : Samjyāprakaran Section 'B' (50 Classes) Laghusiddhāntakaumudī : Sandhiprakaraa Section 'C' (30 Classes) Laghusiddhāntakaumudī: Vibhakti prakaran						

### **QUESTION PATTERN**

### B. A. (Honours) in Sanskrit

### SEMESTER – I

### <u>Core Corse – 1</u>

		End Semester	Full Marks - 50
Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – E	-	Two Short Notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10
Section – D	-	Internal Assessment Project (In Sanskrit Language with Devanagari Script)	Full Marks - 25 ) 10
		Short Questions (Any one should be In Sanskrit Language with Devan	2x5 = 10 agari Script)
		Attendance	5



### <u>Core Corse – 2</u>

#### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – D	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		Two Short Notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10
Section – E	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – B		Internal Assessment Project (In Sanskrit Language with Devanagari Script	Full Marks - 25 ) 10
Section – C		Short Questions (Any one should be In Sanskrit Language with Devan	2x5 = 10 agari Script)
		Attendance	5



### **SEMESTER – II**

## Core Corse – 3

		End Semester	Full Marks - 50
Section –A	-	One long answer type question	1x10 = 10
		Three Short notes/Explanations (In Sanskrit Language with Devanagari Script)	3x5 = 15
Section – B	-	One long answer type question	1x10 = 10
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – C	-	One Short None/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	Internal Assessment Project (In Sanskrit Language with Devanagari Script)	Full Marks - 25 10
		Short Questions (Any one should be In Sanskrit Language with Devana	2x5 = 10 agari Script)
		Attendance	5



### Core Corse – 4

#### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	-	One long answer type question	1x10 = 10
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question	1x10 = 10
		Three Short notes/Explanations (In Sanskrit Language with Devanagari Script)	3x5 = 15
Section – C	-	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	Internal Assessment Project (In Sanskrit Language with Devanagari Script)	Full Marks - 25 ) 10
		Short Questions (Any one should be In Sanskrit Language with Devan	2x5 = 10 agari Script)
		Attendance	5
		AECC/MIL	
		Full Marks – 25	

Only Internal Assessment Full Marks - 25

Multiple Choice Based Questions	20
Attendance -	5



### **SEMESTER – III**

## <u>Core Corse – 5</u>

		End Semester	Full Marks - 50
Section –A	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B -	-	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
		Three Short notes/Explanations (In Sanskrit Language with Devanagari Script)	3x5 = 15
Section – B	-	Internal Assessment Project (In Sanskrit Language with Devanagari Script	Full Marks - 25 ) 10
		Short Questions (Any three should be In Sanskrit Language with Deva	2x5 = 10 inagari Script)
		Attendance	5



### Core Corse – 6

End Semester	Full Marks - 50

Section – B	- One long answer type question	1x10 = 10
Section – C	<ul> <li>One long answer type question</li> <li>(In Sanskrit Language with Devanagari Script)</li> </ul>	1x10 = 10
Section – D	<ul> <li>Short answer type Questions</li> <li>(In Sanskrit Language with Devanagari Script)</li> </ul>	5x2 = 10
	Four Short notes/Explanations (In Sanskrit Language with Devanagari Script)	4x5 = 20

		Internal Assessment	Full Marks - 25
Section – A	-	Project (In Sanskrit Language with Devanagari Script	) 10
		Short Questions (Any three should be In Sanskrit Language with Deva	2x5 = 10 Inagari Script)
		Attendance	5



### Core Corse – 7

#### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	-	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	One long answer type question	1x10 = 10
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10
Section – D	-	<i>Internal Assessment</i> Project (In Sanskrit Language with Devanagari Script	Full Marks - 25 ) 10

Short Questions 2x5 = 10 (Any three should be In Sanskrit Language with Devanagari Script)

Attendance

5



## <u>SEC1</u>

## (Skill Based)

Only Internal Assessment	Full Marks - 25
Translation (From Bengali/English to Sanskrit)	10
Paragraph Writing or Letter Writing in Sanskrit	10
Attendance	5



### **SEMESTER – IV**

## <u>Core Corse – 8</u>

		End Semester	Full Marks - 50
Section –A	-	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	One long answer type question	1x10 = 10
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

		Internal Assessment	Full Marks - 25
Section – D	-	Project (In Sanskrit Language with Devanagari Script	) 10
		Short Questions	2x5 = 10
		(Any three should be in Sanskrit Language with Deva	inagarı Script)
		Attendance	5



### Core Corse – 9

	End Semester	Full Marks - 50
Section – A -	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	Two long answer type questions (Any one In Sanskrit Language with Devanagari Scrip	2x10 = 20 t)
	Four Short notes/Explanations (In Sanskrit Language with Devanagari Script)	4x5 = 20

		Internal Assessment	Full Marks - 25
Section – A	-	Project (In Sanskrit Language with Devanagari Script)	) 10
		Short Questions (Any three should be In Sanskrit Language with Deva	2x5 = 10 nagari Script)
		Attendance	5



## Core Corse – 10

	End Semester	Full Marks - 50
Section – A -	<ul> <li>One Short note/Explanation</li> <li>(In Sanskrit Language with Devanagari Script)</li> </ul>	1x5 = 5
	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
Section – B	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
	One long answer type question	1x10 = 10
	Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

		Internal Assessment	Full Marks - 25
Section – B	-	Project (In Sanskrit Language with Devanagari Script	:) 10
		Short Questions (Any three should be In Sanskrit Language with Deva	2x5 = 10 anagari Script)
		Attendance	5



## <u>SEC2</u>

## (Skill Based)

Viva	10
Practical on Computer Awareness	10
Attendance -	5



### SEMESTER – V

### Core Corse – 11

#### Full Marks – 75

	End Semester	Full Marks - 50
-	Two long answer type questions Three Short notes/Explanations	2x10 = 20 3x5 = 15
-	One Short note/Explanation Short answer type Questions	1x5 = 5 5x2 = 10
	-	<ul> <li>End Semester</li> <li>Two long answer type questions Three Short notes/Explanations</li> <li>One Short note/Explanation Short answer type Questions</li> </ul>

		Internal Assessment	Full Marks - 25
Section – C	-	Project (In Sanskrit Language with Devanagari Script)	) 10
		Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5



### Core Corse – 12

#### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	- Sł	nort answer type Question	5x2 = 10
Section – B	- lo	ng answer type questions	1x10 = 10
	Tv	wo Short notes/Explanations	2x5 = 10
Section – D	- O	ne long answer type question	1x10 = 10
	Tv	wo Short notes/Explanations	2x5 = 10

		Internal Assessment	Full Marks - 25
Section – C	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5



**CBCS Syllabus** 

DSE1

## Veda & Vyakarana

#### Full Marks – 75

		End Semester	Full Marks - 50
i)	-	Short answer type Questions	5x2 = 10
ii)	-	One long answer type question	1x10 = 10
iii)		One Short note/Explanation	1x5 = 5
iv)	-	One Short note/Explanation	1x5 = 5
v)	-	One long answer type question	$1 \times 10 = 10$
vi)	-	Two Formations/Explanations of Sutras	2x5 = 10

Internal Assessment	Full Marks - 25

<u>On any from i to vi</u>	-Project (In Sanskrit Language with Devanagari Script)	10
	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5



<u>DSE2</u>

## Darshana

Full Marks – 75

End Semester	Full Marks - 50
<ul> <li>Short answer type Questions</li> <li>Four Short notes/Explanations</li> </ul>	5x2 = 10 4x5 = 20
panishad - Two long answer type questions	2x10 = 20
	<ul> <li>End Semester</li> <li>Short answer type Questions</li> <li>Four Short notes/Explanations</li> <li>panishad - Two long answer type questions</li> </ul>

		Internal Assessment	Full Marks - 25
Saptapadrthi	-	Project (In Sanskrit Language with Devanagari Script	) 10
Brihadarannyako	opanish	ad -Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5



DSE3

## Kavya

#### Full Marks – 75

### All the questions are to be answered in Sanskrit Language with Devanagari Script

	End Semester	Full Marks - 50
Sahityadarpanam -	Two long answer type questions	2x10 = 20
Shisupalavadham -	Four Short notes/Explanations	4x5 = 20
Yugajivanam -	Short answer type Questions	5x2 = 10
Shisupalavadham-	Internal Assessment Project (In Sanskrit Language with Devanagari Script	Full Marks - 25 ) 10
Sahityadarpanam -	Short Questions	2x5 = 10

(In Sanskrit Language with Devanagari Script)

Attendance		5

### **SEMESTER – VI**

## Core Corse – 13

#### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	- Short and	swer type Questions	5x2 = 10
Section – B	- One long	answer type question	1x10 = 10
	Two Sho	rt notes/Explanations	2x5 = 10
Section – C	- One long	answer type question	1x10 = 10
	Two Sho	rt notes/Explanations	2x5 = 10

		Internal Assessment	Full Marks - 25
Section – C	-	Project (In Sanskrit Language with Devanagari Script)	10
Section – B	-	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5



### Core Corse – 14

#### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	-	Short answer type Questions Change of voice	5x2 = 10 5x2 = 10
Section – B Section – C	-	Translation Bengali/English to Sanskrit Essay Writing	15 15

Internal Assessment	Full Marks - 25
On any from A, B & C Project (In Sanskrit Language with Devanagari Script	t) 10
Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
Attendance	5



B.A.(Honours) Sanskrit

<u>DSE4</u>

# Veda & Vyakarana

#### Full Marks – 75

	End Semester	Full Marks - 50
I	- One long answer type question	1x10 = 10
II	- Short answer type Questions	5x2 = 10
Ш	- Two Short notes/Explanations	2x5 = 10
IV	<ul> <li>One long answer type question</li> <li>Two Short notes/Explanations</li> </ul>	1x10 = 10 2x5 = 10

	Internal Assessment	Full Marks - 25
<u>On any from I to IV</u>	Project (In Sanskrit Language with Devanagari Scrip	t) 10
	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5



B.A.(Honours) Sanskrit

DSE5

## Darshana

Full Marks – 75

	End Semester	Full Marks - 50
Bangiyadarshanachinta -	Short answer type Questions Two long answer type questions	5x2 = 10 2x10 = 20
Comparative Studies -	Four Short notes/Explanations	4x5 = 20

	Internal Assessment	Full Marks - 25
Bangiyadarshanachinta -	Project (In Sanskrit Language with Devanagari Script)	) 10
Comparative Studies -	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5



DSE6

## Kavya

#### Full Marks – 75

#### All the questions are to be answered in Sanskrit Language with Devanagari Script

	End Semester	Full Marks - 50
Kavyalankarasutravritti —	One long answer type Question	10
	Short answer type questions	5x2 = 10
Bhattikavyam -	One long answer type question	10
	Four Short notes/Explanations	4x5 = 20

	Internal Assessment	Full Marks - 25
Kavyalankarasutravritti -	Project (In Sanskrit Language with Devanagari Script)	10
Bhattikavyam -	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5

**N.B.:** - The Question Pattern of Generic Elective (H) is similar to the Question Pattern of B.A. Sanskrit Programme (Core Courses).



# Syllabus under CBCS

### FOR

### THREE YEARS B.A.SANSKRIT (PROGRAMME)



## WEST BENGAL STATE UNIVERSITY

### BARASAT

**NORTH 24 PARGANAS** 

PIN - 700126

## West Bengal State University

# Syllabus under CBCS

# FOR

B.A. Programme in Sanskrit

(6 Semesters Pattern)

All questions will be set in Sanskrit Language with Devnagari Script.

\* <u>20% of Questions are to be answered compulsorily in Sanskrit with</u> <u>Devanagari script in 1<sup>st</sup> and 2<sup>nd</sup>Semesters.</u>

\* <u>30% of Questions are to be answered compulsorily in Sanskrit with</u> Devanagari script in 3<sup>rd</sup> and 4<sup>th</sup> Semesters.

✤ 40% Questions are to be answered compulsorily in Sanskrit with Devanagari script in 5<sup>th</sup> and 6<sup>th</sup> Semesters.

\* <u>B.A. Sanskrit Programme Core Courses are similar to Generic</u> <u>Elective Honours Courses.</u>

Semester	Core	DSE	GE	AECC	SEC	Total
						credit
I	DSC 1A			Environmental		20
	DSC 2A			Science		
	English					
II	DSC 1B			English/MIL		20
	DSC 2B			Communication		
	English					
	DSC 1C				SEC1	20
	DSC 2C					
	MIL					
IV	DSC 1D				SEC2	20
	DSC 2D					
	MIL					
V		DSE1A	GE1		SEC1	20
		DSE2A				
VI		DSE1B	GE2		SEC2	20
		DSE2B				
Total number of courses	12	4	2	2	4	120

### **DETAILS OF COURSE STRUCTURE**



		Semester I		Marks			
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	TOTAL
SANGCOR01T		Sanskrit Poetry	6	5 + 1	25 (5+20)	50	75
	Discipline Specific Core1A	Section 'A' (20 Classes) Raghuvaṁśam: Canto-I (Verse: 1- 25) Section 'B' (18 Classes) Kumārasambhavam: Canto-V (Verse: 1-30)					
		Section 'C' (22 Classes) Nītišatakam (1-20 Verses, 1st two Paddhatis)-M. R. Kale Edition. Section 'D' (15 Classes) History of Sanskrit Poetry					
	Discipline Specific Core2A		6	5+1	25 (5+20)	50	75
	ENGLISH		6	5 + 1	25 (5+20)	50	75
ENVSAEC01T	AECC	ENVS	2	2	5	20	25



		Semester II			Marks			
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	TOTAL	
		Sanskrit Prose	6	5 + 1	25 (5+20)	50	75	
SANGCOR02T	Discipline Specific Core1B	Section 'A' (15 Classes) Śukanāsopadeśa Section 'B' (30 Classes) Śivarājavijayam, Niśwāsa-I Section 'C' (30 Classes) Survey of Sanskrit Literature- Prose						
	Discipline Specific Core2B		6	5+1	25 (5+20)	50	75	
	ENGLISH		6	5 + 1	25 (5+20)	50	75	
SANSAEC01M	AECC	ENGLISH/ Bengali/ Sanskrit Declension : Nara, Muni, Sādhu, Pitri, Latā, Mati, Madhu, Marut, Nadī, Dhenu, Badū, Phala, Vāri, Asmad, Yusmad, Tat, Yat Conjugation : Pat, Pac, Gam, Kri, Bhū, Ad, As, Han, Hū, Dib,Tan, Tud, Su, Krī, Sev, Chur Kārakavibhakti Rules, ktva, tumun, Shatri, Shanach, nistha, kritya Comprehension	2	2	5	20	25	



		Semester III				Marks			
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	TOTAL		
SANGCOR03T	Discipline Specific Core1C	Sanskrit Drama	6	5 + 1	25 (5+20)	50	75		
		Section 'A' (25 Classes) Svapnavāsavadattam– Bhāsa Section 'B' (50 Classes) Abhijānašākuntalam							
	Discipline Specific Core2C		6	5+1	25 (5+20)	50	75		
SANLCOR01T	Modern Indian Language	English/Bengali/ Sanskrit A. Prastavana& 1 <sup>st</sup> two stories from Mitralabha B. Nitishatakam–Bhatrihari(1-20 Verses, 1 <sup>st</sup> two Paddhatis)	6	5 + 1	25 (5+20)	50	75		



		Semester IV				Marks			
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	TOTAL		
		Sanskrit Grammar	6	5 + 1	25 (5+20)	50	75		
SANGCOR04T	Discipline Specific Core1D	Section 'A' (25 Classes)Laghusiddhāntakaumudī:Samjyāprakaran:Section 'B' (50 Classes):Laghusiddhāntakaumudī:Sandhiprakaran:Section 'C' (30 Classes):Laghusiddhāntakaumudī: Vibhakti:Prakaran:							
	Discipline Specific Core2D		6	5 + 1	25 (5+20)	50	75		
SANLCOR02T	Modern Indian Language	English/Bengali/ <b>Sanskrit</b> A. Sandhi, Karaka B. Panchatantra - Mitraveda	6	5 + 1	25 (5+20)	50	75		



		Semester V			Marks		
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	TOTAL
		Chose any One Course from SANGDSE01T & SANGDSE02T					
SANGDSE01T	Discipline Specific Elective1A	<b>Veda&amp;Darshana</b> – i) Šuklayajurveda :Rudrādhyāy ii)Brihadarnnyakopanishad – Ch –IV.4 & 5 Bramhanas.	6	5 + 1	25 (5+20)	50	75
SANGDSE02T	Discipline Specific Elective1A	<b>Vyakarana&amp;Kavya</b> i) Kavirahasyam <b>ii)</b> Sahityadarpana- 1-3 Chapters	6	5+1	25 (5+20)	50	75
	Discipline Specific Elective ( DSE2A )		6	5+1	25 (5+20)	50	75
	Generic Elective Elective	Interdisciplinary(Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75


	Semester VI		Marks				
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	TOTAL
		Chose any One Course from SANGDSE03T & SANGDSE04T					
SANGDSE03T	Discipline Specific Elective1B	Veda&Darshana i)Vedic Culture & Vedic studies in West Bengal ii) Bangiyadarshanachinta: Ramakrishna-Vivekananda darshan, GouriyaVaishnabdarshan Shaktadarshan	6	5 + 1	25 (5+20)	6	5 + 1
SANGDSE04T	Discipline Specific Elective1B	<b>Vyakarana&amp;Kavya</b> i)Computational linguistics ii) Kavyalankarasutravritti- 1-4 Chapters	6	5 + 1	25 (5+20)	50	75
	Discipline Specific		6	5 + 1	25 (5+20)	50	75
	Elective (DSE2B)						
	Generic Elective Course	Interdisciplinary(Any Discipline other than Sanskrit) (75 classes)	6	5+1	25 (5+20)	50	75



### SKILL ENHANCEMENT COURSES (SEC)

#### \* <u>All questions will be set in Sanskrit Language with Devnagari Script.</u>

	Odd Semesters (III / V)				Marks		
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	TOTAL
	SEC1	Basic Sanskrit	2	2	5	20	25
SANSSEC01M	SANSSEC01M (Skill Based)	Translation(From Bengali/English to Sanskrit ) (20 Classes) Paragraph Writing (5 Classes) Letter Writing (5 Classes)					
Even Semesters (IV			/ / VI)				
Course Code	Course Type	Spoken Sanskrit & Computer Awareness for Sanskrit	2	2	5	20	25
SANSSEC02M	SEC2 (Skill Based)	Conversation (Asmad, yusmad, tat, yat, etat, bhavat) Lakara, samkhya, avyaya, samaya, Kathapatha, Vibhakti, krit-prtyaya, Lingabheda, kriyapadapryoga. (10 Marks) Basic Computer Awareness, Typing in Unicode for Preservation and Digitalization of Sanskrit Text Web Publishing (10 Marks)					



# Generic Elective Course(Non-Sanskrit Pass)

\* <u>All questions will be set in Sanskrit Language with Devnagari Script.</u>

\* 40% Questions are to be answered compulsorily in Sanskrit with Devanagari script in 5<sup>th</sup> and 6<sup>th</sup> Semesters.

		Semester V				Marks	
Course Code	Course Type	Course Title& Topics	Credits	Lec +Tu	IA	ESE	Total
		Basic Sanskrit	6	5 + 1	25	50	75
SANGGEC01T	Generic Elective Course	<ul> <li>Section 'A' Grammar and composition</li> <li>Part I(20 Classes)</li> <li>Nominative forms of pronouns- asmad, yuşmad, etat and tat in masculine, feminine and neuter.</li> <li>Nominative forms of 'a' ending masculine and neuter gender nouns with path, khād, likh and similar simple verbs in present, past and future. Objective forms of the above nouns and pronouns in singular with more simple verbs</li> <li>Instrumental, dative, ablative forms of the above nouns and pronouns in singular, dual and plural instrumental, dative, ablative forms of the above nouns and pronouns in singular, dual and plural instrumental, dative, ablative forms of all the words in this syllabus</li> <li>'ā' and ' ī' ending feminine words in nominative and accusative cases with lotlakāra (imperative).</li> <li>'ā' and ' ī' ending feminine nouns in singular in Genitive/ possessive and locative cases, genitive and locative cases in singular in pronouns tat, etat, yat, kim</li> <li>Masculine and Feminine nouns ending in 'i' and masculine nouns ending in 'u' in various cases in singular</li> <li>Masculine nouns ending in consonants – bhavat, guņin, ātman and Feminine nouns ending in consonants – vāk, Neuter nouns ending in consonants – jagat , manas</li> <li>Section 'B' Grammar and composition</li> <li>Part II(25 Classes)</li> <li>Special Verb forms – in parasmaipada –past, present, future and imperative 4.</li> <li>Bracial Verb forms – in parasmaipada –past, present, future and imperative dā.</li> <li>ātmanepada – sev, labh</li> <li>Phonetic changes – visargasandhi</li> <li>vowelsandhis.</li> <li>Participles - śatr, śānac, ktavatu, kta.</li> <li>Pratyaya = ktvā, lyap, tumun.</li> <li>Active – passive structures in lakāras – (third person forms only) and pratyayas kta, ktavatu</li> <li>Section 'C' Literature (30 Classes)</li> <li>Gita Chapter XII</li> </ul>					



West Bengal State University

B.A. Sanskrit (Programme)

		Semester VI			Marks		
Course Code	Course Type	Course Title & Topics	Credits	Lec +Tu	IA	ESE	Total
		Critical Survey of Sanskrit Literature	6	5 + 1	25	50	75
SANGGEC02T	Generic Elective Course	Section 'A' (20 Classes) Vedic Literature Samhitā (Rk, Yajuh, Sāma, Atharva) time, subject- matter, religion & Philosophy, social life Brāhmaņa, Āraņyaka, Upanişad, Vedānga (Brief Introduction) Section 'B'(10 Classes) Rāmāyaņa Rāmāyaņa as a Source Text and its Cultural Importance. Section 'C'(10 Classes) Mahābhārata Mahābhārata and its Time, Development, and subject matter Mahābhārata :Encyclopaedic nature, as a Source, Text, Cultural Importance. Section 'D'(10 Classes) Purāņas Purāņas : Subject matter, Characteristics Purāņas : Social, Cultural and Historical Importance Section 'E'(25 Classes) General Introduction to Vyākaraņa, Darśana and Sāhityaśāstra General Introduction to Vyākaraņa: Brief History of Vyākaraņašāstra General Introduction to Darśana: Major schools of Indian Philosophy Cārvāka, Bauddha, Jaina, Sānkhya-yoga, Nyāya-Vaiseśika, Pūrva- mīmāmsā and Uttaramīmāmsā. General Introduction to Poetics: Six major Schools of Indian Poetics-Rasa, Alamkāra, Rīti, Dhvani,Vakrokti and Aucitya					

### **QUESTION PATTERN**

### B. A. (Programme) in Sanskrit

### SEMESTER – I

### <u>DSC – 1A</u>

		End Semester	Full Marks - 50
Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		OneShort Note/Explanation	1x5 = 5
Section – B	-	One long answer type Question	1x10 = 10
		Two Short explanatory notes/Explanations	2x5 = 10
Section – C	-	One long answer type Question	1x10 = 10
		One Short explanatory note/Explanation	1x5 = 5
Section – D		Internal Assessment Project	Full Marks - 25 10
		Short answer type Questions (Any two should be In Sanskrit Language with Deva	2x5 = 10 anagari Script)
		Attendance	5



# SEMESTER – II

# <u>DSC – 1B</u>

### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		TwoShort Notes/Explanations	2x5 = 10
Section – B	-	One long answer type Question	1x10 = 10
		One Short explanatory note/Explanation	1x5 = 5
Section – C	-	One long answer type Question	1x10 = 10
		One Short explanatory note/Explanation	1x5 = 5
Section – C	-	Internal Assessment Project	Full Marks - 25 10
		Short answer type Questions (Any two should be In Sanskrit Language with	2x5 = 10 n Devanagari Script)
		Attendance AECC	5
		Full Marks – 25	
	Multiple Ch	Only Internal Assessment oice Based Questions	Full Marks - 25 20

Attendance -



B.A. Sanskrit (Programme)

# SEMESTER – III

### <u>DSC – 1C</u>

### Full Marks – 75

		End Semester	Full Marks - 50
Section –A	-	Short answer type Questions	5x2 = 10
		(In Sanskrit Language with Devanagari Script)	

Section – B	-	Twolong answer type Questions	2x10 = 20	
		Four Short explanatory note/Explanation	4x5 = 20	
		(Any one should be In Sanskrit Language with Dev	evanagari Script)	

		Internal Assessment	Full Marks - 25
Section – A	-	Project	10
		Short answer type Questions (Any three should be In Sanskrit Language wi	2x5 = 10 ith Devanagari Script)
		Attendance	5
		MIL	

Only Internal Assessment	Full Marks - 25
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Multiple Choice Based Questions	20
Attendance -	5

5

# <u>SEC1</u>

# (Skill Based)

### Full Marks – 25

Only Internal Assessment	Full Marks - 25
Translation(From Bengali/English to Sanskrit)	10
Paragraph Writing or Letter Writing	10

Attendance



# SEMESTER – IV

# <u>DSC – 1D</u>

		End Semester	Full Marks - 50
Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		One Long answer type Question	1x10 = 10
Section – B	-	One long answer type Question	1x10 = 10
		Four Short explanatory notes/Explanations (Any one should be In Sanskrit Language with D	4x5 = 20 evanagari Script)
Section – C	_	Internal Assessment Project	Full Marks - 25 10
		Short answer type Questions (Any three should be In Sanskrit Language with	2x5 = 10 Devanagari Script)
		Attendance MIL	5
		Full Marks – 25	
		Only Internal Assessment	Full Marks - 25
	Multiple Ch	oice Based Questions	20
	Attendance	-	5



# <u>SEC2</u>

# (Skill Based)

### Full Marks – 25

# Only Internal Assessment Full Marks - 25

Viva on Spoken Sanskrit	10
Practical on Computer Awareness	10
Attendance -	5



SEMESTER – V

# DSE1A (SANGDSE01T)

# Veda & Darshana

	End Semester	Full Marks - 50
i)	 Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
	One long answer type question	$1 \times 10 = 10$
	Two Short notes/Explanations	2x5 = 10
ii)	 One long answer type question	1x10 = 10
	Two Short notes/Explanations	2x5 = 10
	(In Sanskrit Language with Devanagari Script)	
	Internal Assessment	Full Marks - 25
ii)	 Project	10
	Short answer type questions (Any Four should be In Sanskrit Language with	2x5 = 10 Devanagari Script)
	Attendance	5



B.A. Sanskrit (Programme)

	<u>DSE1A (SANGDSE02T)</u>	
	Vyakarana&Kavya	
	Full Marks – 75	
	End Semester	Full Marks - 50
Kavirahasyam -	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
	Two Short notes/Explanations (Any two In Sanskrit Language with Devanagari Script)	2x5 = 10
Sahityadrpana -	Two long answer type questions	2x10 = 20
	Two Short notes/Explanations (Any two In Sanskrit Language with Devanagari Script)	2x5 = 10
Sahityadrpana -	Internal Assessment Project	Full Marks - 25 10
	Short answer type questions (Any four should be In Sanskrit Language with Devanaga	2x5 = 10 ari Script)
	Attendance SEC1	5
	<b>(Skill Based)</b> Full Marks – 25	
	Only Internal Assessment	Full Marks - 25
Trans	slation(From Bengali/English to Sanskrit)	10
Para	graph Writing or Letter Writing	10

Attendance

5

i)

ii)

**CBCS Syllabus** 

### SEMESTER – VI

# DSE1B (SANGDSE03T)

# Veda & Darshana

	End Semester	Full Marks - 50
-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
	One long answer type question	1x10 = 10
-	Four Short notes/Explanations (Any two In Sanskrit Language with Devanagari Scrip	4x5 = 20 t)
	One long answer type question	1x10 = 10

	Internal Assessm	nent Full Marks - 25
ii) -	Project	10
	Short answer type questions (Any four should be In Sanskrit Languag	2x5 = 10 ge with Devanagari Script)
	Attendance	5



CBCS Syllabus
DSE1B (SANGDSE04T)

### Vyakarana&Kavya

Full Marks – 75

		End Semester	Full Marks - 50
i)		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		Two Short notes/Explanations	2x5 = 10
ii)		Two long answer type questions	2x10 = 20
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10
ii)		Internal Assessment Project	Full Marks - 25 10
		Short answer type questions (Any four should be In Sanskrit Language with Deva	2x5 = 10 anagari Script)
		Attendance	5
		<u>SEC2</u>	
		<b>(Skill Based)</b> Full Marks – 25	
		Only Internal Assessment	Full Marks - 25
١	/iva on Spo	oken Sanskrit	10
F	Practical o	n Computer Awareness	10
A	Attendance	e -	5

**N.B.:** - The Question Pattern of Generic Elective(H) is similar to the Question Pattern of B.A. Sanskrit Programme(Core Courses).



# Generic Elective Course (Non-Sanskrit Pass)

### **SEMESTER V**

### <u>GE1</u>

	End Semester	Full Marks - 50
Section – A	 Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section B	 Four Short Notes/Explanations (Any two should be in Sanskrit Language with De	4x5 = 20 evanagari Script)
Section – B	 One long answer type question	10
Section – C	 One long answer type question	10
Section – C	 Internal Assessment Project	Full Marks - 25 10
	Short answer type questions (Any four should be In Sanskrit Language with D	2x5 = 10 evanagari Script)
	Attendance	5



# **SEMESTER VI**

# <u>GE2</u>

	End Semester	Full Marks - 50
Section –A	 One long answer type question	1x10 = 10
	One Short note/Explanation	1x5 = 5
Section – D	 Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
	Two Short Notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10
Section – E	 One long answer type question	1x10 = 10
	One Short note/Explanation	1x5 = 5
Section – C	 Internal Assessment Project	Full Marks - 25 10
Section – B	 Short answer type questions (Any four should be In Sanskrit Language with De	2x5 = 10 vanagari Script)
	Attendance	5



# WEST BENGAL STATE UNIVERSITY, BARASAT

Curriculum

### BACHELOR OF SCIENCE(B.Sc.) HONOURS IN ANTHROPOLOGY

(with effect from 2018-2019 academic session)

Course Code	Course Title	Course Type		Credit
ANTACOR01T	Introduction to Biological Anthropology	Core-1	Theory	4
ANTACOR01P	Introduction to Biological Anthropology		Practical	2
ANTACOR02T	Introduction to Social-cultural Anthropology	Core-2	Theory	4
ANTACOR02P	Introduction to Social-cultural Anthropology	-	Practical	2
	One from pool of Generic Electives	Generic-1	Theory	4
	One from pool of Generic Electives	*	Practical	2
ENVSSEC01M	Environmental Science	AECC-1	Theory	2
Total				

### First Semester

\* To be chosen from other disciplines

# <mark>Second Semester</mark>

Course Code	Course Title	Course	<b>Course Type</b>	
ANTACOR03T	Archaeological Anthropology	Coro 2	Theory	4
ANTACOR03P	Archaeological Anthropology	Cole -5	Practical	2
ANTACOR04T	Fundamentals of Human Origin and Evolution	Coro 1	Theory	4
ANTACOR04P	Fundamentals of Human Origin and Evolution	Core -4	Practical	2
	One from pool of Generic Electives	Generic-2	Theory	4
	One from pool of Generic Electives	*	Practical	2
ENGSSEC01M	English	AECC-2	Theory	2
Total			20	

\* To be chosen from other disciplines

### Third Semester

Course Code	Course Title	Course	Course Type	
ANTACOR05T	Tribes and Peasants in India	Corra 5	Theory	4
ANTACOR05P	Tribes and Peasants in India	Core-5	Practical	2
ANTACOR06T	Human Ecology: Biological & Cultural Dimensions	Core-6	Theory	4
ANTACOR06P	Human Ecology: Biological & Cultural Dimensions	Core-o	Practical	2
ANTACOR07T	Biological Diversity in Human Populations	Corro 7	Theory	4
ANTACOR07P	Biological Diversity in Human Populations	Core-/	Practical	2
	One from pool of Generic Electives	Generic-3	Theory	4
	One from pool of Generic Electives	*	Practical	2
ANTSSEC01M	Public Health and Epidemiology	SEC-1	Theory	2
Total				26

\* To be chosen from other disciplines

### Fourth Semester

Course Code	Course Title	Course Type		Credit
ANTACOR08T	Theories of Culture and Society	Core-8	Theory	4
ANTACOR08P	Theories of Culture and Society		Practical	2
ANTACOR09T	Human Growth and Development	Core-9	Theory	4
ANTACOR09P	Human Growth and Development		Practical	2
ANTACOR10T	Research Methods	Core-10	Theory	4
ANTACOR10P	Research Methods		Practical	2
	One from pool of Generic Electives	Generic-4 *	Theory	4
	One from pool of Generic Electives		Practical	2
ANTSSEC02M	Tourism Anthropology	SEC-2	Theory	2
Total			26	

\* To be chosen from other disciplines

### Fifth Semester

<b>Course Code</b>	Course Title	Course Type		Credit
ANTACOR11T	Human Population Genetics	Core-11	Theory	4
ANTACOR11P	Human Population Genetics	-	Practical	2
ANTACOR12T	Anthropology in Practice	Core-12	Theory	4
ANTACOR12P	Anthropology in Practice		Practical	2
ANTADSE01T	Indian Archaeology	<b>DSE</b> -1 DSE-2 #	Theory	4
ANTADSE01P	Indian Archaeology		Practical	2
ANTADSE02T	Anthropology of Health		Theory	4
ANTADSE02P	Anthropology of Health		Practical	2
ANTADSE03T	Tribal Culture and Tribal Development in India		Theory	4
ANTADSE03P	Tribal Culture and Tribal Development in India		Practical	2
Total				24

ANTADSE02T, ANTADSE02P/ ANTADSE03T, ANTADSE03P

### Sixth Semester

<b>Course Code</b>	Course Title	Course Type		Credit
ANTACOR13T	Forensic Anthropology	Core-13	Theory	4
ANTACOR13P	Forensic Anthropology		Practical	2
ANTACOR14T	Anthropology of India	Core-14	Theory	4
ANTACOR14P	Anthropology of India		Practical	2
ANTADSE04T	Physiological Anthropology	DSE-3 @	Theory	4
ANTADSE04P	Physiological Anthropology		Practical	2
ANTADSE05T	Rural and Urban Anthropology		Theory	4
ANTADSE05P	Rural and Urban Anthropology		Practical	2
ANTADSE06P	Dissertation	DSE-4 ^	Practical	6
Total			24	

@ Choose any one (theory, practical combined) from two options- ANTADSE04T, ANTADSE04P/
 ANTADSE05T, ANTADSE05P
 ^ Mandatory

#### SEMESTER – I

#### ANTACOR01T: INTRODUCTION TO BIOLOGICAL ANTHROPOLOGY

#### Theory

Credit-4

**Unit I**: Biological Anthropology: Meaning, aim and Scope; Its approaches: Biocultural, comparative and evolutionary. Application of concepts of adaptation and evolution in Biological anthropology; different branches and fields of study; Relationship of biological anthropology with: medical and health science, life science, earth science and environmental science.

**Unit II**: Theories of organic evolution. Lamarckism, Neo-Lamarckism, Darwinism, Synthetic theory, Mutation theory.

**Unit III**: Primates in relation to human evolution:

1. Primates: Definition, General characteristics, Evolutionary trends.

2. Classification of living primates up to family level with example (Simpson); concepts of strepsirrhini and haplorrhini.

3. Anatomical and behavioural characteristics of great apes (Gibbon, Orang Utan, Chimpanzee, Gorilla).

4. Significance of studying non-human primate in Biological Anthropology.

**Unit IV:** Human Skeletal anatomy and functional morphology of bones as parts of total skeleton: relevance of studying human anatomy as a part of anthropology, classification of bones, their anatomical positions and functions.

#### Suggested Readings

#### Introduction:

- 1. Comas J.1960, Manual of Physical Anthropology. Illinois: Charles C. Thomas.
- 2. Ashley-Montagu, M F.1961. An Introduction to Physical Anthropology. Illinois: Charles C. Thomas.
- 3. Buettner-Janusch, J. 1966. Origins of Man. New York: John Wiley and Sons, Inc.
- 4. Jurmain R, Kilgore L, Trevathan W. 2006. Essentials of Physical Anthropology. (7<sup>th</sup> Ed). Belmont: Wadsworth.
- 5. Stein and Rowe, Introduction to Physical Anthropology. McGrow Hill.
- 6. Das B M. 2003. Outlines of Physical Anthropology. New Delhi: Kitab Mahal.
- 7. Shukla and Rastogi. Phisical Anthropology and Human genetics. New Delhi: Palka Prakasan.
- 8. Ember CR, Ember M, and Peregrine P N. 2002. Anthropology (Tenth Edition). Singapore: Pearson Education.
- 9. Kotak, Anthropology. McGraw Hill.
- 10. Haviland W A. 2003. Anthropology (Tenth Edition). Thomson (Wadsworth)
- 11. Turnbaugh W, Jurmain R, Nelson H, Kilgore L. 1996. Understanding Physical Anthropology and Archaeology. New York: West Publishing Co.
- 12. Sarkar, R M, 2004. Fundamentals of Physical Anthropology. Kolkata: Vidyodoy Library.
- 13. Roy, I B. 2003. Anthropology. New Delhi: S Chand & Co.

#### Theories of organic evolution:

- 1. Stearns SC and RF Hoekstra. Evolution: An Introduction.Oxford Univ. Press. Lond.
- 2. E Mayr. 2002. What evolution is? London: Phoenix.
- 3. Poirier F E, & J K McKee. 1998. Understanding Human Evolution. New jersey: Prentice Hall.
- 4. Mayr E. 2002. What evolution is? London: Phoenix.
- 5. B. Hall and B. Hallgrimsson. 2014. Strickberger's Evolution. 5<sup>th</sup> edition. Jones and Barilett.

#### **Primates:**

- 1. Napier J R, Napier PH. 1985. The Natural History of the Primates. British Museum of Natural History.
- 2. Buettner-Janusch, J. 1966. Origins of Man. New York: John Wiley and Sons, Inc.
- 3. Fleagle JG. Primate adaptation and evolution. San Diego: Academic Press.
- 4. Ember CR, Ember M, and Peregrine P N. 2002. Anthropology (Tenth Edition), Singapore: Pearson Education.
- 5. De Vore I. 1965. Primate Behaviour. Holt, Rinehart and Winston.
- 6. Sarkar R M. 2004. Fundamentals of Physical Anthropology. Kolkata: Vidyodoy Library.

#### Osteology:

1. Podder S, and A Bhagat. 1989. Handbook of Osteology. Patna: Scientific Book Company.

- Grey H. 1958. Anatomy, Descriptive and Applied. (Edited by T B Johnson, D V Davis & F Davis). London: Longman.
- 3. ANY TEXT BOOK ON HUMAN SKELETAL ANATOMY.

#### ANTACOR01P: INTRODUCTION TO BIOLOGICAL ANTHROPOLOGY Practical Credit-2

**Unit 1.** Identification of Human cranium- its different normas- *norma verticalis; norma lateralis; norma occipitalis; norma basalis; norma frontalis;* Identification of Frontal bone, Parietal bone, Temporal bone, Occipital bone, Maxilla bone, Zygomatic bone, Sphenoid bone, Mandible (anatomical position, side and sex determination, where applicable). Sex determination of human skull. Femur, Tibia, fibula, Humerus, Radius, Ulna **Unit H**:

Unit II:

Anthroposcopy: Assessment of Skin Colour: exposed (forehead) and unexposed (inner surface of the upper arm). Head Hair: form, colour, texture, quantity, whorl (number and type), hair limit. Facial Hair: Beard and Moustache. Nose: depression of the nasal root, height of the nasal bridge, nasal profile, tip of the nose, inclination of the septum, nasal wings. Ear: size, shape, Ear lobe: size, form and attachment, hypertrichosis of Ear.

(Note: For all practical papers, laboratory note book/report duly signed and forwarded by the teacher(s)/HOD should be submitted during practical examination for evaluation)

#### Suggested Readings:

- 1. BRK Shukla & S Rastogi (2012). Laboratory Manuals of Physical Anthropology.
- 2. S Poddar and A Bhagat (2002). Handbook of Osteology.
- **3.** Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology.
- **4.** JS Weiner and JA Louri. 1981. Practical Human Biology.

#### ANTACOR02T: INTRODUCTION TO SOCIAL-CULTURAL ANTHROPOLOGY Theory Credit- 4

Unit I: a) Fundamentals of Social-Cultural Anthropology: Meaning & Definition, Aim & Scope, Social- Cultural Anthropology, Distinctiveness (Holism, Cultural Relativism, Cross Cultural Perspective, Anthropological Comparison); Concepts of the major subfields: Economic Anthropology, Political Anthropology, Anthropology of Religion, Anthropology of Education, Psychological Anthropology, Rural & Urban Anthropology, Medical Anthropology, Ecological Anthropology, Cognitive Anthropology, Interpretative anthropology, visual Anthropology.

**b)** Relationship with major subjects of Social Sciences: History, Political Science, Sociology, Geography, Education, Economics, Folklore.

Unit II: Concepts of society and Culture (Brief notes on meaning, definition and salient features)

a) Society, Group, Community, Social Institution, Social Unit, Social Association, Social Fact, Socialization, Social System (Social Structure & Social function), Status and Role; Social Action; Social Conflict; Social Stratification, and Civil Society.

b) Culture: Definition & Concepts by E.B. Tylor, L. White, A. Kroeber, N.K. Bose, C. Geertz.; Attributes of Culture: Learned, Shared, Transmitted, Adaptive, Symbolic, Dynamic; Norms, Values, Enculturation, material Culture, Culture Element, Culture Trait, Trait

Complex, Overt & Covert, Diffusion, Acculturation, Ethos & Eidos, Ethnocentrism, Culture Universal, World View.

#### Unit III: Family, Marriage, Kinship system & Other aspects of Social Organization:

**a) Family**: Definition, Types, Structure & Function, Changes due to Industrialization & Urbanization (with special reference to Indian Context).

**b)** Marriage. Definition, Type, Preferential & Prescribed forms of marriage, Functions of Marriage, Universality of Marriage, Ways of acquiring mates in tribal society, Forms of Marital transaction (Dowry, Bride price, Gift), Post Marital Residence, Divorce & Remarriage.

c) Kinship:: Definition, Structure of Kinship (Murdock) Function of Kins in everyday life and Ceremonial occasion, Kinship behaviour: Avoidance, Joking, Couvade, Teknonymy, Kinship system: Hawaiian, Eskimo, Sudanese, Iroquis, Crow- Omaha, Bengali Kinship system; Descent : Types & Functions: Unilateral, Bilateral & Double descent

d) Other Concepts : Tribe, Moiety, Phratry, Lineage, Clan.

#### Unit IV: Fieldwork in Anthropology:

Meaning of Fieldwork in different branches of Anthropology. Importance of fieldwork in Anthropology, Historical Genesis of Anthropological fieldwork. Research Strategies: Synchronic & Diachronic, Etic vs Emic. Deductive vs Inductive, Qualitative vs Quantitative.

#### Suggested Readings

- 1. Beattie J. (1964). Other Cultures. London: Cohen & West Limited.
- 2. Bernard H.R. (1940). Research Methods in Cultural Anthropology. Newbury Park: Sage Publications.
- 3. Davis K. (1981). Human Society. New Delhi: Surjeet Publications.
- 4. Delaney C. (2004). 'Orientation and disorientation' In Investigating Culture: An
- Experiential Introduction to Anthropology. Wiley-Blackwell.
- 5. Ember C. R. et al. (2011). Anthropology. New Delhi: Dorling Kindersley.
- 6. Ferraro G. and Andreatta S. (2008). In Cultural Anthropology: An Applied Perspective. Belmont: Wadsworth.
- Karen O'reilly. (2012). 'Practical Issues in Interviewing' Ethnographic Methods. Abingdon: Routledge
- Lang G. (1956). 'Concept of Status and Role in Anthropology: Their Definitions and Use. The American Catholic Sociological Review.17(3): 206-218
- 9. O'reilly K. (2012). Ethnographic Methods. Abingdon: Routledge.
- 10. Parsons T. (1968). The Structure of Social Action. New York: Free Press
- 11. Rapport N. and Overing J. (2004). Key Concepts in Social and Cultural Anthropology. London: Routledge.

12. Royal Anthropological Institute of Great Britain and Ireland (1971). 'Methods' In Notes and Queries on Anthropology. London: Routledge & Kegan Paul Ltd.

#### ANTACOR02P: INTRODUCTION TO SOCIAL-CULTURAL ANTHROPOLOGY Practical Credit- 2

(The practical will include the following techniques and methods in collection of

data in Social-Cultural Anthropology)

#### a) Prepare a Project Report on of the following (1 Credit / project)

#### (To be submitted with signature of individual Mentor/Supervisor)

i) Writing ONE CASE STUDY on any one of the following events from one family

(happened within last one year): Birth, Marriage, Death, Thread Ceremony, Household ritual

(e.g. Pujas/ brotos, religious ritual and festival of other communities).

ii) Drawing ONE GENEALOGICAL CHART (with kinship terminology) of one family

(Minimum up to 3 generations).

iii) Preparation of a **SCHEDULE / QUESTIONNAIRE** on any one of the following:

- a) Census Schedule (General Demography, Economy)
- **b**) Village / Hamlet / Urban Locality Description.

Note: for all branches of practical papers, laboratory note book/report duly signed and forwarded by the teacher(s)/HOD should be submitted during practical examination for evaluation.

### SEMESTER –II

<ul> <li>Theory Credit-4</li> <li>Unit I: Introduction to Archaeological anthropology</li> <li>Definition and Scope of Archaeological Anthropology, Relationship with other disciplines - history, anthropology and other natural sciences.</li> <li>Prehistory: Definition, aim, scope, concept of periodization.</li> <li>Definition of Tool, Artifact, Industry, Assemblage; A brief introduction to different cultural stages in pre-history and Protohistory.</li> <li>Methods of study: Ideas of site survey and excavation, Different Methods of exploration/site survey; different stages of excavation, pre-excavation stage, actual stages of digging up of archaeological site, Trial trench, horizontal and vertical excavation, differences between excavation and exploration.</li> <li>Unit II: Methods of Estimation of time in archaeology</li> <li>Concept of chronology in Prehistory, Relative and Absolute dating methods, Following dating methods are to be studied based on the points: Discovery, first use, datable material, basic principle, precautions, method of sample collection, advantages and disadvantages, specific examples, Relative methods of dating: Stratigraphy, Typo-technological analysis, FUN estimation, Absolute methods of dating: C14, K/Ar, Dendrochronology, TL. Differences between Absolute and Relative dating methods.</li> <li>Unit III: Paleoenvironment</li> <li>Concept of geochronology, Geological Time scale: eras, periods, epochs, Environmental background of Quaternary period, Basal Pleistocene, Villafranchian, Causes of ice age, Climatic fluctuations of Pleistocene period for reconstruction of paleoenvironment: Moraine, Glacio-fluvial deposits, River terraces, U shaped valley, Loess, Gravel and silt deposition, Importance of paleoenvironmental srudy on paleoanthropology and prehistory, Holocene period; climatic stabilization.</li> <li>Unit IV: Typo-technological Study of Stone tools:</li> <li>Concept of tool types, primary and combination fabrication technology, Basic co</li></ul>
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Africa: The earliest Paleolithic assemblages of Africa- Oldowan, Acheulian; Middle
Stone Age, Later Stone Age.
Europe: Acheulian, Levalloisean, Middle and Upper Paleolithic Culture, Mesolithic
Culture. Prehistoric art (home and cave art).
India and South East Asia: The earliest Paleolithic assemblages, Acheulian, Middle

Practical         credit-2           Identification of Typo-technological attributes, cultural ages, probable functions, method of hafting and Drawing of the tool types:         Lower Paleolithic Tools- Chopper/ Chopping Tools, Hand Axe, Cleaver.           Middle Paleolithic Tools- Staper, Knife, Point.         Upper Paleolithic Tools- Blade, Core, Burin, Leaf Point, Baton de Commandment, Spear Thrower Harpoon Heads, Bone Points.           Mesolithic Tools- Micro Blades, Cores, Lunates         Neolithic Tools- Micro Blades, Cores, Lunates           Neolithic Tools- Axe Head, T-cell, Ring Stones         Pointery Types (any two)           (In absence of original specimens, cast or distinct photographs may be utilised)         ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Credit-4           Unit-I:         Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Sivapithecus, Sivapithecus, distribution, features and their phylogenetic relationships.         Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships. Appearance of genus Homo (Homo habilis) and related finds.           Unit-II:         Homo rectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status.           Unit-V:         Origin of Momo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux – saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.           Unit-V:         Origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.           Unit-V:         He origin of modern	ANTACOR03P: ARCHAEOLOGICAL ANTHROPOLOGY
<ul> <li>Identification of Typo-technological attributes, cultural ages, probable functions, method of hafting and Drawing of the tool types:         <ul> <li>Lower Paleolithic Tools- Chopper/ Chopping Tools, Hand Axe, Cleaver.</li> <li>Middle Paleolithic Tools- Scraper, Knife, Point.</li> <li>Upper Paleolithic Tools- Blade, Core, Burin, Leaf Point, Baton de Commandment, Spear Thrower Harpoon Heads, Bone Points.</li> <li>Mesolithic Tools- Axe Head, T-celt, Ring Stones</li> <li>Pottery Types (any two)</li> <li>(In absence of original specimens, cast or distinct photographs may be utilised)</li> </ul> </li> <li>ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Theory</li> <li>Credit-4</li> <li>Unit-I: Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Primate origins and radiation with special reference to Miocene hominoids: Dryopithecus, Sivapithecus, distribution, features and their phylogenetic relationships.</li> <li>Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships.</li> </ul> <li>Unit-IV: The origin of Homo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux – saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.</li> <li>Unit-V: The origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.</li> <li>Unit-V: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings         <ul> <li>Buetmer-Janusch, J. (196). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy, GC. (1990). Primate Evolution. New York: Norton.</li> <li>Conroy, GC. (1997). <i>Recorstructing Human Origins: A Modern Synt</i></li></ul></li>	Practical credit- 2
<ul> <li>and Drawing of the tool types: Lower Paleolithic Tools- Chopper/ Chopping Tools, Hand Axe, Cleaver. Middle Paleolithic Tools- Scraper, Knife, Point. Upper Paleolithic Tools- Blade, Core, Burin, Leaf Point, Baton de Commandment, Spear Thrower Harpoon Heads, Bone Points. Mesolithic Tools- Axe Head, T-celt, Ring Stones Pottery Types (any two)</li> <li>(In absence of original specimens, cast or distinct photographs may be utilised)</li> <li>ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Theory</li> <li>Credit-4</li> <li>Unit-I: Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Primate origins and radiation with special reference to Miocene hominoids: Dryopithecus, Sivapithecus, distribution, features and their phylogenetic relationships.</li> <li>Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships. Appearance of genus Homo (Homo habilis) and related finds.</li> <li>Unit-III: Homo erectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status.</li> <li>Unit-V: Origin of Homo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux - saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.</li> <li>Unit-V: Origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade: Distribution and features and their phylogenetic status.</li> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings</li> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. 1990. Primate Evolution. New York: Norton.</li> <li>Conroy G C. 1997. Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine</li></ul>	Identification of Typo-technological attributes, cultural ages, probable functions, method of hafting
<ul> <li>Lower Paleolithic Tools- Chopper Chopping Tools, Hand Axe, Cleaver. Middle Paleolithic Tools- Scraper, Knife, Point.</li> <li>Upper Paleolithic Tools- Blade, Core, Burin, Leaf Point, Baton de Commandment, Spear Thrower Harpoon Heads, Bone Points. Mesolithic Tools- Axe Head, T-celt, Ring Stones Pottery Types (any two)</li> <li>(In absence of original specimens, cast or distinct photographs may be utilised)</li> <li>ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Theory</li> <li>Credit- 4</li> <li>Unit-I: Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Primate origins and radiation with special reference to Miocene hominoids: Dryopithecus, Sivapithecus, distribution, features and their phylogenetic relationships.</li> <li>Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships. Appearance of genus Homo (Homo habilis) and related finds.</li> <li>Unit-IV: The origin of Homo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux – saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.</li> <li>Unit-VI: The origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.</li> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings         <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. (1997). <i>Reconstructing Human Origins: A Modern Synthesis.</i> W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). <i>Nercons of Anthropology</i>. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). <i>The Life of Primates</i>. PHI Learning Private Limited, New Delhi.<td>and Drawing of the tool types:</td></li></ol></li></ul>	and Drawing of the tool types:
<ul> <li>Middle Paleolithic Tools- Scraper, Knife, Point.</li> <li>Upper Paleolithic Tools- Blade, Core, Burin, Leaf Point, Baton de Commandment, Spear Thrower Harpoon Heads, Bone Points.</li> <li>Mesolithic Tools- Axe Head, T-celt, Ring Stones</li> <li>Pottery Types (any two)</li> <li>(In absence of original specimens, cast or distinct photographs may be utilised)</li> <li>ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Theory</li> <li>Credit- 4</li> <li>Unit-I: Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Primate origins and radiation with special reference to Miocene hominoids: Dryopithecus, Sivapithecus, distribution, features and their phylogenetic relationships.</li> <li>Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships.</li> <li>Unit-III: Australopithecines: distribution and types, features and their phylogenetic relationships. Appearance of genus Homo (Homo habilis) and related finds.</li> <li>Unit-III: Homo erectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status.</li> <li>Unit-V: The origin of Homo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux – saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.</li> <li>Unit-V: Origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.</li> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings         <ul> <li>Neutner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier FE, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy, G.C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds.</li></ul></li></ul>	Lower Paleolithic Tools- Chopper/ Chopping Tools, Hand Axe, Cleaver.
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<ul> <li>Thrower Harpoon Heads, Bone Points. Mesolithic Tools- Micro Blades, Cores, Lunates Neolithic Tools- Axe Head, T-celt, Ring Stones Pottery Types (any two)</li> <li>(In absence of original specimens, cast or distinct photographs may be utilised)</li> <li>ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Theory Credit-4</li> <li>Unit-I: Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Primate origins and radiation with special reference to Miocene hominoids: Dryopithecus, Sivapithecus, distribution, features and their phylogenetic relationships.</li> <li>Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships. Appearance of genus Homo (Homo habilis) and related finds.</li> <li>Unit-III: Homo erectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status.</li> <li>Unit-IV: The origin of Homo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux – saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.</li> <li>Unit-V: Origin of modern humans (Homo sapiens sajens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.</li> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings         <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Porier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). The Primates. Northern Bo</li></ol></li></ul>	Upper Paleolithic Tools- Blade, Core, Burin, Leaf Point, Baton de Commandment, Spear
<ul> <li>Mesolithic Tools- Micro Blades, Cores, Lunates Neolithic Tools- Axe Head, T-celt, Ring Stones Pottery Types (any two)</li> <li>(In absence of original specimens, cast or distinct photographs may be utilised)</li> <li>ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Theory</li> <li>Credit-4</li> <li>Unit-I: Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Primate origins and radiation with special reference to Miocene hominoids: Dryopithecus, Sivapithecus, distribution, features and their phylogenetic relationships.</li> <li>Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships. Appearance of genus Homo (Homo habilis) and related finds.</li> <li>Unit-III: Homo erectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status.</li> <li>Unit-IV: The origin of Homo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux – saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.</li> <li>Unit-V: Origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.</li> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings         <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier FE, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. 1990. Primate Evolution. New York: Norton.</li> <li>Conroy, G.C. (1977). <i>Horicons of Anthropology</i>. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Stingh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology. Kamla-Raj Enterprises, Delhi.<td>Thrower Harpoon Heads, Bone Points.</td></li></ol></li></ul>	Thrower Harpoon Heads, Bone Points.
<ul> <li>Neolithic Tools- Axe Head, T-celt, Ring Stones Pottery Types (any two)</li> <li>(In absence of original specimens, cast or distinct photographs may be utilised)</li> <li>ANTACOR04T: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Theory Credit-4</li> <li>Unit-I: Oligocene Anthropoids: Parapithecus, Aegyptopithecus; Primate origins and radiation with special reference to Miocene hominoids: Dryopithecus, Sivapithecus, distribution, features and their phylogenetic relationships.</li> <li>Unit-II: Australopithecines: distribution and types, features and their phylogenetic relationships. Appearance of genus Homo (Homo habilis) and related finds.</li> <li>Unit-III: Homo erectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status.</li> <li>Unit-V: The origin of Homo sapiens: Fossil evidences of Neanderthals :Classic Neandertals (La-Chapelle-Aux – saints), Progressive Neandertals (Tabun); Archaic Homo sapiens.</li> <li>Unit-V: Origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.</li> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings         <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). The Primates. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). Ant</li></ol></li></ul>	Mesolithic Tools- Micro Blades, Cores, Lunates
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<ul> <li>Chancelade : Distribution and features and their phylogenetic status.</li> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. 1990. Primate Evolution. New York: Norton.</li> <li>Conroy, G.C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind. PHI Learning Private Limited, New Delhi.</li> </ol> </li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ul>	<b>Unit-V</b> : Origin of modern humans (Homo saniens saniens): Cro-Magnon Grimaldi
<ul> <li>Unit-VI: Hominization process, Bio-cultural evolution of Man.</li> <li>Suggested Readings         <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. 1990. Primate Evolution. New York: Norton.</li> <li>Conroy, G.C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). The Primates. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind. PHI Learning Private Limited, New Delhi.</li> </ol></li></ul> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li>	Chancelede : Distribution and features and their phylogenetic status
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<ol> <li>Suggested Readings         <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. 1990. Primate Evolution. New York: Norton.</li> <li>Conroy, G.C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). The Primates. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind. PHI Learning Private Limited, New Delhi.</li> </ol> </li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ol>	<b>Unit- V1:</b> Hommization process, bio-cultural evolution of Man.
<ol> <li>Bugtster Readings         <ol> <li>Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. 1990. Primate Evolution. New York: Norton.</li> <li>Conroy, G.C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). The Primates. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind. PHI Learning Private Limited, New Delhi.</li> </ol> </li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ol>	Suggested Deadings
<ol> <li>Bucthel-statusch, S. (1966). Origins of Math. Physical Anthropology. Joint Wiley &amp; Sons, Inc., New York, London, Sydney.</li> <li>Poirier F E, &amp; J K McKee. 1998. Understanding Human Evolution. New Jersy: Prentice Hall.</li> <li>Conroy G C. 1990. Primate Evolution. New York: Norton.</li> <li>Conroy, G.C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). Horizons of Anthropology. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). The Primates. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ol>	Suggested Readings
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<ol> <li>Fonder F. B., &amp; S. K. Merkee. 1990. Onderstanding Human Divortion. New Setsy. Frenctee Hum.</li> <li>Conroy G.C. (1990. Primate Evolution. New York: Norton.</li> <li>Conroy, G.C. (1997). <i>Reconstructing Human Origins: A Modern Synthesis</i>. W. W. Norton &amp; Company, New York, London.</li> <li>Howell F.C. (1977). <i>Horizons of Anthropology</i>. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). <i>The Life of Primates</i>. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). <i>The Primates</i>. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). <i>Anthropometry: A Laboratory Manual on Biological Anthropology</i>. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). <i>Biological Anthropology: The Natural History of Mankind</i>. PHI Learning Private Limited, New Delhi.</li> </ol>	1 Poirier F.F. & I.K. McKee, 1998, Understanding Human Evolution, New Jersy: Prentice Hall
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<ul> <li>Company, New York, London.</li> <li>Howell F.C. (1977). <i>Horizons of Anthropology</i>. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.</li> <li>Nystrom P. and Ashmore P. (2011). <i>The Life of Primates</i>. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). <i>The Primates</i>. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). <i>Anthropometry: A Laboratory Manual on Biological Anthropology</i>. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). <i>Biological Anthropology: The Natural History of Mankind</i>. PHI Learning Private Limited, New Delhi.</li> </ul>	3 Conroy G C (1997) Reconstructing Human Origins: A Modern Synthesis W W Norton &
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<ul> <li>Publishing House, Chicago.</li> <li>4. Nystrom P. and Ashmore P. (2011). <i>The Life of Primates</i>. PHI Learning Private Limited, New Delhi.</li> <li>4. Seth P. K. and Seth S. (1986). <i>The Primates</i>. Northern Book Centre, New Delhi.</li> <li>5. Singh I. P. and Bhasin M.K. (1989). <i>Anthropometry: A Laboratory Manual on Biological Anthropology</i>. Kamla-Raj Enterprises, Delhi.</li> <li>6. Standford C.; Allen J.S. and Anton S.C. (2012). <i>Biological Anthropology: The Natural History of Mankind</i>. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical Credit-2</li> </ul>	3. Howell F.C. (1977). <i>Horizons of Anthropology</i> . Eds. S. Tax and L.G. Freeman. Aldine
<ol> <li>Nystrom P. and Ashmore P. (2011). <i>The Life of Primates</i>. PHI Learning Private Limited, New Delhi.</li> <li>Seth P. K. and Seth S. (1986). <i>The Primates</i>. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). <i>Anthropometry: A Laboratory Manual on Biological Anthropology</i>. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). <i>Biological Anthropology: The Natural History of Mankind</i>. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical Credit-2</li> </ol>	Publishing House. Chicago.
<ul> <li>Delhi.</li> <li>4. Seth P. K. and Seth S. (1986). <i>The Primates</i>. Northern Book Centre, New Delhi.</li> <li>5. Singh I. P. and Bhasin M.K. (1989). <i>Anthropometry: A Laboratory Manual on Biological</i> <i>Anthropology</i>. Kamla-Raj Enterprises, Delhi.</li> <li>6. Standford C.; Allen J.S. and Anton S.C. (2012). <i>Biological Anthropology: The Natural</i> <i>History of Mankind</i>. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ul>	4. Nystrom P. and Ashmore P. (2011). <i>The Life of Primates</i> . PHI Learning Private Limited, New
<ol> <li>Seth P. K. and Seth S. (1986). <i>The Primates</i>. Northern Book Centre, New Delhi.</li> <li>Singh I. P. and Bhasin M.K. (1989). <i>Anthropometry: A Laboratory Manual on Biological</i> <i>Anthropology</i>. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). <i>Biological Anthropology: The Natural</i> <i>History of Mankind</i>. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ol>	Delhi.
<ol> <li>Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology. Kamla-Raj Enterprises, Delhi.</li> <li>Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical Credit-2</li> </ol>	4. Seth P. K. and Seth S. (1986). <i>The Primates</i> . Northern Book Centre, New Delhi.
<ul> <li>Anthropology. Kamla-Raj Enterprises, Delhi.</li> <li>6. Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ul>	5. Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological
<ul> <li>6. Standford C.; Allen J.S. and Anton S.C. (2012). <i>Biological Anthropology: The Natural</i> <i>History of Mankind</i>. PHI Learning Private Limited, New Delhi.</li> <li>ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical</li> </ul>	Anthropology. Kamla-Raj Enterprises, Delhi.
History of Mankind. PHI Learning Private Limited, New Delhi. ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical Credit- 2	6. Standford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural
ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION Practical Credit- 2	History of Mankind. PHI Learning Private Limited, New Delhi.
Practical Credit- 2	ANTACOR04P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION
	Practical Credit- 2
UNIT I. Identification of extant anthropoid skulls with reference to features relevant to	UNIT I. Identification of extant anthropoid skulls with reference to features relevant to
Hominid evolution (Gorilla, Chimpanzee, Orang utan and Gibbon). In the absence of original	Hominid evolution (Gorilla, Chimpanzee, Orang utan and Gibbon). In the absence of original

specimen, cast models or appropriate photographs may be utilized in the laboratory

UNIT II. Identification of extinct anthropoid remains: Parapithecus mandible, Dryopithecus mandibular fragment, Australopithecus africanus, One typical specimen of H. habilis, H. erectus (Java and Peking man), Neanderthal (La-Chapple-aux-saints), H. sapiens (Cro-Magnon)

(Cast models or appropriate photographs may be utilized)

### **SEMESTER –III**

ANTACOR05T: TRIBES AND PEASANTS IN INDIA			
Theory Credit 4			
UNIT 1: Anthropological concept of tribes			
i. General traditional concept of tribes (Meaning and Criteria)			
a. Tribe as pre-political and pre-contract society			
b. Tribe in the evolutionary scheme of social type			
c. Tribe as the primitive society (primitivism vis-à-vis tribalism)			
ii. Definition of tribe			
iii. Features of tribes			
a Economic features			
h Political features			
c. Social cultural features			
iv Indian tribes			
a Indian tribes and their habitat – Regional Distribution			
h Demographic profile of Indian tribe			
c. Economic linguistic and ethnic classification			
LINIT 2: Tribes and wider world			
i The history of tribal administration			
1. The instory of those administration			
a. Traditional political organization of the Santais, the Garos, the Todas, the			
ii. Constitutional sofoguards for the Indian tribes			
iii Draft National Tribal Policy			
iv Issues of acculturation assimilation and integration			
IV. Issues of acculturation assimilation and mogrammas on tribal life			
V. Impact of development schemes and programmes on tribal me			
i The concert of necesarity (definition and type)			
i. A personalized to the study of personalise according political and cultural			
ii. Characteristics of Indian willows assist experimetion, connecting and cultural.			
in. Characteristics of Indian village: social organization; economy			
iv. Tradition and changes in Indian villages			
v. Caste and peasantry in India: origin history and present situation.			
vi. Changes in traditional caste system in India.			
Unit 4: Ethnicity in India			
1. Concepts and meaning of ethnicity			
11. Tribal and peasant movements in colonial and post-colonial India			
Suggested Readings			
1. Gupta D. (1991). Social Stratification. Oxford University Press: Delni.			
2. Madali V. (2002). The Village III India. Oxford University Fless. Defini.			
4 National Tribal Policy (draft) (2006) Ministry of Tribal Affairs Government of India			
5. Patnaik S.M. (1996), Displacement, Rehabilitation and Social change. Inter India Publication, Delhi,			
6. Shah G. (2002). Social Movement and the State. Delhi: Sage.			
7. Shanin T. (1987). Peasants and Peasantry. New York, Blackwell.			
8. Vidyarthi L.P. and Rai B.K. (1985) Tribal Culture in India, New Delhi, Concept Publishing Company.			
9. Wolf E. (1966). Peasants. NJ, Prentice Hall.			
10. Desai AR. Rural Sociology in India. Popular Prakashan, Bombay.			
11. D.G. Mandelbaum. 2016. Society in India. Sage Pub.			
ANTACOR05P: TRIBES AND PEASANTS IN INDIA			
Practical Credit 2			
Reading of Ethnography: Students are required to read and analyse any two of the ethnographic			
monographs (as listed below) and prepare a review report based upon it. The report should clearly link			
up the study with the concept of tribe and peasantry and delineate clearly the concept used in the text.			
1. Research questions/objectives of the study and their relevance.			
2 Theoretical scheme			

- 2. Theoretical schema.
- 3. Methods and techniques used in the study.

4. Key findings and their significance in the context of the objectives of the study.

5. Critical analysis of the finding on the basis of contemporary available resources.

Some List of Ethnographies:

- Walker A. (1986). The Todas. Delhi : Hindustan Publishing Corporation
- Bhowmik, PK. 1963. The Lodhas of West Bengal. Punthi Pustak
- Elwin Verrier (1992). The Muria and their Ghotul. USA: Oxford University Press.
- Malinowski M. (1922). Argonauts of the Western Pacific. London: Routledge and Kegan Paul
- Furer-Haimendorf C.V. (1939). The Naked Nagas. London: Methuen and Co.
- Evans-Pritchard E.E. (1940). The Nuer: A Description of the Modes of Livelihood and Political Institutions of a Nilotic People. Oxford : Clarendon Press.
- Majumdar D. N. (1950). Affairs of tribes. Lucknow: Universal Publishers Ltd.
- Dube S.C. (1955). Indian Village. London: Routledge and Kegan Paul Ltd.
- Berreman G.D. (1963). Hindus of Himalayas. Berkeley: California University Press.
- S. C. Roy. Mundas and Their Country.

#### ANTACOR06T: HUMAN ECOLOGY: BIOLOGICAL & CULTURAL DIMENSIONS Theory Credit 4

Unit I: Defining environment and ecology; Component of ecosystem, Energy flow, Basic concepts of abiotic and biotic ecology.

Unit II: Ecological rules and their applicability to human populations, Distinctiveness of human ecology, Approaches to studying human ecology: Evolutionary ecology and Biological human ecology.

Unit III: Concepts of acclimatization, adaptation and adaptability; Adaptation to various ecological stressors: Temperature, Altitude and Nutrition; Impacts of urbanization and industrialization on humans.

Unit IV: Culture as a tool of adaptation; Human adaptive strategies in pre-state societies: Hunting and gathering, Pastoralism iii. Shifting cultivation

Unit V: Cultural ecology: Julian Steward's concept and application of the cultural ecological method; Ecological Anthropology; Ethno-ecology.

Unit VI: Ecological themes of state formation: i. Neolithic revolution, ii. Hydraulic theory; Agriculture and peasantry; Industrial civilization and growth of urban societies.

#### Suggested Readings

1. Human Biology-An introduction to human evolution, variation, growth, and adaptability. (1988), Harrison GA, Tanner JM, Pilbeam DR, Baker PT. 3<sup>rd</sup> edition, Oxford University Press: Oxford.

2. Human ecology: (2006) Schutkowski, H. Berlin. Springer Verlag.

3. Human ecology and cognitive style: comparative studies in cultural and physical adaptation.

(1976).Berry, J.B. New York: John Wiley.

4. Human ecology. (1964) Stapledon. Faber & Faber.

5. Studies in Human Ecology. (1961) Theodorson, G.A. Row, Peterson & Company Elmsford, New York.

6. Human ecology: (1973) Problems and Solutions. Paul R. Ehrlich, Anne H. Ehrlich and John P.

Holdress.W.H. Freeman & Company, San Francisco.

7. Cohen, Yehudi A. 1968. Man in adaptation; the cultural present. Chicago: Aldine Pub. Co.

8. Redfield, Robert. (1965). Peasent society and culture an anthropological approach to civilization. Chicago [u.a.]: Univ. of Chicago Press.

9. Childe, V.G. (1936). Man Makes Himself. Collins.

ANTACOR06P: HUMAN ECOLOGY: BIOLOGICAL & CULTURAL DIMENSIONS
Practical
Credit 2
Anthropometry:

- 1. Maximum head length
- 2. Maximum head breadth
- 3. Minimum frontal breadth
- 4. Maximum bizygomatic breadth
- 5. Bigonial breadth
- 6. Nasal height
- 7. Nasal length
- 8. Nasal breadth
- Indices: Body Mass Index, Ponderal Index, Relative Sitting Height.

(Analysis of the collected data by using basic Statistics: mean, median, mode, standard deviation and standard error).

14. Stature

#### **Suggested Readings:**

1. Lohman, T. G., Roche, A. F., & Martorell, R. (1988). Anthropometric Standardization Reference Manual. Champaign, Ill: Human Kinetics,.

15. Sitting height

16. Body weight

9. Morphological facial height

12. Mid-upper arm circumference

11. Head circumference

13. Calf circumference

10. Morphological upper facial height

- 2. Wilder. A laboratory manual of Anthropometry.
- 3. Sen T, A Guide to Anthropometry. World Press, Kolkata.
- 4. Das B M & R Deka.2004. Physical Anthropology Practical. Kitab Mahal, Allahabad.
- 5. Rastogi S & B R K Shukla. Laboratory Manual of Physical Anthropology.
- 6. Singh I P & M K Bhasin. Anthropometry: A Laboratory Manual of Biological Anthropology. Kamla Raj Enterprise, Delhi.
- 7. JS Weiner and JA Louri. 1981. Practical Human Biology.
- 8. Mukherji D., Mukherjee DP and Bharati P. Laboratotory Manual for Biological Anthropology. ASIN.

### ANTACOR07T: BIOLOGICAL DIVERSITY IN HUMAN POPULATIONS

#### Theory

Credit- 4 Unit I: Concepts of Biological Variability; Sources of genetic variability, Crossing over and

Recombination, codominance, multiple alleles, variable expressivity and penetrance, modifying genes; Mutation (brief concepts).

Unit II. Hardy-Weinberg law: Concept and statements; Sources of Genetic Variation;

Unit III: Concept of Race; Conventional classification of major human races of the world; Racial classification of Indian population on the basis of different racial elements by Risley, Guha, and Sarkar (broad groups only), UNESCO statement on Race;

Unit IV: Modern concepts of population, Cliner distribution of traits; Intra and interpopulation variation. health and epidemiology; Bio-cultural factors influencing disease pattern and nutritional status of population; Evolution of Human diet.

Unit V: Demographic Anthropology; Sources of demographic data, Concepts of Population, Fundamental demographic measures and their significance in population dynamics: fertility, Mortality and migration, fertility and mortality rates. Factors responsible for demographic variation.

#### **Suggested readings:**

1. Baker P.T. and J.S. Weiner (ed.) (1996) The Biology of Human Adaptability. Oxford & New York, Oxford University Press.

- 2. Bhende A. and T. Kantikar (2006) Principles of Population Studies. Himalayan Publishing House, Mumbai
- 3. Bogin B. (1999). Pattern of Human Growth. 2nd edition CUP.
- 4. Cameron Noel and Barry Bogin (2012) Human Growth and development. Second

5. Cummins H. and Midlo C. (1961). Fingerprints: Palms and Soles- An Introduction to Dermatoglyphics. Philadelphia: Dover Publication. NewYork.

6. Eckhardt R.B.(1979) The Study of Human Evolution. McGrand Hill Book Company, USA.

7. Frisancho R. (1993) Human Adaptation and Accommodation. University of Michigan press

 Harrison G.A., Tanner, J.M., Pilbeam, D.R., Baker, P.T. (1988) Human Biology. Oxford University Press.
 Jurmain Robert Lynn kilgore Wenda Trevathan and Ciochon (2010). Introduction to Physical Anthropology. Wadsworth Publishing, USA.

10. Kapoor A.K. and Satwanti Kapoor (ed) (1995). Biology of Highlanders. Jammu, Vinod Publisher & Distributor.

11. Kapoor A.K. and Satwanti Kapoor (eds) (2004) India's Elderly-A Multidisciplinary Dimension. Mittal Publication, New Delhi.

12. Klepinge L.L. (2006). Fundamentals of Forensic Anthropology. John Willey & Sons., New Jersey.

13. Malhotra K.C. and B. Balakrishnan(1996). Human Population Genetics in India

14. Malina Robert M., Claude. Bouchard, Oded. Bar-Or. (2004) Growth, and Physical Activity. Human Kinetics.

15. Stanford C., Allen, S.J. and Anton, C.S. (2013): Biological Anthropology. 3rd edition, Pearson, USA

#### ANTACOR07P: BIOLOGICAL DIVERSITY IN HUMAN POPULATIONS

#### Practical

Credit- 2

- 1. Craniometric Measurements (Skull & Mandible) (Direct measurements on at least 3 human skulls)
  - Linear: Maximum Cranial Length, Maximum Cranial Breadth, Morphological Facial Height, Bi-zygomatic diameter, Bi-gonial diameter, Nasal Length, Nasal Breadth, Orbital Height, Orbital Breadth, Least Frontal Breadth, Mandibular Length, Bi-condylar diameter.
  - ii) Indices: Cranial Index, Morphological Facial Index, Nasal index, Jugo-Frontal Index.
  - iii) Chord: Frontal Chord, Parietal Chord, Occipital Chord.
  - iv) Arc: Frontal Arc, Parietal Arc, Occipital Arc.
  - v) Angular: Frontal profile angle, Nasal profile angle, Alveolar profile angle, Frontal-, Bregma- and Lambda angles of schwalbe.

2. Determination ABO and Rh(D) blood groups of ten subjects by direct slide method.

3. Dermatoglyphics (on 6 subjects)

i) Finger dermatoglyphics: Identification of finger pattern types –Arch (Plain and Tented), Loop (Ulnar and Radial), Whorl (True, Twin loop, Lateral pocket loop, Central pocket loop), calculation of Pattern Intensity index.

ii) Palmar dermatoglyphics: Identification of a,b,c, d, t triradii,Ttracing of A, B, C, D Main Line, Main Line Formula, atd angle.

(Analysis of the collected data by using basic Statistics: mean, median, mode, standard deviation and standard error).

4. Construction and drawing of a population pyramid from secondary data and learning to interpret different types of population pyramids.

#### **Suggested readings:**

- 1. Wilder. A laboratory manual of Anthropometry.
- 2. Sen T, A Guide to Anthropometry. World Press, Kolkata.
- 3. Singh I P & M K Bhasin. Anthropometry: A Laboratory Manual of Biological Anthropology. Kamla Raj Enterprise, Delhi.
- 4. Mukherji D., Mukherji D and Bharati P. Laboratotory Manual for Biological Anthropology. ASIN.
- 5. Cummins H & C Midlo. Finger Prints, Palms and soles: an Introduction to dermatoglyphics. Dover pub., Inc. New York. 1943.

### SEMESTER -IV

ANTACOR08T: THEORIES OF CULTURE AND SOCIETY			
Theory	Credit- 4		
UNIT I:			
Theory	What is it? How to frame a theory? The Boundaries of theory: Importance of		
studvin	studying theory in Social Sciences at large and Social-Cultural Anthropology in particular		
Ninetee	enth Century Evolutionism: E.B. Tylor and L.H. Morgan.		
Neo-Ev	volutionism: L. White: Multilinear Evolution: Julian Steward		
LINIT II	orationism. E white, watchinear Evolution, suman Steward.		
Cultural	Relativism Historical particularism: Franz Boas		
Structur	al Annroaches: Durkheim's Social Fact. Functionalism – B. Malinowski: Structural functionalism		
	ad Approaches. Durkhenn 5 Social I act, I unchonarisin – D. Mannowski, Suuctural-functionalisin		
-A. K. K			
Cultura	I materialism (Marvin Harris); Symbolic and Interpretative approach: Clifford Geertz's		
Thick de	escription.		
Suggeste	d Readings:		
1.	Ritzer, Geroge. 2016. Classical Sociological Theory. New Delhi: MC Graw Hill and Rawat		
2. 3	Ritzer George 2016 Modern Sociological Theory New Delhi: MC Graw Hill and Rawat		
<i>4</i> .	Barnard, Alan. 2000. <i>History and Theory in Anthropology</i> . Cambridge: Cambridge University Press.		
5.	Ritzer, George. 2005. Encyclopedia of Social Theory. Volume I&II. California: Sage		
6.	Barnard, Alan., & Jonathan Spencers . 2002. The Encyclopedia of Social and Cultural Anthropology.		
	London: Routledge		
7.	Rapport, Nigel and Joanna Overing. 2000. Social and Cultural Anthropology: The Key Concepts.		
8.	Gordon, Robert., Andrew P. Lyons and Harriet D. Lyons. 2015. <i>Fifty Key Anthropologists</i> . London:		
	Routledge		
9.	Durkheim E. The Rules of Sociological Method		
10.	Tylor EB. Primitive Culture.		
11.	J Steward. Theory of Culture Change.		
12.	M. Jha. Anthropological thoughts and theories.		
13. 14	Unadhyay V S and Pandey G (1997) History of Anthropological Thought, Concept Publishing		
11.	Company, New Delhi		
15.	AR Radcliffe-Brown. Structure and Function of Primitive Society.		
16.	Free web sources:		
17.	https://anthropology.ua.edu/cultures/search.htm		
18.	https://decolonizeallthethings.com/2017/01/31/summary-of-classical-sociological-theory/		
19.	http://uregina.ca/~gingrich/028f99.htm		
20.	http://www.d.unin.edu/cia/iacuity/jilanini/4111/Durkneini%20- %20Division%20of%20Labor_files/durkheim.html		
21.	http://faculty.olympic.edu/charker/deadsociologistsociety.htm		
	ANTACOR08P: THEORIES OF CULTURE AND SOCIETY		
Practical Credit- 2			
1.	Teachers will give them two to five core texts relating to the above-mentioned		
	theories in ANTACOR08T (can be compilation of different texts as well) to be		
	studied. Students will make presentations based on such studies and based on		
	discussion during the presentation and submit a research proposal including the		
	suitable methodology for the work to be taken up		
2	Collect data (field data or secondary data) analyse them and write a report of a		
4.	minimum of 2000 words)		
	minimum of 2000 words).		

#### ANTACOR09T: HUMAN GROWTH AND DEVELOPMENT

#### Theory

Credit- 4

**Unit I:** Concepts of human growth, development and maturation; Cellular processes: hyperplasia, hypertrophy and accretion;

**Unit II:** Methods of studying human growth and development: cross sectional, longitudinal, mixed and linked longitudinal.

**Unit III:** Stages of growth: Prenatal and Post natal period of growth (general characteristics), growth spurt, Scammon's curves of systemic growth; chronological age and biological age.

**Unit IV:** Distance and velocity growth curves: their features and significance. Growth reference, growth standard, growth chart, Variation in normal growth curve (concepts of canalization, Catch –up growth).

**Unit V:** Growth and Nutritional Status: Growth retardation and faltering: low birth weight, stunting, wasting and underweight in children, concept of z-score statistic, MAM and SAM in children, Kwashiorkor, Marasmus; Biocultural understanding of human growth: factors affecting human growth. Anthropometric assessment of malnutrition in adults (BMI and MUAC).

Unit VI: Concepts of body composition- brief introduction of models and techniques).

#### Suggested readings:

- 1. Harrison G A. et al. 1988. Human Biology: an introduction to human evolution, variation, and adaptability. Oxford Scince Publications.
- 2. Weiss M L & A E Mann. 1991. Human Biology and Behaviour in Anthropological Perspective. Scott, Fresman.
- 3. Tanner J M. 1978. Foetus into Man. Harvard University Press
- 4. Bogin B. 1999. Patterns of Human Growth. 2<sup>nd</sup> edition. Cambridge University Press.
- 5. Falkner F & Tanner J M. 1979. Human Growth: Principles and prenatal growth.(3 Vols) Plenum Press: London.
- 6. Sinclair DG. 1989. Human Growth after Birth. Oxford University Press.
- 7. Houspie RC, Cameron N, Molinary L. 2004. Methods in Human Growth Research. New York: Cambridge University Press.

#### ANTACOR09P: HUMAN GROWTH AND DEVELOPMENT

#### Practical

Credit- 2

- 1. Calculation of z-scores of height and weight from a secondary data set.
- 2. Assessment of children's nutritional status from the secondary data set.

# 3. Determination of nutritional status by BMI and MUAC from the data set (at least 20 subjects).

4. Skinfold measurements: biceps, triceps, medial calf; Estimation of body composition by skinfold thicknesses (the same 20 subjects).

(Analysis of the collected data by using basic Statistics: mean, median, mode, standard

### deviation and standard error).

#### Suggested readings

- 1. Mukherji D., Mukherji D and Bharati P. Laboratotory Manual for Biological Anthropology. ASIN.
- 2. Das D, Das A.1993. Statistics in Biology and Psychology. Kolkata: Academic Publishers
- 3. Lohman, T. G., Roche, A. F., & Martorell, R. (1988). *Anthropometric Standardization Reference Manual*. Champaign, Ill: Human Kinetics,.

#### ANTACOR10T: RESEARCH METHODS

#### Unit I: Research Design

Theory

- 1. Review of literature, conceptual framework, formulation of research problem, formulation of hypothesis,
- 2. Sampling, tools and techniques of data collection, data analysis and reporting, guiding ideals and critical evaluation of major approaches in research methods,
- 3. Qualitative research and quantitative research, their relationship and uses in anthropology

#### **Unit II**: Field work tradition in Anthropology

- 1. Theoretical approaches
  - a. Cultural relativism, ethnocentrism, etic and emic perspectives, comparative and historical methods, inductive and deductive approach
  - b. techniques of rapport establishment; identification of representative categories of informants, maintenance of field diary and logbook

#### Unit III: Tools and techniques of data collection

- 1. Survey vs. ethnography
- 2. Construction of different field tools
  - a. Technical aspects of preparing questionnaire and interview schedule
  - b. Standardization of validity, sensitivity and reliability factors of the applicable tools
  - c. Observation Direct, Indirect, Participant, Non-participant, Controlled
  - d. Interview Structured and unstructured, Focussed Group Discussion, key informant interview
  - e. Case Study and life history
  - f. Genealogy and its application

#### Unit III: Ethics of Research

- 1. Identify, define, and analyse ethical issues in the context of human subject research
- 2. Iimportance of consent, privacy and confidentiality in research

#### Unit IV: Analysis and Writing Up

- 1. Chapterization, preparing a text for submission and publication, concepts of preface, notes (end and footnotes), glossary, prologue and epilogue, appendix, bibliography (annotated) and references cited, review and index
- 2. Introduction of software for data analysis.

#### Unit V: Bio-Statistics

- Nature of data, Quantitative and Qualitative; Discrete and Continuous variables, Tabulation of Data, Frequency distribution, Class interval and Class limit, Cumulative and relative frequencies, Graphical representations, Data distribution: normal and others, z-distribution; measurements of Central tendency (Arithmetic Mean, Median, Mode) and Dispersion (Range, Variance, SD and SE of Mean), test of significance (Chi-square and students' t-test);
  - 2. Correlation, Basic linear regression model.

#### **Suggested Readings**

Practical

- 1. Garrard E and Dawson A. What is the role of the research ethics committee? Paternalism, inducements, and harm in research ethics. Journal of Medical Ethics 2005; 31: 419-23.
- 2. Bernard H.R. Research Methods in Anthropology, Qualitative and Quantitative Approaches. Jaipur: Rawat Publications. 2006.
- 3. Madrigal L. Statistics for Anthropology. Cambridge: Cambridge University Press. 2012.
- 4. Pelto PJ and Pelto GH. Anthropological Research, the Structure of Inquiry. Cambridge: Cambridge University Press. 1978.

#### ANTACOR10P: RESEARCH METHODS

Credit- 2

Project proposal writing- statement of the problem, hypothesis and objectives, study design, proposed analyses and expected outcomes and utility, Preparation of schedule and questionnaire
 Calculation of statistical measures as mentioned in Unit V, ANTACOR10T by software.
 Learning to use a modern library and internet information, net-searching, use of INFLIBNET etc. (laboratory note book should show evidences of such work based on definite objectives and results); Hands on demonstration in a library may be conducted.

#### Semester V

#### ANTACOR11T: HUMAN POPULATION GENETICS

Theory

Credit- 4

Credit- 2

Unit I: Fundamentals:

1. The historical development of human genetics – major milestnes.

2. Mendel's Experiments: Monohybrid and Dihybrid cross; Principles of segregation and Independent assortment; concepts of 'dominant' and 'recessive', genotype and phenotype, homogygous and heterogygous, back cross and test cross, Punnet square.

3. Patterns of inheritance: Autosomal Dominant, Autosomal Resessive, X linked Dominant, X linked Recessive and Y linked inheritance in human.

4. Exceptions to Mendelian Inheritance: Outline: Linkage (Sex linkage and sex influenced traits), Epistatis and genomic imprinting

5. Outline of Quantitative genetics, quantitative/complex inheritance, multifactorial and polygenic inheritance, Multiple alleles, Co-dominance,

6. Outline of the methodology human genetics: Family method, Twin Method, Cytogenetics, Population genetics.

#### **Unit II: Ecological Genetics and Polymorphism**

1. Concept of Phenotype and Genotype, Phenocopy and Genocopy.

2. Genetic Polymorphism: transient polymorphism and balanced polymorphisms (Sickle cell trait and Malaria) 3. Association of Polymorphism: Relationship of communicable and non-communicable disease with Blood groups.

#### Unit III: Equilibrium of allele frequency: Hardy-Weinberg principle

1. Genotype and allele frequencies,

2. Concept of Hardy-Weinberg equilibrium, its applications and alternation in evolutionary perspective.

#### Unit IV: Dynamics of Allele Frequency: Evolutionary Forces

1. Mutation, selection (pattern and mechanism), Genetic drift (bottle neck and founder effect), Gene flow/migration, inbreeding (inbreeding co-efficient and its genetic consequences)

#### Unit V: Population structure and admixture in human populations

1. Concept of Random and non-random mating (positive and negative assortative mating), **Unit VI: Human Evolutionary Genetics:** Basic concepts and application in human welfare.

#### Suggested readings:

- 1. Barua S. 2002. Human Genetics : An Anthropological Perspective. Kolkata: Classique Books.
- 2. Mange E J, Mange A P. 1997. Basic Human Genetics. Meerut: Rastogi Pub.
- 3. Stern C. 1968. Principles of Human Genetics, New delhi: Eurasia Pub. House.
- 4. Jurmain R, Kilgore L, Trevathan W. 2006. Essentials of Physical Anthropology. (7<sup>th</sup> Ed). Belmont: Wadsworth.
- 5. Russel P J. 1987. Essentials of Genetics. London: Blackwell Scientific Pub.
- 6. Gardner D J, Snustad D P. Principles of genetics. New York: John Wiley & Sons.
- 7. Stein and Rowe, Introduction to Physical Anthropology. McGrow Hill
- 8. Thompson M W, McInnes R R, Willard H F. 1991. Genetics in Medicine. W B Saunders Co., Philadelphia.
- 9. Bodmer W F and L L Cavali-Sforza. 1976. Genetics, Evolution and Man. San Francisco: Freeman.

#### ANTACOR11P: HUMAN POPULATION GENETICS

#### Practical

1. Blood group typing- ABO blood group, Rh (D) (At least 10 participants.

2. Color Blindness: Deutan and Protan type. Estimation of carriers. Estimation of male female ratio (at least 20 participants)

3. Identification of Sex Chromatin (Inactivated X Chromosomes): one male and one female, 50 cells

each

4. PTC taste testing ability: At least 20 participants. Allele frequency estimation.

### Suggested readings:

- 1. Mukherji D., Mukherjee DP and Bharati P. Laboratotory Manual for Biological Anthropology. ASIN.
- **2.** JS Weiner and JA Louri. 1981. Practical Human Biology.

ANTACOR12T: ANTHROPOLOGY IN PRACTICE			
Theory Credit: 4			
Unit I: Applied fields of Anthropology			
Applied, Action and Development Anthropology: Definition, Meaning and Historica	ıl		
Development and Empirical examples from projects. Brief discussion on			
modernization, dependency and world systems theory of Development Issues.			
Unit II: Role of Anthropology in Development			
Introduction to the Concepts of Development Anthropology & Anthropology of			
Development. Sustainable Development: Meaning, Characters and Empirical Project	ts.		
Concept of Development and Welfare; Development of tribal communities in India	in		
relation to Economic, Social, Educational, Health & Environmental concern			
(Development programmes); Role of NGOs in Development Anthropology.			
Unit III: Constitutional Provisions and Human Rights			
Constitutional Definition for SC & ST; Constitutional Safeguards for SC's/ST's &			
OBC's. Human Rights: Definition, Characters, Constitutional Provisions related to			
Human Rights. International citizen's chartered on Human rights; United Nation			
Millennium Goal; Composition and function of International, National and State			
Human Right Commission; Human rights of special category and marginal groups &	5		
Child.			
Unit IV: Anthropology and Development in Indian Context			
Major tool used in rural development and management- RRA and PRA; Local self			
Government (Constitutional provisions, Composition, Electoral Process, Membershi	p,		
Functions, importance in decentralization of power) - Rural (Panchayat Raj System),	,		
Urban (Municipality and Municipal Corporation).			
Suggested readings:			
1. Scupin R, C. De-Corse. Anthropology: World Perspective. 2005. New Delhi: Prentice Hall.			
2. Kottak C. Cultural Anthropology. McGraw Hill, 2001.			
4 R M Sarkar Development Anthropology Kolkata: Sahavatri 2018			
5. Chaudhuri B. Tribal Development in India: Problems and Prospects. Inter India Pub.			
6. Bhaowmik PK. Applied, Action and development Anthropology. 1990.			
7. Eller, JD. Cultural Anthropology: Global Forces, Local Lives, Routlege, 2012.			
ANTACOR12P: ANTHROPOLOGY IN PRACTICE			
Practical Credit: 2	2		
a) A Project on Evaluation of any one Development Programme – Aim ar	nd		
Objective, Constitutional Provision, Concept and Functionaries, Available Da	ıta		
and any other relevant issues. (based on secondary data source)			
b) Student will visit nearest Gram Panchayat or Municipality Office and colle	ct		
information about the Composition of the Board, Different Stake holder	ſS,		
Functionary Mechanism, various Developmental and Welfare Programme	es		
adopted, Special initiatives taken by the body for the area under its jurisdiction	on		
and any other relevant anthropological issues.			

### **SEMESTER- VI**

#### ANTACOR13T: FORENSIC ANTHROPOLOGY

#### Theory

Credit: 4

#### Unit-I

Introduction to Forensic Anthropology: Definition, Brief History, Scope, Applications of Forensic Anthropology.

#### Unit-II

Basic Human Skeletal Biology, Identification of Human and Non-Human Skeletal Remains, Ancestry, age, sex and stature estimation from bones, Discovery and Techniques for recovering human skeletal remains.

#### Unit-III

Personal Identification, Complete and partial identification, methods of identification in living persons: somatometry, somatoscopy, occupational marks, scars, bite marks, tattoo marks, fingerprints, latent fingerprints, footprints, lip prints, handwriting, deformities and others.

#### Unit-IV

Serology: identification and individualization of bloodstain, urine, semen and saliva. Types and patterns of bloodstains and its use.

#### Unit-V

Individualization: Forensic Odontology- tooth Structure and growth, bite marks, facial reconstruction, DNA Profiling: principles and application.

#### Suggested readings:

- 1. Bass W.M. (1971). Human Osteology: A Laboratory and Field manual of the Human Skeleton. Columbia: Special Publications Missouri Archaeological Society.
- 2. Black S. and Ferguson E. (2011). Forensic Anthropology 2000 to 2010. CRC Press, London.
- 3. Byers, S. N. (2008). Forensic Anthropology. Boston: Pearson Education LTD.
- 4. Gunn A. (2009) Essential Forensic Biology (2nd ed). Chichester: Wiley-Blackwell
- 5. Reddy V. R. (1985). Dental Anthropology, Inter-India Publication, New Delhi.
- 6. Spencer, C. (2004). Genetic Testimony: A Guide to Forensic DNA Profiling, Pearson, New Delhi.

#### ANTACOR12P: FORENSIC ANTHROPOLOGY

#### Practical

Credit: 2

- 1. Study of Human Long Bones. Estimation of age, sex and stature from bones.
- 2. Identification of bloodstain and saliva.
- 3. Examination of Fingerprints: Identification of patterns and minutae, ridge counting.

#### ANTACOR14T: ANTHROPOLOGY OF INDIA

Credit: 4

#### Theory Unit - I :

Indian Anthropology: Origin, History, Growth and Development of Anthropology (Mentioning Phases or Stages); Major Contributions of some Indian Anthropologists: S.C.Roy, I.Karve, D.N.Majumdar, N.K.Bose, M.N.Srinivas, L.P.Vidhyarthi, T.C.Das, P.K.Bhowmick, B.S.Guha and S.S.Sarkar, SRK Chopra, HD Sankalia, D. Sen, D.K. Bhattacharya; Racial and Linguistic elements in Indian population;

#### Unit - II :

Village Studies in India: Concepts, features and types of village, significance of village studies, Contribution of some Indian Anthropologists to study Indian Villages- M.N.Srinivas, S.C. Dubey, Andre Beteille; Indian traditional social system: concept of Varna, Jati, Caste, Ashram or purusharatha,

3. Social Change: Concept, factor and reasons for social change ,Concepts related to social change in India.

4. Basic Concepts: Great Tradition and Little Tradition, Universalization and Parochialization, Sanskritization and Westernization, Sacred Complex, Dominant Caste, Tribe-Case Continuum,

Nature-Man-Spirit Complex, Industrialization, Urbanization, Culture Contact (Acculturation): The Hindu Method of Tribal Absorption.

Unit - III :

1. Tribal Displacements and Rehabilitation Problem, Role of Anthropologists in Tribal welfare. Unit - IV :

1. Constitutional definition of Scheduled Caste and Scheduled Tribe and other Backward Classes and some provisions mentioned in 5th and 6th Schedule.

2. Safeguards for the Scheduled Castes and Scheduled Tribes.

3.Problems of exploitation and deprivation of Scheduled caste and Scheduled Tribe and other Backward Classes.

#### **Suggested Reading**

1.Dube,S.C.(1992).Indian Society, National Book Trust, India: New Delhi.

2.Dumont,L.(1980).Homo Hierarchicus,University of Chicagon Press.

3.Bernard, C.S. (2000), India: The Social Anthropology of Civilization, Delhi: Oxford University Press.

4. Chaudhuri B. Tribal Development in India: Problems and Prospects. Inter India Pub.

5.Upadhyay, V.S. and Pandey, G. (1997). History of Anthropological Thought, Concept Publishing Company, New Delhi.

6. Das, B.M. (2016). Outline of Physical Anthropology, Kitab Mahal, Allahabad.

7. Hasnain, N. (1992). General Anthropology, Jawahar Publishers and Distributors, New Delhi.

8.Gupta, D.Social Stratification, Delhi: Oxford University Press.

9.Karve.I (1961).Hindu Society: An Interpretation.Poona:Deccan College.

10.Guha,B.S.(1931).The Racial Attributes of People of India,Vol.I,Part-III(BPO,Simla)

#### ANTACOR14P: ANTHROPOLOGY OF INDIA

Practical 1.Book Review: Credit -2

Students should read a basic Anthropological Book/Monograph on Indian Society thoroughly and learn the skill of reviewing a book. They should submit a hard copy of the review, with full Reference, duly signed by the concerned teachers(within 500 words).

#### 2.Project Report:

The evaluation of project report should be considered on the following aspects -

Highlight the contribution of any two contemporary Indian Anthropologists: as per the list mentioned in ANTA COR T14 Unit 1.

Note: for all branches of practical papers, laboratory note book/report duly signed and forwarded by the teacher(s)/HOD should be submitted during practical examination for evaluation.
# **Discipline specific Elective Courses**

#### **SEMESTER V**

(2 courses to be chosen from the following three)

#### TADEEA1T. INDIAN ADCHAEA

AN I ADSEULT: INDIAN AKCHAEOLOGY
Theory Credit: 4
• A brief historical perspective- from R. B. Foote till present.
• Paleenvironmental condition with special reference to Potwar Plateau and Kashmir,
Rajasthan, Son Valley, Narmada and Teri sites.
• Survey of various cultural phases of Indian prehistory: Chronological phases and terminologies for the study of various cultural phases in different geographical regions
• Lower Palaolithic Culture of India: Important sites and radions Potwar plateau (works of de
• Lower Later on the Culture of muta. Important sites and regions 1 of war plateau (works of de
India with special references to Bhimbetka, Attripakkam, Hunsgi-Baichbal Valley,
Chotanagpur Plateau, Nagpur Plateau etc.
• Middle Paleolithic culture of India: Concept of Flake tool culture complex with special references to Bellan Valley. Kalegaon Nevasa and Narmada Valley.
<ul> <li>Unper Palaolithic Culture of India: special references to Patna Kurnool caves Bagor and</li> </ul>
• Opper l'acontine Culture of India. special references to l'ane, Rumoor caves, Dagoi and Tilwere. Serei Necher Rei, Mehedehe, Demdeme etc. Unner Deleolithie Brohlem of India
Misselittic Celtere of India. Consider of mana to Decen Leastheric Dickharmer, Teri Site
• Microniune Culture of India: Special reference to Bagor, Langinaj, Birbianpur, Teri Sites,
Adamgarn, Brimbelka, Sarai Nanar rai, Damdama, Manadana. Micronunc rock art of india.
• Neolithic Culture of India: North India- Burzahom, South India- Bellary, Brahmagiri,
Sanganakallu, Tekkalakota; Eastern and North-Eastern India- Assam, Deojali hading, Bengal-
Bihar-Orissa Culture Complex, Neolithic culture of North West India- Kili ghul Mohammad,
Mahergarh beginning of village economy etc.
• Chalcolithic Culture of India: Use of Metal, Technology, Tools and Pottery, Central Indian
Kayatha Culture, Ahar Culture, Northern Deccan- Malwa and Jorwe Culture.
• Early Civilization: Origin and development of Harappan Civilization, Geographical
distribution, extent and settlement pattern, Important excavated sites, Town Planning and
Architecture, Trade, Economy, Technology and Art, Script, Socio-political and religious life,
Decline- various causes.
• Beginning of Iron age and second Urbanization: Black and Red Ware culture (BRW), Painted
Grey Culture (PGW), Northern Black Polished Ware culture (NBPW), Megalithic burial
types- Menhirs, Dolmens, Alignments, Cairn Circle, Rock Cut Cayes, Umbrella Stones
(Kodakkal). Cists etc: Living megalith tradition.
<ul> <li>Brief ideas about preservation of cultural heritage of India</li> </ul>
Suggested readings:
1 D K Rhattacharva (1996) An Outline of Indian Prehistory Delhi Palika Prakashan
2 D K Bhattacharya Prehistoric Archaeology Delhi Palika Prakashan
2. H. D. Sankalia (1974) Prehistory and Protohistory of India and Pakistan. Poona. Deccan College.
3. H. D. Sankalia (1982) Stone Tool Type and Technology. Delhi, B.R.Publication.
4. Agarwal DP
5. F. Fagan and M Durrani. Archaeology: A brief introduction
6. BM Fagan and M Durani. People of the Earth: An introduction of World Prehistory.
ANTADSE01P: INDIAN ARCHAEOLOGY
Practical Credit: 2
1. Toposheet Reading method
2. Learning the use of GIS
3. Field Exploration OR Museum Visit.
Field exploration: Students will be taken to field to study the geomorphological features (Use of
Topographic maps/ GPS, River Terraces, Exposed Stratigraphic lavers and measurements. River.
i o i retroit and other shores of the same Crief methods and this transh

hill, streams, soil types and other physical features of the area. Grid methods and trial trench, Instruments used. Preference should be given to known archaeological sites of India. (Cultural remains found from the site) A report duly forwarded by the teacher(s)/HOD to be submitted during practical examination for evaluation.

#### **ANTADSE02T: ANTHROPOLOGY OF HEALTH** Theory Credit: 4 Unit 1: Introduction and Overview of the Field of Anthropology & Health. The unique place of anthropology in health science; Concepts of Health, Illness, Sickness, healing and disease in modern science and in cross-cultural perspective; Bio-medical versus naturalistic approaches; limitations of modern health promotion and health care delivery programmes: family planning, child health and nutrition, immunization; Medical anthropological perspectives of health; Theoretical and applied medical anthropology; Unit 2: Cultural Dimensions of health, Application of concepts of culture in population health, "sick role" models, variation in health seeking and health care practices, Culture competence and responsiveness in health care practice. Unit 3: Measuring population / community health: Concepts of epidemiology, cultural epidemiology, morbidity and mortality, Epidemiology of common communicable diseases: Malaria, Tuberculosis, Leprosy, Diabetes, Cardiovascular disease and Sexually Transmitted Diseases (STDs), HIV/AIDS, social-cultural determinants. Diseases associated with specific sociocultural and environmental contexts: Kuru, osteomalacia, sickle cell anaemia. Unit 4: Healing and Healers in Cross-Cultural Perspectives: Medical pluralism, folk healers and alternative medicine, Shaman, Magic, Witchcraft and Sorcery, Ethnomedicine, Problems in evaluating efficacy, Sources of dissatisfaction with mainstream medicine. Unit - 8: Legal Aspects & Future Prospects for Health: International health organizations and policies, Critical issues in global health, Medical Ethics. **Suggested Readings** 1. Rajesh Khanna and A.K. Kapoor. 2007. Ethnic Groups and Health Dimensions. Discovery Publishing House, New Delhi. 2. Helman, Cecil G. 2001. Culture, Health, and Illness. 4th ed. London: Arnold. 3. Mann, Jonathon M., et al. (eds.) 1999. Health and Human Rights. New York: Routledge. 4. Albrecht, Gary L., Ray Fitzparick, and Susan C. Scrimshaw (eds.) 2000. The Handbook of Social Studies in Health and Medicine, SAGE.Publications. 5. Bannerman, Robert, J. Burton, and Ch'en Wen-Chieh (eds.) 1983. Traditional Medicine and Health Care Coverage. Geneva: World Health Organization. 6. Chen, Lincoln C. Arthur Kleinman, and Norma C. Ware 1994. Health and Social Change in International Perspective. Harvard University Press. 7. Coreil, Jeannine and J. Dennis Mull (eds.) 1990. Anthropology and Primary Health Care, Boulder: Westview Press. 8. Hahn, Robert A. 1999. Anthropology in Public Health. Bridging Differences in Culture and Society. New York: Oxford University Press. 9. Helman, Cecil G. 1994. Culture, Health, and Illness. 3rd ed. Oxford: Butterworth-Heinemann. 10. Inhorn, Marcia C. and Peter J. Brown 1997. The Anthropology of Infectious Disease. International health Perspectives. Gordon and Breach Publishers. 11. Koop, C. Everett, Clarence E. Pearson, and M. Roy Schwartz (eds.) 2001. Critical Issues in Global Health. San Francisco: Jossey-Bass. A Wiley Company. 12. Mayer, Kenneth H. and H.F. Pizer (eds.) 2000. The Emergence of AIDS. The Impact on Immunology, Microbiology, and Public Health. Washington, D.C.: American Public Health Association.

- 13. Nichter, Mark and Mimi Nichter 1996. Anthropology and International Health. Asian Case Studies. Gordon and Breach Publishers.
- 14. Paul, Benjamin D. (ed.) 1955. Health, Culture, and Community. Case Studies of Public Reactions to Health Programs.

#### ANTADSE02P: ANTHROPOLOGY OF HEALTH

Practical

Credit: 2

1. Make a Schedule on Anthropological study of health

2. Identify any contemporary health care problem of any community and prepare a project report with reference to medical anthropological approaches.

#### ANTADSE03T: TRIBAL CULTURE AND TRIBAL DEVELOPMENT IN INDIA Theory Credit: 4

Unit I: Concept of tribes and its problematic nature, Definition given in the Constitution, General and specific characteristics of tribes, Tribes in India: historical, academic, administrative and anthropological importance, concept of Denotified tribes and PVTGs.

Unit II: Classification of tribal population in India on the basis of Geographical distribution, Race, Language & Economy.

Unit III: Tribal Movements in India - Santal Movement, Birsa Movement, Tebhaga Movement, Tana Bhagat movement and Jharkhand movement.

Unit IV: Problems of tribal development, Concept of different tribal development programmes in India (ITDP, TRYSEM, TSP, LAMPS, NREGA, EMRS, Ashram School), Forest policies and tribes, Migration and occupational shift, Tribal arts and aesthetics, Displacement and Rehabilitation and Impact of Globalization among Indian tribes.

#### Suggested Readings

- 1. Behera, D.K and Georg Pfeffer, 1997, Contemporary Society Tribal Studies (Volume I to VII). New Delhi: Concept Publishing Company.
- 2. Bose, N. K., 1977, Tribal Life in India, New Delhi:National Book Trust.
- 3. Chaudhuri, B. (Edited) 1982, Tribal Development in India: Problems and Prospects, New Delhi: Inter-India Publications.
- 4. Haimendorf, Furer., 1982, Tribes of India, Bombay: Oxford University Press.
- 5. Guha, B.S.,1931, The racial attributes of people of India. In: Census of India, 1931, vol I, Part III (BPO, Simla).
- 6. Mahapatra, L.K., 1972, "Social Movements among the Tribes of India", (edited by K.S. Singh), Tribal Situation in India, Simla: Indian Institute of Advanced Study.
- 7. Panda, N., Policies, 2006, Programmes and Strategies for Tribal Development: A Critical Appraisal, Delhi: Kalpaz publications.
- 8. Risley, H.H. 1891, Tribes and Castes of Bengal (Vol. 1 and Vol. 2), Calcutta: Bengal secretariat press.
- 9. Singh, K.S., 1982, Tribal Movements in India, Calcutta: Anthropological Survey of India.
- 10. Vidyarthi L.P. and Rai B.K., 1976, Tribal Culture in India, New Delhi: Concept Publishing Company.
- 11. Vidyarthy.L.P. and B.N. Sahay, 1980, Applied Anthropology in India, New Delhi: National Publishing House.

#### ANTADSE03P: TRIBAL CULTURES AND TRIBAL DEVELOPMENT IN INDIA Practical Credit: 2

- 1. Detailed study of tribal map of India.
- 2. Preparation of a brief report (around 2500 words) on the Scheduled Tribes (ST) and Particularly Vulnerable Tribal Groups (PVTG) of India with the help of latest Census data available, Map showing distribution of STs (presentation by the students).

#### SEMESTER VI

# (1 course to be chosen from ANTADSE04T and 05T; ANTADSE06P (Dissertation) is mandatory)

#### ANTADSE04T: PHYSIOLOGICAL ANTHROPOLOGY

Theory

Credit: 4

**Unit 1:** The aim and scope of human physiology and physiological anthropology; Functional organization of the human body: cell, extracellular fluid – characters and functions, A brief outlines of the homeostatic mechanisms of the major functional systems of human body; Control systems: regulation of  $-O_2$  and  $CO_2$  in extracellular fluid, arterial blood pressure.

**Unit 2:** Fundamentals of work capacity- meaning and concept. Work capacity and environmental stresses. Exercise and cardio-vascular- respiratory efficiency, Factors affecting physical performance and work capacity, relation between physique, body composition, nutrition and performance.

#### **Unit 2: Respiratory Functions & Determinants**

Concept & determinants of static and dynamic lung functions; Lung function tests. Spirometry and evaluation of airway problems.

#### Unit 3: Metabolism: Rest and Exercise

Concept of metabolism, types of metabolism, Defining metabolic rate, Factors affecting metabolic rate; Metabolic disorders and nutritional status, population variation.

#### Unit 4: Cardiovascular Health and Risk Factors

Meaning and concept of CVD, Types of CVD, Risk factors for CVD, Screening, prevention and management; Population variation in CVD and their risk factors, biological and environmental susceptibilities, Relationship of body measurements with cardio-vascular and respiratory functions.

#### Suggested Readings:

- 1. Textbook of Medical Physiology by A. C. Guyton and JE Hall. Elsevier. 2011
- 2. A. Damon. Physiological Anthropology. Oxford University Press.
- 3. Human Physiology by Vander, Sherman & Luciano, 2004 (McGraw-Hill).
- 4. Human Adaptation and Accommodation, byA Roberto Frisancho, 1993 (University of Machigan Press).
- 5. Exercise physiology by Tudor Hale, 2005 (John Wiley & Sons).
- 6. Heart diseases in women by S Wilansky and JT Willerson, 2002 (Churchill Livingstone).

#### ANTADSE04T: PHYSIOLOGICAL ANTHROPOLOGY

#### Practical

Credit: 2

- 1. Cardiovascular function (Blood pressure, pulse rate)
- 2. Somatotyping: Sheldon, Heath and Carter methods
- 4. Measurement of Human Body Composition: general obesity, regional obesity

#### ANTADSE05T: RURAL AND URBAN ANTHROPOLOGY

#### Theory

Credit: 4

#### A) RURAL ANTHROPOLOGY

#### Unit I: Village Studies in India.

- Definition of Village. Types of Village. Historical genesis of Village Studies in India. Significance of Village Studies in Social Anthropology.
- Rural Anthropology: Concepts developed from Rural Anthropology: Dominant
   Caste, Faction, Village Unity, Sanskritization. Village as Unit of Indian Civilization.

#### Unit: II: Agrarian Social Structure, Agrarian Unrest & Changing Rural Society.

- Concept of Agrarian Social Structure, History of Study of Agrarian Social Structure. Meaning of Land Tenure System and Land Reforms in India.
- Concept of Peasant, Peasant Movements in India. Peasant Movements in Pre and Independence India: Moplah Rebellion ((1921); Naxalbari Struggle & Other Contemp peasant struggles.
- iii) Changing Rural Society: factors; impact of urbanization, industrialization modernization, Contemporary Rural Cultural Changes.

#### **B) URBAN ANTHROPOLOGY**

#### **Unit 1: Introducing the Concepts:**

- Defining the Concepts: Urban, Urbanism & Urbanization; Urbanization Process (Prima Secondary) & Anthropology of Urbanization., Urban Anthropology: Historical discour Contemporary situation.
- ii. Origin & Types of Cities; Cities as Centers of Innovation Diffusion and Progress. Basic Statistics about Indian Cities.

#### Unit 2: Methodology Issues & New Developments

- i) Urban ethnography: concepts and methods, attribute analysis.
- ii) Structural and the Functional Paradigm of Urban Anthropology.
- iii) Introducing contemporary urban issues: Urban Space, Urban poverty, Urban Inequality, Urban Class; Urban Ecology.

#### **Suggested readings**

- 1. David G Mandelbaum. Society in India. Univ. Of California Press. 1970.
- 2. A R Desai. Rural Sociology of India. 1994. Bombay: Popular Prakashan.
- 3. S. M. Low. 1996. The anthropology of Cities. Ann Rev Anthropol. 25:383-409.
- 4. Childe, V. Gordon. 1950. "Urban Revolution." Town Planning Review
- 5. Cities, classes and the social order. Anthony Leeds, Roger Sanjek
- 6. Doshi, Harish, 1974. Traditional Neighbourhood in a Modern City. New Delhi : Abhinav Publications.
- 7. Doshi, S.L. & P.C. Jain, 2009. Rural Sociology. Jaipur: Rawat Publication.
- 8. Fox, Richard.1977. Cities in their Cultural Settings. New Jersey: Prentice Hall.
- 9. Giuliana B. Prato & Italo pardo, 2013, Urban Anthropology in Urbanites Volm No. 3.
- 10. http://www.oxfordbibliographies.com/
- 11. Kosambi, Meera. 1994. Urbanization and Urban Development of India. New Delhi: ICSSR.
- 12. Low Reader Part V: "The Postmodern City" in Low pp. 317-377; Dear and Flusty .
  - Methodological Issues".
- 13. Rao, M.S.A (ed) .1974, Urban Sociology in India.1974: Orient Longman.
- 14. Rao, M.S.A. 1974. *Traditional Urbanism and Urbanization*. in Rao, M.S.A (ed) 1974, *Urban Sociology in India*. Hyderabad: Orient Longman.
- 15. Redfield, R & M. Singer, 1954. The Cultural Role of Cities in Economic Development and Culture Change; Volume-III, No-I, pp.53-73.
- 16. Ross, A.D, 1961. The Hindu Family in its Urban Setting. Canada: University of Toronto press.
- 17. Singer, M. 1974 *The Great Tradition in a Metropolitan Centre* in Rao, M.S.A (ed) 1974, *Urban Sociology in India* Hyderabad: Orient Longman.
- 18. Singer.M, 1991: Semiotics of Cities, Selves and Cultures Explorations in Semiotic Anthropology. New York: Mouton de Gruyter.

19. Singh Yogendra, 1999. Modernization of Indian Tradition. New Delhi: Rawat Publications.

20. Sinha, S (ed), 1972 Cultural Profile of Calcutta, Calcutta: Indian Anthropological Society.

21. Southall, Aidan (ed). 1973. Cross Cultural Studies of Urbanization. New York: Oxford University Press.

22. Southall, Aidan. 1998. The City in Time and Space. Cambridge: Cambridge University Press.

23. Wirth Louis. 1938. Urbanism as a Way of Life. In American Journal of Sociology. 44: 1-24.

#### ANTADSE05T: RURAL AND URBAN ANTHROPOLOGY

#### Practical

Credit: 2

Prepare a Project Report on **any two** of the following (1 Credit / project; Projects should be submitted under individual Mentor / Supervisor)

(i) Visit city life in a locality /a single apartment house or a housing community from one's own locality and prepare a brief report on the demography, the social-cultural inter-relationship attributes amongst the neighbours.

(ii) Prepare a brief report on any Popular Culture performance/ Ritual cum Festival in an urban locality

(iii) Photographs of events in city life with captions and texts relating to urban attributes.

(iv) A brief report with photography on any form of Urban Market (From hawker to shopping mall)

#### ANTADSE06P: DISSERTATION (MANDATORY)

# Theory Credit: 6 Each student should undertake compulsory training for fieldwork on any little known/ unknown community in any village or locality (tribal or multi caste village) in India.

Duration: Not less than 10 days. (excluding journey dates)

Before proceeding to field work, at-least 18 lectures should be arranged for theoretical preparation and methodological issues on fieldwork.

#### Guidelines for the Field Report

Introduction: Relevance, Genesis and tradition of Field work in Anthropology, Approaches to the preparation of present field work. Aim and Objectives of the present study, Means of data collection (as per theory syllabus)

General information of the study area

The village and the people (including their Demographic profile)

Some aspects of material culture

Subsistence pattern and principal occupations with case studies.

Some aspects of Social Organization

Political organization (both traditional and modern)

Life cycle rituals and ceremonies (with at least two case studies each): Birth, Childhood and adolescence, Marriage, Death

Rituals and festivals

Impact of development/ Welfare programmes: Problems and approaches- economy, health, education, infrastructure etc

Bibliographic and / or Reference style: Any one standard form e.g., Chicago, APA, Harvard etc., to be followed uniformly throughout the report.

# Skill Enhancement Courses (SEC)

#### SEMESTER-III

#### ANTSSEC01M: PUBLIC HEALTH AND EPIDEMIOLOGY

Theory Credit: 2
Unit I: Principles of Epidemiology in Public Health: Definitions and scopes of Public Health and
Epidemiology; Social-cultural determinants, policies, and practices associated with public health;
Cultural, social, behavioural, psychological and economic factors that influence health and illness
Unit II: Health and Culture: Bio-medical versus naturalistic approaches; limitations of modern
health promotion and health care delivery programmes: family planning, child health and nutrition,
immunization; Application of concepts of culture in epidemiology and public health, Cultural
epidemiology.
Unit III: Epidemiology of disease: understanding etiology of communicable and non-communicable
diseases: Malaria, STD, HIV/AIDS, Diabetes, Cancer, Cardiovascular diseases, Mental and emotional
disorders; determining change in trend over time: prevalence and incidence; implementation of
control measures;
<ul> <li>Suggested reading <ol> <li>Gordis L. (2004). Epidemiology. Third edition. Philadelphia: Elsevier Saunders.</li> <li>Remington PL, Brownson RC, and Wegner MV. (2010). Chronic Disease Epidemiology and Control. American Public Health Association. </li> <li>Pagano M and Gauvreau K. (2000). Principles of Biostatistics. Belmont, CA: Wadsworth.</li> <li>Turnock B. (2011). Public health. Jones &amp; Bartlett Publishers.</li> <li>Edberg M. (2013). Essentials of Health Behavior. Social and Behavioral Theory in Public Health. Second Edition, Jones and Bartlett Publishers.</li> <li>Griffith JR and White KR. (2010). The Well-Managed Healthcare Organization. Health Administration Press: Chicago, IL. Kovner AR, McAlearney AS, Neuhauser D. (2013). Health Services Management: Cases, Readings, and Commentary. 10th Ed. Chicago, IL: Health Administration Press. Lee LM. (2010). Principles and Practice of Public Health. Surveillance. Oxford University Press Turnock B. (2011). Essentials of Public Health. Jones &amp; Bartlett Publishers 10. Merson M, Black RE, Mills A. (2006). International Public Health: Diseases, Programs, Systems and Policies. Jones &amp; Bartlett Learning. 11. Aschengrau A and Seage GR. (2008). Essentials of Epidemiology in Public Health. Boston, Massachusetts. 12. Hahn RA and Inhorn MC. (2009). Anthropology and Public Health. 2nd Ed. New York: Oxford University Press. </li> </ol></li></ul>

#### **SEMESTER-IV**

#### ANTSSEC02M: TOURISM ANTHROPOLOGY

TheoryCredit: 2Unit I: Concept of Tourism Anthropology - aspects and prospects, anthropological issuesand theoretical concerns, tourist as ethnographer; pilgrimage and Authenticity IssuesUnit II: Past and present of tourism anthropology, Interconnections between tourism historyand the rise of the socio-cultural study of tourism including temporary migration, colonialexploration, pilgrimage, visiting relatives, imagined and remembered journeys and tourismUnit III: Implications of tourism as a major mechanism of cross-cultural interaction; tourismand the commodification of culture, culture change, Globalization, Tourism and TerrorismUnit IV: New Directions in the Anthropology of Tourism: applied aspects of anthropology intourism development and planning, Ecotourism and sustainable development, role ofmuseums and other branches of the cultural industries (including music, art, and food) intourism economies.

#### **Suggested Readings:**

1. Chambers E. (2000). Native Tours: The Anthropology of Travel and Tourism. Prospect Heights: Waveland. 2. Crick M. (1995). The Anthropologist as Tourist: An Identity in Question. In Lanfant MF, Allcock JB, Bruner EM (eds.)International Tourism: Identity and Change. London: Sage. pp. 205-223.

3. Dann GMS, Nash D and Pearce PL. (1988). Methodology in Tourism Research. Annals of Tourism Research. 15:1-28.

4. Gmelch SB. (2004). Tourists and Tourism: A Reader. Long Grove: Waveland.

5. Graburn NHH. (1977). Tourism: The Sacred Journey. Hosts and Guests: The Anthropology of Tourism.

Valene L. Smith, ed. Philadelphia: University of Pennsylvania Press. Pp. 33-47.

6. Dann G. (2002). The Tourist as a Metaphor of the Social World. Wallingford: CAB International.

7. Nash D. (1996). Anthropology of Tourism. New York: Pergamon. 8. Kirshenblatt-Gimblett B.(1998).

Destination Culture: Tourism, Museums, and Heritage. University of California Press.

9. Lippard LR. (1999). On the Beaten Track: Tourism, Art and Place. New Press.

10. Picard M and Wood R. (1997). Tourism, Ethnicity, and the State in Asian and Pacific Societies.University of Hawai Press.

11. Crick M. (1994). Anthropology and the Study of Tourism: Theoretical and Personal Reflections. In Crick M (eds.). Resplendent Sites, Discordant Voices: Sri Lankans and International Tourism. Chur, Switzerland: Harwood Publishers.

12. Wood R. (1997). Tourism and the State: Ethnic Options and the Construction of Otherness. In Picard and Wood Tourism, Ethnicity and the State in Asian and Pacific Societies. University of Hawai Press.

13. Richard B. (1992). Alternative Tourism: The Thin Edge of the Wedge. In Valene Smith and Eadington Tourism (eds.). Alternatives: Potentials and Problems in the Development of Tourism. University of PennsylvaniaPress.

14. Hitchcock. (1997). Cultural, Economic and Environmental Impacts of Tourism among the Kalahari. In Chambers E (eds.) Tourism and Culture: An Applied Perspective. SUNY Press.

# BACHELOR OF SCIENCE (B.Sc.) GENERAL COURSE

(with effect from 2018-2019 academic session)

First Semester					
Course Code	Course Title	Course Type		Credit	
ANTGCOR01T	Introduction to Anthropology	Core-1	Theory	4	
ANTGCOR01P	Introduction to Anthropology	Core-1	Practical	2	
	Discipline B	Core-1 (Discipline B)	Theory +Practical	6	
	Discipline C	Core-1 (Discipline C)	Theory +Practical	6	
ENVSSEC01M	Environmental Science	AECC-1	Theory	2	
			Total	20	

## **Second Semester**

Course Code	Course Title	Course T	Credit	
ANTGCOR02T	Fundamentals of Anthropology	Core-2	Theory	4
ANTGCOR02P	Fundamentals of Anthropology	Core-2	Practical	2
	Discipline B	Core-2 (Discipline B)	Theory +Practical	6
	Discipline C	Core-2 (Discipline C)	Theory +Practical	6
ENGSSEC01M	English	AECC-2	Theory	2
Total				20

# **Third Semester**

Course Code	Course Title	Course T	Credit	
ANTGCOR03T	Applications of Anthropology	Core-3	Theory	4
ANTGCOR03P	Applications of Anthropology	Core-3	Practical	2
	Discipline B	Core-3 (Discipline B)	Theory +Practical	6
	Discipline C	Core-3 (Discipline C)	Theory +Practical	6
ANTSSEC01M	Public Health and Epidemiology	SEC-1 * (Discipline A)	Theory	2
			Total	20
* Or you can choose SEC from Discipline B or C				

## **Fourth Semester**

Course Code	Course Title	Course T	Credit	
ANTGCOR04T	Research Methods	Core-4	Theory	4
ANTGCOR04P	Research Methods	Core-4	Practical	2
	Discipline B	CC-4 (Discipline B)	Theory +Practical	6
	Discipline C	CC-4 (Discipline C)	Theory +Practical	6
ANTSSEC02M	Tourism Anthropology	SEC-2 * (Discipline A)	Theory	2
Total			20	

\* Or you can choose SEC from Discipline B or C

Fifth Semester				
Course Code	Course Title	Course Type		Credit
ANTGDSE01T	Fundamentals of Human Origin and Evolution		Theory	4
ANTGDSE01P	Fundamentals of Human Origin and Evolution	DSE-1 (Discipline A)	Practical	2
ANTGDSE02T	Theories of Social-Cultural Anthropology	#	Theory	4
ANTGDSE02P	Theories of Social-Cultural Anthropology		Practical	2
	One from pool of Discipline Specific Electives of Discipline B	DSE-1 (Discipline B)	Theory +Practical	6
	One from pool of Discipline Specific Electives of Discipline C	DSE-1 (Discipline C)	Theory +Practical	6
ANTSSEC01M	Public Health and Epidemiology	SEC-3 * (Discipline A)	Theory	2
			Total	20

# Choose any one (theory, practical combined) from two options- ANTGDSE01T, ANTGDSE01P/ ANTGDSE02T, ANTGDSE02P

\* Or you can choose SEC from Discipline B or C; You can choose ANTSSEC01M if not selected at 3<sup>rd</sup> semester

Sixth Semester				
Course Code	Course Title	Course Type		Credit
ANTGDSE03T	Human Growth and Development		Theory	4
ANTGDSE03P	Human Growth and Development	DSE-2 #	Practical	2
ANTGDSE04T	Anthropology of India	(Discipline A)	Theory	4
ANTGDSE04P	Anthropology of India		Practical	2
	One from pool of Discipline Specific Electives of Discipline B	DSE-2 (Discipline B)	Theory + Practical	6
	One from pool of Discipline Specific Electives of Discipline C	DSE-2 (Discipline C)	Theory + Practical	6
ANTSSEC02M	Tourism Anthropology	SEC-4 * (Discipline A)	Theory	2
			Total	20

# Choose any one (theory, practical combined) from two options- ANTGDSE03T, ANTGDSE03P/ ANTGDSE04T, ANTGDSE04P

\* Or you can choose SEC from Discipline B or C; You can choose ANTSSEC02M if not selected at 4<sup>th</sup> semester

#### Semester – I

# ANTGCOR01T: INTRODUCTION TO ANTHROPOLOGY Theory:

#### Credit – 4

Unit – I: Introducing Anthropology: Definitions, aims and scope & branches. The Anthropological Perspective: Holism, Comparative Theme, Relativism, Fieldwork & Participant Observation.

Unit – II: Archaeological Anthropology: Definitions, Aims & Scope, sub-fields: Environmental archaeology, experimental archaeology, ethno-archaeology, Geoarchaeology, Conjunctive approach.

Unit - III: Biological Anthropology: Definitions, Subject matter, Aims & Scope, subfields: Palaeoanthropology, Primatology, Human Genetics, Adaptation & Variations, Human Growth, Forensic Anthropology

Unit – VI: Social Cultural Anthropology: Definitions, Subject matter, Aim & Scope, Ethnography & Ethnology, Relationship with economics, political science, sociology, history.

#### ANTGCOR01P: INTRODUCTION TO ANTHROPOLOGY

#### Practical:

#### Credit – 2

#### Archaeological Anthropology:

Basic ideas about identification of stone tools (diifferences between naturally flaked objects and stone tools on the basis of location, direction and number of flake scars, shape); core and flake tools (identification of cortex, flake scar, ripple mark, striking platform, point of impact, positive and negative bulb of percussion, drawing of linear diagram).

#### **Biological Anthropology:**

#### Anthroposcopy:

Assessment of Skin Colour: exposed (forehead) and unexposed (inner surface of the upper arm). Head Hair: form, texture, whorl (number and type).

Nose: depression of the nasal root, height of the nasal bridge, nasal profile, tip of the nose, inclination of the nasal septum, nasal wings.

Ear: Lobe attachment, hypertrichosis of Ear.

#### Social-Cultural Anthropology:

#### Project work:

Preparation of a generalised census schedule and applying it on at least 10 families in any nearby locality (family composition, SES: occupation and education); A comprehensive brief report on this study to be prepared by the student and submit.

#### SEMESTER – II

#### ANTGCOR02T: FUNDAMENTALS OF ANTHROPOLOGY Theory: Credit – 4

Archaeological Anthropology: Prehistory - Definition, aims, scope, concept of periodization, concept of culture in prehistory: definition of tool, artifact, industry, assemblage; A brief introduction to different cultural stages in pre-history and proto-history, tool technology and typology.

Biological Anthropology: Human morphology, External morphological features with evolutionary significance. Skeleton morphology: Definition and functions of human skeleton, names and anatomical position of human bones; modification of human skeleton due to assumption of erect posture, human dentition: different types of teeth, their basic structure and functions, dental formula.

Social Cultural Anthropology: Social Unit and Institution: Basic concept- Family, marriage, kinship, clan, *Gotra*, Phratry, moiety, lineage, community, group, tribe, caste, society and culture, social organization and social structure, civilization.

#### ANTGCOR02P: FUNDAMENTALS OF ANTHROPOLOGY

#### Practical

#### Credit – 2

**Archaeological Anthropology**: Procedure of drawing tools, drawing and labelling of typo-technological features, cultural age, probable use and method of hafting of tools (Core tools: Hand axe, cleaver and chopper) (Flake tools: Scraper, point, blade) (Bone tools: Harpoons, Baton, spear thrower) (Microliths: Bladelet, fluted core, lunate) (Polished tools: celt, ring stone)

N.B. In absence of original specimen cast, photograph may be used with references.

**Biological Anthropology**: Human Anatomy - Identification of human skull. Identification of human skull bones: frontal, parietal, temporal, occipital, zygomatic, maxilla, mandible, sphenoid. Identification of Human post-cranial bones: Scapula, Clavicle, Humerus, Radius, Ulna, Pelvis, Femur, Tibia, Fibula (anatomical position and side determination, where applicable) Skull and pelvic girdle should be studied in the perspective of sex differences. Identification of Human permanent teeth.

**Social Cultural Anthropology**: Learning the technique and collection of genealogical data, preparation of a typical genealogical diagram and table (including analysis: occupational and educational status) of one's own family (at least three generations). A report to be prepared and submitted.

# ANTGCOR03T: Applications of Anthropology Theory

**Archaeological anthropology**: Brief idea about cultural resource management, concept of heritage (tangible and intangible), Museums: types and objectives, preservation of cultural heritage of India: different extant organisations operating in India, specific laws and regulations for cultural heritage preservation in India.

**Biological anthropology**: Application of concepts and methods of biological anthropology in human growth and nutrition, health, forensic anthropology, genetic counselling, population biology and population genetics.

**Social-cultural anthropology**: Applied, Action and Development Anthropology: definition, meaning, distinct features and historical development. Problems related to land, forest, occupation, education and health of the indigenous communities in India; constitutional safeguards for SC, ST and OBC.

ANTGCOR03P: Applications of Anthropology Practical

Credit- 2

Anthropometry: (minimum 10 subjects)

- a) On head and face:
  - i) Maximum head length
  - ii) Maximum head breadth
  - iii) Least frontal breadth
  - iv) Maximum Bizygomatic breadth
  - v) Bigonial breadth
  - vi) Nasal length
  - vii) Nasal breadth
  - viii) Nasal depth
  - ix) Morphological facial height

b) On trunk and limbs

- i) Height vertex;
- ii) Sitting height vertex;
- iii) Hand length;
- iv) Hand breadth;
- v) Foot length;
- vi) Foot breadth;
- vii) Body weight

<u>c) Indices:</u>

- i) Cephalic index
- ii) Nasal index
- iii) Morphological facial index
- iv) Jugo-frontal index

Credit 4

# ANTGCOR04T: RESEARCH METHODS Theory

Credit- 4

Research Design (Introduction)

- 4. Sampling, tools and techniques of data collection, data analysis and reporting, guiding ideals and critical evaluation of major approaches in research methods,
- 5. Basic tenets of qualitative research and quantitative research and their relationship

Observation - Direct, Indirect, Participant, Non-participant, Controlled Interview - Structured and unstructured, Focused Group Discussion, key informant interview

Case Study and life history

Genealogy and its application

Statistics for Anthropology

- 1. Types of variables, presentation and summarization of data (tabulation and illustration)
- 2. Descriptive statistics- Measurers of Central Tendency, Measure of Variation, Skewness and Kurtosis, Variance and standard deviation, Normal and binomial distribution

#### ANTGCOR04P: RESEARCH METHODS

#### Practical

#### Credit- 2

Fieldwork (Duration: 5-6 days, excluding journey period)

Each student should undertake compulsory field training on any community in any village or locality (tribal or multi caste village).

Before proceeding to field work, at-least 10 class hours should be arranged for theoretical preparation and methodological issues on fieldwork.

#### Focal theme of Field work:

a) Importance of Fieldwork in Anthropology.

b) Method / Techniques of fieldwork.

c) General features of the Village / Area (including Layout).

d) Household survey of the village/ hamlet/ locality/ community seeking primary information on age-sex, education, occupation (primary & secondary), marital status, family size & Type. (with descriptive statistical representation)

e) Economic pursuit: General description of the economic pursuits along with One case study on the economy practiced by the studied community (Agriculture, Fishing. Handicraft etc).

f) Outline of social cultural life of the village community.

g) Development & Welfare programmes & its impact on the community studied.

Note: for all three branches of practical papers, laboratory note book/report duly signed and forwarded by the teacher(s)/HOD should be submitted during practical examination for evaluation.

#### Semester – V Department Specific Elective Courses (DSE)

ANTGDSE01T: **FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION** (Fossil and Culture)

#### Theory

Credit- 4

#### Unit-I:

Oligocene Anthropoids: Parapithecus, Aegyptopithecus;

Miocene apes: Dryopithecus, Sivapithecus;

Primate origins and radiation with special reference to Miocene hominoids: Ramapithecus, distribution, features and their phylogenetic relationships.

#### Unit-II:

1. Hominization process, Bio-cultural evolution of Man, Human's capacity for culture; expansion of the brain, reduction of the face, teeth and jaws;

2. Australopithecines: distribution and types, features and their phylogenetic relationships.

3. Appearance of genus Homo (Homo habilis) and related findings.

#### Unit-III:

Homo erectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status.

#### Unit-IV:

The origin of Homo sapiens: Fossil evidences of Neanderthals: Classic Neandertals (La-Chapelle-Aux– saints), Progressive Neandertals (Tabun); Archaic Homo sapiens sapiens

#### Unit-V:

Origin of modern humans (Homo sapiens sapiens): Cro-Magnon, Grimaldi, Chancelade : Distribution and features and their phylogenetic status.

#### ANTGDSE01P: FUNDAMENTALS OF HUMAN ORIGIN AND EVOLUTION

#### Practical

#### UNIT I. Living anthropoid skull

Identification of anthropoid skulls (Gorilla, Chimpanzee, Orang utan and Gibbon). In the absence of original specimen or cast models, appropriate photographs may be utilized in the laboratory.

#### UNIT II. Fossil anthropoid skull

i. Identification of fossil apes (Parapithecus mandible, Dryopithecus mandibular fragment,).

Cast models or appropriate photographs may be utilized.

ii. Identification of protohominid --- Australopithecus africanus.

#### UNIT III. Palaeoanthropology

Drawing and identification characteristics of fossil hominids. One typical specimen of H. habilis, H. erectus (Java and Peking man), Neanderthal (La-Chapple-aux-saints), H. sapiens (Cro Magnon) (Appropriate photographs may be utilised).

#### **Suggested Readings**

1. Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley & Sons, Inc., New York, London, Sydney.

2. Conroy, G.C. (1997). Reconstructing Human Origins: A Modern Synthesis. W. W.

Norton & Company, New York, London.

3. Howell F.C. (1977). *Horizons of Anthropology*. Eds. S. Tax and L.G. Freeman, Aldine Publishing House, Chicago.

4. Nystrom P. and Ashmore P. (2011). *The Life of Primates*. PHI Learning Private Limited, New Delhi.5. Seth P. K. and Seth S. (1986). *The Primates*. Northern Book Centre, New Delhi,

Allahabad.

6. Singh I. P. and Bhasin M.K. (1989). *Anthropometry: A Laboratory Manual on Biological Anthropology*. Kamla-Raj Enterprises, Chawri Bazar, Delhi.

7. Standford C.; Allen J.S. and Anton S.C. (2012). *Biological Anthropology: The Natural History of Mankind*. PHI Learning Private Limited, New Delhi.

8. Swindler D. R. (2009). Introduction to the Primates. Overseas Press India Pvt. Ltd., New Delhi.

#### ANTGDSE02T: Theories of Social Cultural Anthropology Theory

#### Credit- 4

Importance of studying theory in Social Sciences at large and Social-Cultural Anthropology in particular, Broader explaining parameters: Subject/Object, Ideology/Materialism, Structure/Agency.

Evolutionism: E.B. Tylor and L.H. Morgan

Cultural Relativism as a reaction to nineteenth century evolutionism – Franz Boas

Cultural ecology: J. Steward.

**Structural Approaches:** Functionalism – B. Malinowski; Structural Functionalism: A. R. Radcliffe-Brown.

#### Practical

#### Credit- 2

- 1. Students will be asked to explain any ritual/practice/everyday event they see in their community from the lens of any one or more theories they have studied.
  - a. A report of 1000 words
  - b. A presentation.

#### Suggested Readings:

- 1. Gaillard, Gérald. 1997. The Routledge Dictionary of Anthropologists. London: Routledge
- 2. Barnard, Alan. 2000. History and Theory in Anthropology. Cambridge: Cambridge University Press.
- 3. Barnard, Alan. & Jonathan Spencers . 2002. The Encyclopedia of Social and Cultural Anthropology. London: Routledge
- 4. Rapport, Nigel and Joanna Overing. 2000. Social and Cultural Anthropology: The Key Concepts. London: Routledge.
- 5. Gordon, Robert. Andrew P. Lyons and Harriet D. Lyons.2015. Fifty Key Anthropologists. London: Routledge
- 6. https://anthropology.ua.edu/cultures/search.htm
- 7. <u>https://decolonizeallthethings.com/2017/01/31/summary-of-classical-sociological-theory/</u>
- 8. <u>http://uregina.ca/~gingrich/o28f99.htm</u>
- 9. http://faculty.olympic.edu/cbarker/deadsociologistsociety.htm

#### Semester – VI

#### ANTGDSE03T: HUMAN GROWTH AND DEVELOPMENT

#### Theory

#### Credit- 4

**Unit I:** Concept of human growth, development and maturation. Bio-cultural understanding of human growth.

Unit II: Methods of studying human growth and development: cross sectional, longitudinal

Unit III: Stages of growth: Prenatal and Post natal period of growth.

Unit IV: growth curves: distance, velocity, Catch -up growth, growth spurt.

**Unit V:** Community Nutrition and Nutritional Anthropometry (Nutritional status: over and under nutrition), Kwashiorkor, Marasmus.

Unit VI: Somatotyping and human physique (Sheldon) and body composition- models.

#### ANTGDSE03P HUMAN GROWTH AND DEVELOPMENT

#### Practical

#### Credit- 2

Growth status: Anthropometry (at least 5 subjects)

1. **Linear measurements:** maximum head length, maximum head breadth, least frontal diameter, bizygomatic diameter, morphological facial height, morphological superior facial height, nasal length, nasal breadth, nasal depth, height vertex, bi- acromial diameter, hand length, hand breadth, foot length, foot breadth, body weight.

2. Circumference: head circumference, MUAC, calf circumference.

3. **Indices** (classification where applicable): cephalic index, morphological facial index, morphological upper facial index, nasal index, jugo- frontal index, BMI.

#### ANTGDSE04T: Anthropology of India

#### Theory

#### Credit - 4

Unit - I:

1. Indian Anthropology: Origin, History, Growth and Development of Anthropology (Mentioning Phases or Stages)

2. Major Contributions of some Indian Anthropologists - S.C.Roy, I.Karve, D.N.Majumdar,

N.K.Bose, M.N.Srinivas, L.P.Vidhyarthi, T.C.Das, P.K.Bhowmick, B.S.Guha and S.S.Sarkar

3. Racial and Linguistic elements in Indian population.

Unit - II:

1. Village Studies in India: Concepts, features and types of village, significance of Village studies.

3. Social Change: Concept, factor and reasons for social change, Concepts related to social change in India.

4. Basic Concepts: Great Tradition and Little Tradition, Universalization and Parochialization, Sanskritization and Westernization, Dominant Caste, Tribe-Catse Continuum, Urbanisation and Industrialiation. Culture-contact (Acculturation).

Unit - III:

1. Tribal Displacements and Rehabilitation Problem, Role of Anthropologists in Tribal welfare. Unit - IV:

1. Constitutional definition of Scheduled Caste and Scheduled Tribe and other Backward Classes and some provisions mentioned in 5th and 6th Schedule.

2. Safeguards for the Scheduled Castes and Scheduled Tribes.

3. Problems of exploitation and deprivation of Scheduled caste and Scheduled Tribe and other Backward Classes.

#### ANTGDSE04P: Anthropology of India

#### Practical

#### Credit- 2

#### 1. Book Review:

Students should read a basic Anthropological Book/Monograph on Indian Society thoroughly and learn the skill of reviewing a book. They should submit a hard copy of the review, with full Reference, duly signed by the concerned teachers (within 500 words).

#### 2. Project Report:

The evaluation of project report should be considered on the following aspects -

Highlight the contribution of any two contemporary Indian Anthropologists.

Suggested Reading:

1. Dube, S.C. (1992).Indian Society, National Book Trust, India: New Delhi.

- 2. Dumont, L. (1980). Homo Hierarchicus, University of Chicagon Press.
- 3. Bernard, C.S. (2000). India: The Social Anthropology of Civilization, Delhi: Oxford University Press.
- 4. Haddon, A.C. (1929). Races of Man, Cambridge University, London.

5. Upadhyay, V.S. and Pandey, G. (1997). History of Anthropological Thought, Concept Publishing Company, New Delhi.

6. Das, B.M. (2016). Outline of Physical Anthropology, Kitab Mahal, Allahabad.

7. Hasnain, N. (1992). General Anthropology, Jawahar Publishers and Distributors, New Delhi.

8. Gupta, D. Social Stratification, Delhi: Oxford University Press.

9. Karve, I. (1961). Hindu Society: An Interpretation.Poona:Deccan College.

10. Guha, B.S. (1931). The Racial Attributes of People of India, Vol. I, Part-III (BPO, Simla)

# **Skill Enhancement Courses (SEC)**

(To be chosen in 3 <sup>rd</sup> OR in 5 <sup>th</sup> Semester)
ANTSSEC01M: PUBLIC HEALTH AND EPIDEMIOLOGY
Theory Credit: 2
Unit I: Principles of Epidemiology in Public Health: Definitions and scopes of Public Health and
Epidemiology; Social-cultural determinants, policies, and practices associated with public health;
Cultural, social, behavioural, psychological and economic factors that influence health and illness
Unit II: Health and Culture: Bio-medical versus naturalistic approaches; limitations of modern
health promotion and health care delivery programmes: family planning, child health and nutrition,
immunization; Application of concepts of culture in epidemiology and public health, Cultural
epidemiology.
Unit III: Epidemiology of disease: understanding etiology of communicable and non-communicable
diseases: Malaria, STD, HIV/AIDS, Diabetes, Cancer, Cardiovascular diseases, Mental and emotional
disorders; determining change in trend over time: prevalence and incidence; implementation of
control measures;
<ul> <li>Suggested reading</li> <li>1. Gordis L. (2004). Epidemiology. Third edition. Philadelphia: Elsevier Saunders.</li> <li>2. Remington PL, Brownson RC, and Wegner MV. (2010). Chronic Disease Epidemiology and Control. American Public Health Association.</li> <li>3. Pagano M and Gauvreau K. (2000). Principles of Biostatistics. Belmont, CA: Wadsworth.</li> <li>4. Turnock B. (2011). Public health. Jones &amp; Bartlett Publishers.</li> <li>5. Edberg M. (2013). Essentials of Health Behavior. Social and Behavioral Theory in Public Health. Second</li> </ul>
<ul><li>6. Griffith JR and White KR. (2010). The Well-Managed Healthcare Organization. Health Administration Press: Chicago, IL.</li></ul>
7. Kovner AR, McAlearney AS, Neuhauser D. (2013). Health Services Management: Cases, Readings, and Commentary. 10th Ed. Chicago, IL: Health Administration Press.
8. Lee LM. (2010). Principles and Practice of Public Health Surveillance. Oxford University Press 9. Turnock B. (2011). Essentials of Public Health. Jones & Bartlett Publishers
10. Merson M, Black RE, Mills A. (2006). International Public Health: Diseases, Programs, Systems and Policies. Jones & Bartlett Learning.
11. Aschengrau A and Seage GR. (2008). Essentials of Epidemiology in Public Health. Boston, Massachusetts. 12. Hahn RA and Inhorn MC. (2009). Anthropology and Public Health. 2nd Ed. New York: Oxford University Press.

#### (To be chosen in 3<sup>rd</sup> OR in 5<sup>th</sup> Semester)

ANTSSEC02M: TOURISM ANTHROPOLOGY
Theory Credit: 2
Unit I: Concept of Tourism Anthropology - aspects and prospects, anthropological issues
and theoretical concerns, tourist as ethnographer; pilgrimage and Authenticity Issues
Unit II: Past and present of tourism anthropology, Interconnections between tourism history
and the rise of the socio-cultural study of tourism including temporary migration, colonial
exploration, pilgrimage, visiting relatives, imagined and remembered journeys and tourism
Unit III: Implications of tourism as a major mechanism of cross-cultural interaction; tourism
and the commodification of culture, culture change, Globalization, Tourism and Terrorism
Unit IV: New Directions in the Anthropology of Tourism: applied aspects of anthropology in
tourism development and planning, Ecotourism and sustainable development, role of
museums and other branches of the cultural industries (including music, art, and food) in
tourism economies.
Suggested Readings:
<ol> <li>Chambers E. (2000). Native Tours: The Anthropology of Travel and Tourism. Prospect Heights: Waveland.</li> <li>Crick M. (1995). The Anthropologist as Tourist: An Identity in Question. In Lanfant MF, Allcock JB, Bruner EM (eds.)International Tourism: Identity and Change. London: Sage. pp. 205-223.</li> </ol>
3. Dann GMS, Nash D and Pearce PL. (1988). Methodology in Tourism Research. Annals of Tourism Research. 15:1-28.
4. Gmelch SB. (2004). Tourists and Tourism: A Reader. Long Grove: Waveland.

5. Graburn NHH. (1977). Tourism: The Sacred Journey. Hosts and Guests: The Anthropology of Tourism.

Valene L. Smith, ed. Philadelphia: University of Pennsylvania Press. Pp. 33-47.

6. Dann G. (2002). The Tourist as a Metaphor of the Social World. Wallingford: CAB International.

7. Nash D. (1996). Anthropology of Tourism. New York: Pergamon. 8. Kirshenblatt-Gimblett B.(1998).

Destination Culture: Tourism, Museums, and Heritage. University of California Press.

9. Lippard LR. (1999). On the Beaten Track: Tourism, Art and Place. New Press.

10. Picard M and Wood R. (1997). Tourism, Ethnicity, and the State in Asian and Pacific Societies. University of Hawai Press.

11. Crick M. (1994). Anthropology and the Study of Tourism: Theoretical and Personal Reflections. In Crick M (eds.). Resplendent Sites, Discordant Voices: Sri Lankans and International Tourism. Chur, Switzerland: Harwood Publishers.

12. Wood R. (1997). Tourism and the State: Ethnic Options and the Construction of Otherness. In Picard and Wood Tourism, Ethnicity and the State in Asian and Pacific Societies. University of Hawai Press.

13. Richard B. (1992). Alternative Tourism: The Thin Edge of the Wedge. In Valene Smith and Eadington Tourism (eds.). Alternatives: Potentials and Problems in the Development of Tourism. University of PennsylvaniaPress.

14. Hitchcock. (1997). Cultural, Economic and Environmental Impacts of Tourism among the Kalahari. In Chambers E (eds.) Tourism and Culture: An Applied Perspective. SUNY Press.

# **GENERIC FOR OTHER HONOURS SUBJECT STUDENTS**

1ST SEMESTER-ANTHGEC01T & ANTHGEC01P: Introduction to Anthropology 2ND SEMESTER-ANTHGEC02T & ANTHGEC02P: Fundamentals of Anthropology 3RD SEMESTER-ANTHGEC03T & ANTHGEC03P: Applications of Anthropology 4TH SEMESTER-ANTHGEC04T & ANTHGEC04P: Research Methods Details of syllabus: Same as Core course of B.Sc. General Syllabus

# B.Sc. with Physics (Hons) & B.Sc. (General) with Physics

Choice Based Credit System Syllabus

First Draft (With updated paper codes)

1.	List of Papers from Physics	4
•	For B.Sc. Honours in Physics	4
	Core Papers	4
	Discipline Specific Elective Papers	5
•	For B.Sc. General with Physics	5
	Core Papers	5
	Discipline Specific Elective Papers	6
•	For B.Sc. Honours in Subjects Other than Physics	6
	Generic Elective Papers	6
•	Skill Enhancement Courses to be Offered from PHYSICS	6
2.	Scheme for CBCS Curriculum of B.Sc. in Physics (Honours)	7
•	Semester-wise Curriculum	7
3.	Syllabi of Core Papers for B.Sc. Honours in Physics	10
•	PHSACOR01T – Mathematical Physics-I	10
•	PHSACOR01P – Mathematical Physics -I Lab	12
•	PHSACOR02T – Mechanics	14
•	PHSACOR02P – Mechanics Lab	16
•	PHSACOR03T - Electricity and Magnetism	17
•	PHSACOR03P – Electricity and Magnetism Lab	19
•	PHSACOR04T - Waves and Optics	20
•	PHSACOR04P – Wave and Optics Lab	22
•	PHSACOR05T - Mathematical Physics-II	23
•	PHSACOR05P – Mathematical Physics II Lab	25
•	PHSACOR06T - Thermal Physics	27
•	PHSACOR06P – Thermal Physics Lab	29
•	PHSACOR07T - Digital Systems and Applications	
•	PHSACOR07P – Digital Systems and Applications Lab	32
•	PHSACOR08T - Mathematical Physics III	
•	PHSACOR08P – Mathematical Physics III Lab	
•	PHSACOR09T - Elements of Modern Physics	

	•	PHSACOR09P – Elements of Modern Physics Lab	40
	•	PHSACOR10T - Analog Systems and Applications	41
	•	PHSACOR10P – Analog Systems and Applications Lab	44
	•	PHSACOR11T - Quantum Mechanics and Applications	46
	•	PHSACOR11P – Quantum Mechanics and Applications Lab	49
	•	PHSACOR12T - Solid State Physics	51
	•	PHSACOR12P – Solid State Physics Lab	53
	•	PHSACOR13T - Electromagnetic Theory	54
	•	PHSACOR13P – Electromagnetic Theory Lab	56
	•	PHSACOR14T – Statistical Mechanics	57
	•	PHSACOR14P – Statistical Mechanics Lab	59
4.	S	yllabi of Department Specific Elective Papers for B.Sc. Honours in Physics	61
	•	PHSADSE01T - Advanced Mathematical Physics I	61
	•	PHSADSE01P – Advanced Mathematical Physics I Lab	63
	•	PHSADSE02T – Advanced Dynamics	64
	•	PHSADSE03T - Nuclear and Particle Physics	66
	•	PHSADSE04T - Advanced Mathematical Physics II	68
	•	PHSADSE05T - Astronomy and Astrophysics	70
	•	PHSADSE06T - Communication Electronics	72
	•	PHSADSE06P – Communication Electronics Lab	74
4	S	cheme for CBCS Curriculum B.Sc. (General) Program with Physics as one of the disciplines	75
	•	Scheme for CBCS Curriculum	75
5.	S	yllabi of Core Papers (from Physics) for B.Sc. General with Physics	77
	•	PHSGCOR01T - Mechanics	77
	•	PHSGCOR01P – Mechanics Lab	79
	•	PHSGCOR02T - Electricity and Magnetism	80
	•	PHSGCOR02P – Electricity and Magnetism Lab	82
	•	PHSGCOR03T - Thermal Physics and Statistical Mechanics	83
	•	PHSGCOR03P – Thermal Physics and Statistical Lab	85
	•	PHSGCOR04T - Waves and Optics	86

٠	PHSGCOR04P – Waves and Optics Lab
6.	Syllabi of Department Specific Electives Papers (from Physics) for B.Sc. General with Physics
•	PHSGDSE01T - Digital, Analog Circuits and Instrumentation
•	PHSGDSE01P – Digital, Analog Circuits and Instrumentation Lab91
•	PHSGDSE02T - Perspectives of Modern Physics
•	PHSGDSE03T – Solid State Physics
•	PHSGDSE03P – Solid State Physics Lab96
•	PHSGDSE04T - Nuclear and Particle Physics97
7	Syllabi of Generic Elective Papers (from Physics) for B.Sc. Honours in Subjects Other than Physics99
8	Skill Enhancement Courses
•	PHSSSEC01M - Basic Instrumentation Skills100
•	PHSSSEC02M - Computational Physics Skills103

# **1. List of Papers from Physics**

# • For B.Sc. Honours in Physics

#### **Core Papers**

Semester	Paper Code	Paper Name	Credit		Remarks
	PHSACOR01T	Mathematical Physics - I	4	6	
I	PHSACOR01P	Mathematical Physics - I Lab	2		Compulsory
	PHSACOR02T	Mechanics	4	6	j
	PHSACOR02P	Mechanics Lab	2		
	PHSACOR03T	Electricity and Magnetism	4	6	
II	PHSACOR03P	Electricity and Magnetism Lab	2		Compulsory
	PHSACOR04T	Waves and Optics	4	6	I I I I J
	PHSACOR04P	Waves and Optics Lab	2		
	PHSACOR05T	Mathematical Physics - II	4	6	
	PHSACOR05P	Mathematical Physics – II Lab	2		
III	PHSACOR06T	Thermal Physics	4	6	Compulsory
	PHSACOR06P	Thermal Physics Lab	2		
	PHSACOR07T	Digital Systems and Applications	4	6	
	PHSACOR07P	Digital Systems and Applications Lab	2		
	PHSACOR08T	Mathematical Physics - III	4	6	
	PHSACOR08P	Mathematical Physics – III Lab	2		Compulsory
IV	PHSACOR09T	Elements of Modern Physics	4	6	
	PHSACOR09P	Elements of Modern Physics Lab	2		I I I I J
	PHSACOR10T	Analog Systems and Applications	4	6	
	PHSACOR10P	Analog Systems and Applications Lab	2		
	PHSACOR11T	Quantum Mechanics and Applications	4	6	
v	PHSACOR11P	Quantum Mechanics and Applications Lab	2		Compulsory
	PHSACOR12T	Solid State Physics	4	6	i i i j
	PHSACOR12P	Solid State Physics Lab	2		
	PHSACOR13T	Electromagnetic Theory	4	6	
VI	PHSACOR13P	Electromagnetic Theory Lab	2		Compulsory Compulsory Compulsory Compulsory Compulsory
	PHSACOR14T	Statistical Mechanics	4	6	
	PHSACOR14P	Statistical Mechanics Lab	2		

Semester	Paper Code	Paper Name	Credit		Remarks
	PHSADSE01T	Advanced Mathematical Physics - I	4	6	Student has
	PHSADSE01P	Advanced Mathematical Physics – I Lab	2		to choose 2 among
V	PHSADSE02T	Advanced Dynamics	5+ 1*	6	these 3 courses of six credit
	PHSADSE03T	Nuclear and Particle Physics	5+ 1*	6	each
	PHSADSE04T	Advanced Mathematical Physics - II	5+ 1*	6	Student has to choose 2 among
VI	PHSADSE05T	Astronomy and Astrophysics	5+ 1*	6	these 3 courses of six credit
	PHSADSE06T	Communication Electronics	4	6	each
	PHSADSE06P	Communication Electronics Lab	2		

### **Discipline Specific Elective Papers**

\* Tutorials of 1 Credit will be conducted in case there is no practical component

#### • For B.Sc. General with Physics

#### **Core Papers**

Semester	Paper Code	Paper Name	Credit		Remarks
Ι	PHSGCOR01T	Mechanics	4	6	Compulsory
	PHSGCOR01P	Mechanics Lab	2		
II	PHSGCOR02T	Electricity and Magnetism	4	6	Compulsory
	PHSGCOR02P	Electricity and Magnetism Lab	2		I I I I J
III	PHSGCOR03T	Thermal Physics and Statistical Mechanics	4	6	Compulsory
	PHSGCOR03P	Thermal Physics and Statistical Mechanics Lab	2		y
IV	PHSGCOR04T	Waves and Optics	4	6	Compulsory
·	PHSGCOR04P	Waves and Optics Lab	2	-	r wisory

	Discipline	Specific	Elective	Papers
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Semeste	Paper Code	Paper Name	Credit		Remarks
	PHSGDSE01T	Digital, Analog Circuits and Instrumentation	4	6	Student has
v	PHSGDSE01P	Digital, Analog Circuits and Instrumentation Lab	2	U	between
	PHSGDSE02T	Perspectives of Modern Physics	5+ 1*	6	these 2 courses of six credit each
	PHSGDSE03T	Solid State Physics	4	6	Student has
VI	PHSGDSE03P	Solid State Physics Lab	2		between
	PHSGDSE04T	Nuclear and Particle Physics	5+ 1*	6	these 2 courses of six credit each

### • For B.Sc. Honours in Subjects Other than Physics

#### **Generic Elective Papers**

Semester	Paper Code	Paper Name	Credit		Remarks
Ι	PHSHGEC01T	Mechanics	4	6	Elective
	PHSHGEC01P	Mechanics Lab	2		
II	PHSHGEC02T	Electricity and Magnetism	4	6	Elective
	PHSHGEC02P	Electricity and Magnetism Lab	2	_	
III	PHSHGEC03T	Thermal Physics and Statistical Mechanics	4	6	Elective
	PHSHGEC03P	Thermal Physics and Statistical Mechanics Lab	2		
IV	PHSHGEC04T	Waves and Optics	4	6	Elective
	PHSHGEC04P	Waves and Optics Lab	2		

#### • Skill Enhancement Courses to be Offered from PHYSICS

Semester	Paper Code	Paper Name	Credit	Remarks
Odd	PHSSSEC01M	Basic Instrumentation Skills	2	Elective
Even	PHSSSEC02M	Computational Physics Skills	2	Elective

# 2. Scheme for CBCS Curriculum of B.Sc. in Physics (Honours)

#### • Semester-wise Curriculum

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course – I	English communication / Environmental Science	2
	Core course – I PHSACOR01T	Mathematical Physics-I	4
	Core course – I Practical <b>PHSACOR01P</b>	Mathematical Physics-I Lab	2
	Core course – II PHSACOR02T	Mechanics	4
	Core course – II Practical <b>PHSACOR02P</b>	Mechanics Lab	2
	Genetic Elective – 1 TBD		4
	Generic Elective – 1 Practical	TBD	2
п	Ability Enhancement Compulsory Course – II	English communication / Environmental Science	2
	Core course – III PHSACOR03T	Electricity and Magnetism	4
	Core course – III Practical PHSACOR03P	Electricity and Magnetism Lab	2
	Core course – IV PHSACOR04T	Waves and Optics	4
	Core course – IV Practical <b>PHSACOR04P</b>	Waves and Optics Lab	2
	Generic Elective – 2	TBD	4
	Generic Elective – 2 Practical	TBD	2

ш	Core course – V PHSACOR05T	Mathematical Physics-II	4
	Core course – V Practical <b>PHSACOR05P</b>	Mathematical Physics-II Lab	2
	Core course – VI PHSACOR06T	Thermal Physics	4
	Core course – VI Practical <b>PHSACOR06P</b>	Thermal Physics Lab	2
	Core course – VII PHSACOR07T	Digital Systems and Applications	4
	Core course – VII Practical <b>PHSACOR07P</b>	Digital Systems & Applications Lab	2
	Skill Enhancement Course – 1	TBD	2
	Generic Elective – 3	TBD	4
	Generic Elective – 3 Practical	TBD	2
IV	Core course – VIII PHSACOR08T	Mathematical Physics III	4
IV	Core course – VIII PHSACOR08T Core course – VIII Practical PHSACOR08P	Mathematical Physics III Mathematical Physics-III Lab	4
IV	Core course – VIII PHSACOR08T Core course – VIII Practical PHSACOR08P Core course – IX PHSACOR09T	Mathematical Physics III Mathematical Physics-III Lab Elements of Modern Physics	4 2 4
IV	Core course – VIII PHSACOR08T Core course – VIII Practical PHSACOR08P Core course – IX PHSACOR09T Core course – IX Practical PHSACOR09P	Mathematical Physics III         Mathematical Physics-III Lab         Elements of Modern Physics         Elements of Modern Physics Lab	4 2 4 2
IV	Core course – VIII PHSACOR08T Core course – VIII Practical PHSACOR08P Core course – IX PHSACOR09T Core course – IX Practical PHSACOR09P Core course – X PHSACOR10T	Mathematical Physics IIIMathematical Physics-III LabElements of Modern PhysicsElements of Modern Physics LabAnalog Systems and Applications	4 2 4 2 4
IV	Core course - VIII PHSACOR08T Core course - VIII Practical PHSACOR08P Core course - IX PHSACOR09T Core course - IX Practical PHSACOR09P Core course - X PHSACOR10T Core course - X Practical PHSACOR10P	Mathematical Physics IIIMathematical Physics-III LabElements of Modern PhysicsElements of Modern Physics LabAnalog Systems and ApplicationsAnalog Systems & Applications Lab	4 2 4 2 4 2 2
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IV	Core course - VIII PHSACOR08T Core course - VIII Practical PHSACOR08P Core course - IX PHSACOR09T Core course - IX Practical PHSACOR09P Core course - X PHSACOR10T Core course - X Practical PHSACOR10T Skill Enhancement Course-2 Generic Elective - 4	Mathematical Physics IIIMathematical Physics-III LabElements of Modern PhysicsElements of Modern Physics LabAnalog Systems and ApplicationsAnalog Systems & Applications LabTBDTBD	4 2 4 2 4 2 2 2 2 4

V	Core course – XI PHSACOR11T	Quantum Mechanics & Applications	4
	Core course – XI Practical <b>PHSACOR11P</b>	Quantum Mechanics Lab	2
	Core course – XII PHSACOR12T	Solid State Physics	4
	Core course – XII Practical <b>PHSACOR12P</b>	Solid State Physics Lab	2
	Discipline Specific Elective – 1	TBD	4
	Discipline Specific Elective – 1 Practical	TBD	2
	Discipline Specific Elective – 2	TBD	4
	Discipline Specific Elective – 2 Practical	TBD	2
VI	Core course – XIII PHSACOR13T	Electro-magnetic Theory	4
VI	Core course – XIII PHSACOR13T Core course – XIII Practical PHSACOR13P	Electro-magnetic Theory Electro-magnetic Theory Lab	4
VI	Core course – XIII PHSACOR13T Core course – XIII Practical PHSACOR13P Core course – XIV PHSACOR14T	Electro-magnetic Theory Electro-magnetic Theory Lab Statistical Mechanics	4 2 4
VI	Core course – XIII PHSACOR13T Core course – XIII Practical PHSACOR13P Core course – XIV PHSACOR14T Core course – XIV Practical PHSACOR14P	Electro-magnetic Theory Electro-magnetic Theory Lab Statistical Mechanics Statistical Mechanics Lab	4 2 4 2
VI	Core course – XIII PHSACOR13T Core course – XIII Practical PHSACOR13P Core course – XIV PHSACOR14T Core course – XIV Practical PHSACOR14P Discipline Specific Elective – 3	Electro-magnetic Theory Electro-magnetic Theory Lab Statistical Mechanics Statistical Mechanics Lab TBD	4 2 4 2 4
VI	Core course – XIII PHSACOR13T Core course – XIII Practical PHSACOR13P Core course – XIV PHSACOR14T Core course – XIV Practical PHSACOR14P Discipline Specific Elective – 3 Discipline Specific Elective –	Electro-magnetic Theory Electro-magnetic Theory Lab Statistical Mechanics Statistical Mechanics Lab TBD TBD	4 2 4 2 4 2 2
VI	Core course - XIII PHSACOR13T Core course - XIII Practical PHSACOR13P Core course - XIV PHSACOR14T Core course - XIV Practical PHSACOR14P Discipline Specific Elective - 3 Discipline Specific Elective - 4	Electro-magnetic Theory Lab Electro-magnetic Theory Lab Statistical Mechanics Statistical Mechanics Lab TBD TBD	4 2 4 2 4 2 2 4

\*TBD: To be decided by the student among the available choices mentioned below.

# **3.** Syllabi of Core Papers for B.Sc. Honours in Physics

#### • PHSACOR01T – Mathematical Physics-I

Mathematical Physics - I					
60 Lectures	4 Cr	edits			
Calculus		20 Lectures			

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). Convergence condition of Taylor series and corresponding tests.

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous and Inhomogeneous second order differential equations with constant coefficients, particular integral. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems.

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

#### Vector Calculus

#### **30 Lectures**

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities using Kronecker delta and Levi-civita symbols.

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

#### **Introduction to probability**

#### **10 Lectures**

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.

Dependent events: Conditional Probability. Bayes' Theorem.

#### **Reference Books**

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.
- > Vector Analysis with an Intro. to Tensor Analysis: Schaum's Outline Series. M.R. Spiegel, McGraw Hill.
- ▶ Introduction to Mathematical Physics. C. Harper, 1989, PHI.
- > An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
- ▶ Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
- Mathematical Physics, Goswami, 1st edition, Cengage Learning
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- > Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
### Page 12

# • PHSACOR01P – Mathematical Physics -I Lab

Mathematical Physics -I				
60 class hours	2 credits			
General Topics				
Computer architecture and organization, memory and Input/output devices.				
Computer architecture and organization, memory and Input/output devices. Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow- emphasize the importance of making equations in terms of dimensionless variables, Iterative methods. Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations.				
Introduction to plotting graphs with QtiPlot (or equivalent)				

Basic 2D and 3D graph plotting - plotting functions and datafiles, fitting data using qtiplot's fit function, polar and parametric plots, modifying the appearance of graphs, Surface and contour plots, exporting plots.

# Introduction to programming in python:

- Python as a number calculator
- algebraic calculation through python interactively
- help searching
- standard I/O statements
- program with formula crunching
- string, list, tuple and the corresponding methods
- Control structures

# **Programs as applications**

- finite series summation
- Taylor series summation with a given precision

# File handling in Python

• File I/O statements

# Least square fitting

• Linear and linearised Least square fitting with supplied data

# User defined functions in Python

• User defined function, default argument.

# synthetic data generation and plotting

• synthetic data generation and plotting with QtiPlot (or equivalent).

### Finding largest and smallest values within a dataset

- Finding largest and smallest values over a time-series data.
- Estimating largest and smallest values of a function within an interval using fixed step size.

# Solution of Algebraic and Transcendental equations

- Root finding: Bisection & Newton-Raphson Method (Initial guess to be determined by plotting) for non-linear equations.
- Applications in simple physical problems (including those of mathematical Physics)

- ▶ Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
- Mathematical Methods. M.C. Potter and J. Goldberg, 2000, PHI.
- > Learning Scientific Programming with Python. C. Hill, 2016, Chambridge.
- Learning with Python-how to think like a computer scientist, J. Elkner, C. Meyer, and A. Downey, 2015, Dreamtech Press.
- > Introduction to computation and programming using Python, J. Guttag, 2013, Prentice Hall India.
- Effective Computation in Physics- Field guide to research with Python, A. Scopatz and K.D. Huff, 2015, O'Rielly
- > A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn., 2007, Wiley India Edition.
- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- > An Introduction to computational Physics, T.Pang, 2nd Edn., 2006, Cambridge Univ. Press
- > Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

# • PHSACOR02T – Mechanics

Mechanics						
60 Lectures	4	Credits				
Fundamentals of Dynamics		5 Lectures				
Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Dynamics of a system of particles Centre of Mass. Principle of conservation of momentum. Impulse.						
Work and Energy		4 Lectures				
Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Po study of one dimensional motion from potential energy curves. Stable and uns potential energy. Force as gradient of potential energy. Work & Potential energy conservative forces. Law of conservation of Energy.	oten stab ergy	ttial Energy. Qualitative ble equilibrium. Elastic y. Work done by non-				
Collisions		3 Lectures				
Elastic and inelastic collisions between particles. Centre of Mass and Laboratory fra	ame	es.				
Rotational Dynamics		10 Lectures				
Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Perpedicular axes theorem and parallel axes theorem and their applications in <i>c</i> alculations of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.						
Elasticity		6 Lectures				
Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Ben- bending moment.	din	g of a beam – internal				
Fluid Motion		4 Lectures				
Kinematics of Moving Fluids: Equation of continuity. Idea of streamiline and turbu number. Poiseuille's Equation for Flow of a viscous Liquid through a Capillary Tu	ılen ıbe.	nt flow, Reynold's				

Gravitation and Central Force Motion	9 Lectures

Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to

spherical shell and solid sphere.

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

### Oscillations

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonances, sharpness of resonance; power dissipation and Quality Factor.

### **Non-Inertial Systems:**

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.

## **Special Theory of Relativity**

Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Relativistic Doppler effect.

### **Reference Books**

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Classical Dynamics of Particles and Systems. S.T. Thornton and J. B. Marion, 2009, Brooks/Cole.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
- General Properties of Matter. F.H. Newman and V.H.L. Searle, 1957, Hodder and Stoughton.
- General Properties of Matter. B. Brown, 1969, Springer Science.
- A Degree Physics Part 1: The General Properties of Matter. C.J. Smith, 1960, Arnold.
- Classical Mechanics and General Properties of Matter. S.N. Maiti and D.P. Raychaudhuri, New Age
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- Special Relativity (MIT Introductory Physics). A.P. French, 2018, CRC Press.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.

Additional Books for Reference

- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning

# 7 Lectures

# 8 Lectures

# • PHSACOR02P – Mechanics Lab

Mechanics					
60 class hours		2 Credits			
General Topic					
Discussion on random errors in observations. Measurement principles of length (or diameter) using vernier caliper, screw gauge and travelling microscope. Discussion on the parts of Sextant.					
List of Practical					
1. To study the random error	in observations of time period of some oscillation	on using chronometer.			
2. To determine the Moment of Inertia of a regular body using another auxiliary body and a cradle suspended by a metallic wire.					
3. To determine g and veloc	ity for a freely falling body using Digital Timing	Technique			
4. To determine Coefficient	of Viscosity of water by Capillary Flow Method	(Poiseuille's method).			
5. To determine the Young's Modulus by flexure method.					
6. To determine the Modulu	s of Rigidity of a wire by a torsional pendulum.				
7. To determine the height of a building using a Sextant.					

- 8. To determine the elastic constants of a wire by Searle's method.
- 9. To determine the value of g using Bar Pendulum.
- 10. To determine the value of g using Kater's Pendulum.
- 11. To study the Motion of Spring and calculate, (a) Spring constant, (b) g and (c) Modulus of rigidity.

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

# • PHSACOR03T - Electricity and Magnetism

Electricity and Magnetism				
60 class hours	4 Credits			
Electric Field and Electric Potential	15 Lectures			

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Charge density of a point charge – Definition of Dirac delta function. Properties of Dirac delta function.

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole. Uniqueness theorem. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Energy stored in Electrostatic field.

# **Dielectric Properties of Matter**

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Boudary conditions at the interface of two media.

Magnetic Field	10 Lectures

Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole).

Ampere's Circuital Law and its application to (1) infinite straight wire, (2) infinite planar surface current, and (3) solenoid. Properties of B: curl and divergence. Axial vector property of B and its consequences. Vector Potential. Calculation of vector potential and magnetic induction in simple cases – straight wire, magnetic field due to small current-loop.

Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform magnetic field.

# **Magnetic Properties of Matter**

Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. Boundary conditions at the interface of two

# 8 Lectures

**10 Lectures** 

**6** Lectures

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Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance, calculation in simple cases (e.g. circular loops, solenoids). Reciprocity Theorem. Energy stored in a Magnetic Field.

<b>Electrical Circuits</b>
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Charge Conservation – equation of continuity. Transients in D.C.:Growth and decay of current, charging and discharging of capacitors in CR, LR & LCR circuits; oscillatory discharge; time constant; time variation of total energy in LCR circuit.

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Phasor diagram. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit

# **Network theorems**

Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits

- Foundations of Electromagnetic Theory. J.R. Reitz, F.J. Milford and R.W. Christy, 2010, Pearson.
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Electromagnetism. I.S. Grant and W.R. Phillips, 2013, Wiley.
- Classical Electromagnetism. J. Franklin, 2008, Pearson Education.
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

# • PHSACOR03P – Electricity and Magnetism Lab

Electricity and Magnetism	
60 class hours	2 Credits

# **General topic**

Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances (e) Checking electrical fuses and (f) circuit continuity check. Demonstartion on Carey Foster's bridge, potentiometer, resistance box, inductor coil, moving coil galvanometer (in dead beat and ballistic mode), etc. Use of computers for plotting of experimental results and corresponding fitting of curves using numerical methods learnt in the last semester, are to be encouraged with evidences in laboratory notebooks

# **List of Practicals**

- 1. To determine an unknown Low Resistance using Carey Foster's Bridge.
- 2. To verify the Thevenin and Norton theorems.
- 3. To verify the Superposition and Maximum Power Transfer theorems.
- 4. To determine self-inductance of a coil by Anderson's bridge.
- 5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
- 6. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
- 7. To study the characteristics of a series RC Circuit.
- 8. To determine an unknown Low Resistance using Potentiometer.
- 9. To determine the resistance of a galvanometer using Thomson's method.
- 10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

# • PHSACOR04T - Waves and Optics

Waves and Optics				
60 Lectures	4 Credits			
Superposition of Collinear Harmonic oscillations	4 Lectures			
Linearity and Superposition Principle. Superposition of two collinear oscill frequencies and (2) different frequencies (Beats).	ations having (1) equal			
Superposition of N collinear Harmonic Oscillations with (1) equal phase differences differences.	es and (2) equal frequency			
Superposition of two perpendicular Harmonic Oscillations	3 Lectures			
Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequent	ncy and their uses.			
Wave Motion	4 Lectures			
Plane and Spherical Waves. Longitudinal and Transverse Waves. Progressive (Travelling) Wave and its differential equation. phase and group velocities for harmonic waves. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves				
Velocity of Waves	5 Lectures			
Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal W Newton's Formula for Velocity of Sound. Laplace's Correction.	Vaves in a Fluid in a Pipe.			
Superposition of Two Harmonic Waves	7 Lectures			
Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical wavefunction with respect to Position and Time. Energy of Vibrating String. Tr Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Superposition of N Harmonic Waves.	Treatment. Changes of ansfer of Energy. Normal Open and Closed Pipes.			
Wave Optics	4 Lectures			
Electromagnetic nature of light. Definition and properties of wave front. Huygen Spatial Coherence. Characteristics of Laser light.	s Principle. Temporal and			
Interference	9 Lectures			

Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

### Interferometer

Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength,(3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

### **Diffraction and Holography**

Kirchhoff's Integral Theorem and Fresnel-Kirchhoff's Integral formula (Statement and Qualitative discussion on consequences only).

Fraunhofer diffraction: Single slit, rectangular aperture. Resolving Power of an optical instrument – Rayleigh's criteria. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

### **Reference Books**

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Vibrations and Waves. A.P. French, 2003, CBS.
- Vibrations & Waves. G.C. King, 2009, Wiley.
- > The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- > Optics. E. Hecht, 2003, Pearson Education.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- Basic Optics: Principles and Concepts. A. Lahiri, 2016, Elsevier.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

# 4 Lectures

# • PHSACOR04P – Wave and Optics Lab

# Wave and Optics 60 class hours 2 Credits General Topic

Discussion on the working principles of electric tuning fork, sodium and mercury vapour lamps, CRO etc. Demonstrations on adjustments of spectrometer, Fresnel biprism, Newton's ring apparatus etc. Measurement principle on the circular scale in a spectrometer. Use of computers for plotting of experimental results and corresponding fitting of curves using numerical methods learnt in the last semester, are to be encouraged with evidences in laboratory notebooks

# **List of Practical**

- 1. To determine the frequency of an electric tuning fork by Melde's experiment and verify  $\lambda^2$  –T law.
- 2. To determine refractive index of the Material of a prism using sodium source.
- 3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
- 4. To determine wavelength of sodium light using Fresnel Biprism.
- 5. To determine wavelength of sodium light using Newton's Rings.
- 6. To determine dispersive power and resolving power of a plane diffraction grating.
- 7. To study Lissajous Figures to determine the phase difference between two harmonic oscillations.
- 8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
- 9. Familiarization with: Schuster's focusing; determination of angle of prism.
- 10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
- 11. To investigate the motion of coupled oscillators.
- 12. To determine the wavelength of sodium source using Michelson's interferometer.

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

# • PHSACOR05T - Mathematical Physics-II

Mathematical Physics – II						
60 Lectures	4 Credits					
Fourier Series	10 Lectures					
Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Euler relation Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.						
Frobenius Method and Special Functions	25 Lectures					
Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Multipole expansion in Electrostatics. Orthonormality of Hermite and Laguerre polynomials (statements only). Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x))and Orthogonality. Airy's disc for Fraunhofer diffraction through circular aperture, resolving power of a telescope.						
Some Special Integrals 4 Lectures						
Beta and Gamma Functions and Relation between them. Expression of Integ Error Function (Probability Integral).	grals in terms of Gamma Functions.					
Variational calculus in physics 5 Lectures						
Idea of functionals. Euler-Lagrange equation from calculus of variation. Idea of constraints (holonomic only), degrees of freedom and generalised co-ordinates. Hamilton's principle and Lagrange's equation from it.						
Analytical Dynamics 10 Lectures						
Applications of Lagrange's equation in simple problems. Canonically cojugate momentum. Idea of cyclic co- ordinate and conservation principles from different symmetries. Idea of Legendre transformation. Its application in mechanics and thermodynamics. Definition of Hamiltonian.						

Canonical equations of motion. Poisson bracket and its properties. Time variation of a dynamical variable in

terms of Poisson bracket and the condition related to the constants of motion.		
Partia	I Differential Equations	6 Lectures
Solution	ns to partial differential equations, using separation of variables: I	Laplace's Equation in problems of
rectang	ular symmetry. Wave equation and its solution for vibrational modes of	f a stretched string.
Reference Books		
	Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris,	Elsevier.
	Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.	
	Mathematical Methods. M. C. Potter and J. Goldberg, 2000, PHI.	
	Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/C	Cole.
	Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.	
	Differential Equations. S. L. Ross, 1984, Wiley.	
	Classical Mechanics: Systems of Particles and Hamiltonian Dynamic	cs. W. Greiner, 2004, Springer.
	Classical Mechanics. J.R. Taylor, 2005, University Science Books.	
	Partial Differential Equations for Scientists & Engineers, S.J. Farlow	v, 1993, Dover Pub.
	Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford Uni	versity Press
	Mathematical methods for Scientists & Engineers, D.A. McQuarrie,	2003, Viva Books
	Mathematical Physics, P. K. Chattopadhyay, 2014, New Academic S	cience.

# • PHSACOR05P – Mathematical Physics II Lab

Mathematical Physics II	
60 class hours	2 Credits
General Topics: Introduction to the python numpy module. Arrays in numpy, array operations, array item selection, slicing, shaping arrays. Introduction to online graph plotting using matplotlib. Use scipy to generate Legendre Polynomials and Bessel function and then plot those using matplotlib. Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case. Simple physical problems based on these methods are to be introduced.	
Sorting:	
<ul><li>bubble sort</li><li>insertion sort</li></ul>	
Statistical Calculations :	
• mean, median and standard deviation for a set of discrete data points	
Interpolation:	
Newton-Gregory forward & backward formula	
Numerical differentiation	
• Forward and Backward difference formula	
Numerical Integration	
• By trapezoidal rule.	
• By Simpson's 1/3 rd rule.	
Integration by stochastic method	
Monte Carlo random dot method	
Solution of ODE First order Differential equation	
• Euler Method	
Reference Books	

- Learning Scientific Programming with Python. C. Hill, 2016, Chambridge.
  - A Friendly Introduction to Numerical Analysis. B. Bradie, 2007, Pearson.
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Numpy beginners guide, Idris Alba, 2015, Packt Publishing

Computational Physics, D.Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

# • PHSACOR06T - Thermal Physics

Thermal Physics	
60 Lectures	4 Credits
Introduction to Thermodynamics	25 Lectures

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between  $C_P$  and  $C_V$ , Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence.

Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

### **Thermodynamic Potentials**

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization (basic principle only), First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations

Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

### **Kinetic Theory of Gases**

**20 Lectures** 

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and

Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.

- Thermodynamics. E. Fermi, 1956, Dover.
- Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford Univ Press.
- Principles of Thermodynamics. M. Kaufman, 2002, Marcel Dekker.
- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
- Thermodynamics, Kinetic Theory, and Statistical Thermodynamics. F. W. Sears and G.L. Salinger, 1998, Narosa.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Basic Thermodynamics. E. Guha, 2010, Narosa.
- > Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
- > Thermodynamics and an introduction to thermostatistics, H. B. Callen, 1985, Wiley.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

# • PHSACOR06P – Thermal Physics Lab

Thermal Physics		
60 clas	s hours	2 Credits
Genera	al Topics:	
Discus	sion on logscale plot to study power law dependence, decay constar	nt etc. Discussion on the
propert	ies of PRT, thermocouple, diode sensor etc.	
List of Practical		
1.	Verification of Stefan's law using a torch bulb.	
2.	To determine the Coefficient of Thermal Conductivity of a bad conductor	by Lee and Charlton's disc
	method.	
3.	To determine the Temperature Coefficient of Resistance by Platinum Resistance	stance Thermometer (PRT)
	using constant current source	
4.	4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two	
	Junctions to find `a´ and `b´ coefficients by null method.	
5.	To calibrate a thermocouple to measure temperature in a specified Range potentiometer.	e by Null Method using a
6.	6. To calibrate a thermocouple to measure temperature in a specified Range by direct measurement	
	using Op-Amp differential amplifier and to determine Neutral Temperate	ure
7.	Mesuring unknown temperature using a diode sensor.	
8.	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's	constant flow method.
9.	To determine the Coefficient of Thermal Conductivity of Cu by Searle's A	pparatus.
10.	To determine the Coefficient of Thermal Conductivity of Cu by Angstrom	's Method.

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani Pub.

**16 Lectures** 

# • PHSACOR07T - Digital Systems and Applications

Digital Systems and Applications	
60 Lectures	4 Credits
Introduction	4 Lectures

Electronic Components and Measuring devices (which are generally used for studying the following circuits) and their general Characteristics, Cathode-Ray Oscilloscope(CRO), Block diagram of CRO. Electron Gun. Deflection System and Time Base. Deflection Sensitivity. Applications of CRO:1)Study of waveform, 2) Measurement of Voltage, Current, Frequency and Phase difference.

Integrated Circuits 5	Lectures
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Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital ICs.

**Digital Circuits** 

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. De Morgan's Theorems. Boolean Laws. AND, OR and NOT Gates (realization using Diodes and Transistor). Simplification of Logic Circuit using Boolean Algebra. NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Arithmetic circuits	5 Lectures

Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.

Data processing circuits	5 Lectures
Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.	
Sequential circuits	6 Lectures
SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset a	nd Clear operations. Race-

around conditions in JK Flip-Flop. M/S JK Flip-Flop. M/S JK Flip-Flop, Combinational logic for the

development of sequential circuit.		
Timers	4 Lectures	
IC 555: block diagram and applications: Astable multivibrator and Monostable mul	tivibrator.	
Registers	4 Lectures	
Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).		
Counters (4 bits)	4 Lectures	
Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.		
Computer Organization 7 Lectures		
Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization &		
addressing. Memory Interfacing. Memory Map.		
Reference Books		
Digital Principles and Applications, A.P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, TMH		
Digital Computer Electronics. A.P. Malvino and J.A. Brown, 2005, TMH.		
Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Lean	ming Pvt. Ltd.	
Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.		
Digital Electronics G K Kharate ,2010, Oxford University Press		
Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning		
Logic circuit design, Shimon P. Vingron, 2012, Springer.		
Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.		
Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill		
Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice		
Hall.		

# • PHSACOR07P – Digital Systems and Applications Lab

Digital Systems and Applications	
60 class hours	2 Credits

- 1) In the Beginning of practical course a *brief history of development of electronics* should be introduced.
- 2) In continuation of the previous topic, physically introduce the Valve, Transformer, Resistance, Capacitor, Potentiometer etc. and also Impotant measuring instruments (viz. digital & analog multimeter, power supply, function generator, Oscilloscope) to be used in the following experiments. Describe their characteristics with an explanation of their working principle).
- 3) In rest of the all practical classes: Approximately 25% of the class period should be used in introducing the perspectives and importance of the experiments to be done; details of the experiments and discussion on the observations of last class.1. a) To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.

# List of Practical

- 1. a) To measure (i) Voltage, and (ii) Time period of a periodic waveform using CRO.
  - b) To test a Diode and Transistor using a Multimeter.
- 2. a) To design a switch (NOT gate) using a transistor.
  - b) To verify and design AND, OR, NOT and XOR gates using NAND gates.
- 3. For a given truth table find logic equation, minimize and design the circuit using logic gate ICs.
- 4. Half Adder, Full Adder and 4-bit binary Adder.
- 5. To build Flip-Flop (RS, D-type and JK) circuits using NAND gates.
- 6. To design an astable multivibrator of given specifications using 555 Timer.
- 7. To design a monostable multivibrator of given specifications using 555 Timer.
- 8. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
- 9. To build JK Master-slave flip-flop using Flip-Flop ICs

- 10. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
- 11. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.

- Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.

# • PHSACOR08T - Mathematical Physics III

Mathematical Physics III	
60 Lectures	4 Credits
Complex Analysis	20 Lectures
Euler's formula. De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.	

### **Integrals Transforms**

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

### **Boundary Value Problems**

Solutions of Laplaces equation in problems with cyldically and spherically symmetric boundary conditions. Examples from Electrostatics. Solutions of heat diffusion equation with boundary conditions of rectangular symmetry.

# Matrices

Hermitian conjugate of a Matrix. Hermitian and Skew- Hermitian Matrices with properties. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Trace of a Matrix. Inner Product of matrices.

# **Eigen-values and Eigenvectors**

Eigenvalues and eigenvectors – calculation, charateristic equation. Cayley- Hamiliton Theorem. Similarity transformation with properties. Diagonalization of Matrices. Solutions of Coupled Linear Ordinary Differential Equations. Functions of a Matrix.

# **Reference Books**

Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.

# **10 Lectures**

**15 Lectures** 

# 7 Lectures

**8** Lectures

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- Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.
- Mathematical Methods of Physics. J. Mathews and R.L. Walker, 2004, Pearson.
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
- Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Complex Variables, A.K. Kapoor, 2014, Cambridge Univ. Press
- Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

# • PHSACOR08P – Mathematical Physics III Lab

Mathematical Physics III	
60 class hours	2 Credits

**General Topics:** Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case. Simple physical problems based on these methods are to be introduced.

# List of Practical

- 1. ODE initial value problems by RK2 & RK4
- 2. Solution of Linear system of equations by Gauss elimination method, determinant by Gauss Jordan method.
- 3. Inverse of a matrix by Gauss-Seidal iterative method.
- 4. Gram-Schmidt orthogonalisation method with 3 vectors.
- 5. Explicit calculation of largest eigenvalue calculation by power iterative method for real symmetric matrix and corresponding eigenvector
- 6. Eigen vectors, eigen values problems (by numpy.linalg)
- 7. Boudary value problems (by finite difference method with fixed grid size):
  - a. Laplace eqn in 1D with Dirichlet boundary condition
  - b. 1D Fourier heat equation with Dirichlet boundary condition
  - c. Poisson equations
  - d. Wave equation
- 8. Find square roots, cube roots of a complex number using two dimensional Newton-Raphson method.
- 9. Integral transform: FT of  $exp(-kx^2)$

10. Dirac Delta Function: Evaluate  $\frac{1}{\sqrt{2\pi\sigma^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}(x+3)dx$ , for  $\sigma=1, .1, .01$  and show it tends to 5

# Octave:

- Introduction of Octave with its basic features.
- Few examples of solving (a) differential equations and (b) matrix eigenvalue problems -- are to be performed using Octave

- Learning Scientific Programming with Python. C. Hill, 2016, Chambridge.
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- A Friendly Introduction to Numerical Analysis. B. Bradie, 2007, Pearson.
- An Introduction to Numerical Analysis. Prasad, 2012, Narosa.

- Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
- Scientific Computing with MATLAB and Octave. A. Quarteroni and F. Saleri, 2006, Springer.
- Numerical Methods using MATLAB. J.H. Mathews and K.D. Fink, 2009, PHI.
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
- https://web.stanford.edu/~boyd/ee102/laplace\_ckts.pdf
- https://ocw.nthu.edu.tw/ocw/upload/12/244/12handout.pdf

# • PHSACOR09T - Elements of Modern Physics

Elements of Modern Physics	
60 Lectures	4 Credits
Relativistic Dynamics	12 Lectures

Invariance of space-time interval under Lorentz transformation. Idea of 4-vector – contravariant and covariant components, metric. 4-scalar. Space-like, time-like and light-like separation, causality in relativity. Proper time. 4-velocity and 4-momentum. Conservation law of 4- momentum. Relativistic mass. Relativistic energy. Rest energy. Equivalence of mass & energy. Applications in two body decay of a particle, two body collisions.

# **Collection of Identical Entities – Classical Approach**

# Large collection of identical entities in an enclosure at thermal equilibrium. Idea of averaging over the collection, relation with bulk variables. Boltzmann weight factor. Law of equipartition of energy for single entity. Example: Cavity radiation and black body, classical theory of blackbody radiation, Rayleigh-Jeans law. Ultraviolet catastrophe.

### **Emergence of Quantum Theory**

Planck's quantum postulate to avoid ultraviolet catastrophe, Planck's constant and Planck's ditribution law for blackbody Radiation. Photo-electric effect and Compton scattering. Light as a collection of photons; Wilson-Sommerfield quantization rule unifying Planck's quantization rule and Bohr's angular momentum quantization rule. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them.

Position measurement- gamma ray microscope thought experiment; Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables) as a consequence of wave description. Estimating minimum energy of a confined particle using uncertainty principle. Energy-time uncertainty principle- application to virtual particles and range of an interaction.

Two-Slit interference experiment with electrons and photons. Wave-particle duality, Bohr's complementarity principle. Matter waves and wave function, linear superposition principle as a consequence; Born's probabilistic interpretation of wave function bridging between wave description and particle description.

### Lasers

# 4 Lectures

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic

### 20 Lectures

lasing.

# **Nuclear Physics**

**18 Lectures** 

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).

### **Reference Books**

- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Relativity. W. Rindler, 2006, Oxford.
- Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles. R. Eisberg and R. Resnick, 1985, Wiley.
- Perspectives of Modern Physics. A. Beiser, 1969, McGraw-Hill.
- > Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
- Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
- An Introduction to Nuclear Physics. W. N. Cottingham and D.A. Greenwood, 2004, Chambridge.
- > Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Additional Books for Reference

- Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
- Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
- Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
- Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
- Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill

# • PHSACOR09P – Elements of Modern Physics Lab

Elements of Modern Physics			
60 class hours		2 Credits	
Genera	al Topics:		
Discussion on properties rotational spectra of iodine, working principles of tunnel diode, vacuum diode, discharge tube.			
List of Practical			
1.	To determine the wavelength of H-alpha emission line of Hydrogen atom.		
2.	2. To determine the absorption lines in the rotational spectrum of Iodine vapour.		
<b>3.</b> To determine the value of e/m by Bar magnet.			
4. To determine the wavelength of laser source using diffraction of double slits.			
5.	5. To determine wavelength using He-Ne/ solid state laser using plane diffraction grating		
6. To determine angular spread of He-Ne/ solid state laser using plane diffraction grating			
7.	7. To determine work function of material of filament of directly heated vacuum diode.		
8.	8. To show the tunneling effect in tunnel diode using I-V characteristics.		
9.	9. Measurement of Planck's constant using black body radiation and photo-detector		
10.	10. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy		
	of photo-electrons versus frequency of light		
11.	<b>11.</b> To determine the Planck's constant using LEDs of at least 4 different colours.		
12.	<b>12.</b> To determine the ionization potential of mercury.		
13.	To setup the Millikan oil drop apparatus and determine the charge of an ele	ectron.	
14.	To determine the wavelength of laser source using diffraction of single slit		
Reference Books			
	Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 197	71, Asia Publishing House	
	Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985,		
	Heinemann Educational Publishers		
	A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 20	11,Kitab Mahal	

# • PHSACOR10T - Analog Systems and Applications

Analog Systems and Applications		
60 Lectures	4 Credits	
History of the development of electronics	3 Lectures	
Valve circuits and advantages of using semiconductor devices in modern electronic systems.		
Semiconductor Diodes	7 Lectures	
P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Derivation for Barrier Potential, Barrier Width and Current for Step Junction.		
Two-terminal Devices and their Applications	7 Lectures	
Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter & $\pi$ - filter(qualitative, expression only), Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.		
Bipolar Junction transistors	8 Lectures	
n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Physical Mechanism of Current Flow (unbiased).Current gains $\alpha$ and $\beta$ Relations between $\alpha$ and $\beta$ . Load Line analysis of Transistors. DC Load line and Q-point. Active, Cutoff and Saturation Regions.		
Field Effect transistors	3 Lectures	
Basic principle of operation of JFET, JFET parameters and CS characteristics		
Amplifiers	8 Lectures	
Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.		

Coupled Amplifier	3 Lectures	
Two stage RC-coupled amplifier and its frequency response.		
Feedback in Amplifiers	4 Lectures	
Concept of feedback, Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.		
Sinusoidal Oscillators	4 Lectures	
Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.		
<b>Operational Amplifiers (Black Box approach)</b>	4 Lectures	
Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.		
Applications of Op-Amps	7 Lectures	
Linear - (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Non-linear – (1) inverting and non-inverting comparators, (2) Schmidt triggers.		
Conversion	2 Lectures	
Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)		
Reference Books		
Electronic Devices and Circuit Theory. R.L. Boylested and L. Nashelsky, 2	2012, Pearson.	
Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.		
Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.		
Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2	2009, PHI Learning	
Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill		
OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall		
Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press		
<ul> <li>Electronic circuits: Handbook of design &amp; applications. U.Tietze, C.Schenk.2008. Springer</li> </ul>		
<ul> <li>Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002</li> </ul>	2, Wiley India	

- Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

# • PHSACOR10P – Analog Systems and Applications Lab

Analog Systems and Applications		
60 clas	s hours 2 Credits	
General Topics: Discussion on the operational principles of the relevant circuits used in the experiments.		
List of Practical		
1.	To study V-I characteristics of PN junction diode and Light emitting diode (LED) ( using both surrent and voltage source)	
2	To study the V-I characteristics of a Zener diode and its use as voltage regulator	
2.	To study the v-r characteristics of a Zener though and its use as voltage regulator.	
3.	Study of V-I & power curves of Solar Cells and find maximum power point and efficiency.	
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.		
5.	5. To study the frequency response of voltage gain of a RC – coupled transistor amplifier.	
6.	6. To design inverting, non- inverting and buffer amplifiers using Op-amp (741/351) for dc voltage.	
7.	To design a Wien bridge oscillator for given frequency using a Op-Amp.	
8.	To add dc voltages using Op-amp in inverting and non-inverting mode.	
9.	9. a) To investigate the use of an op-amp as an Integrator.	
	b) To investigate the use of an op-amp as a Differentiator.	
10.	To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.	
11.	To study the various biasing configurations of BJT for normal class A operation.	
12.	To design a Phase Shift Oscillator of given specification using Op-Amp.	
13.	To study the Colpitt's Oscillator.	
14.	To design a digital to analog converter (DAC) of given specifications.	
15.	To study the analog to digital converter (ADC) IC.	
16.	To design a precision Differential amplifier of given I/O specification using Op-Amp.	
17.	To design a circuit to simulate the solution of a $1^{st}/2^{nd}$ order differential equation.	
18.	To design inverting amplifier using Op-amp (741/351) and study its frequency response	

- 19. To design non-inverting amplifier using Op-amp (741/351) & study its frequency response
- **20.** To study the zero crossing detector and comparator.
- 21. Using Schmitt trigger and associated circuit (with OPAMP) generate different wave forms.

- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- > OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
- Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

# • PHSACOR11T - Quantum Mechanics and Applications

Quantum Mechanics and Applications	
60 Lectures	4 Credits
Basic Formalism	12 Lectures

Departure from matter wave description. Quantum mechanics as a new framework to describe the rules of the microscopic world. Postulates of quantum mechanics: State as a vector in a complex vector space, inner product, its properties using Dirac bra-ket notation. Physical observables as Hermitian operators on state space – eigenvalues, eigenvectors and completeness property of the eigenvectors – matrix representation. Measurement statistics. Unitary time-evolution. Demonstration of the rules in 2-level systems.

Wave-function as the probability amplitude distribution of a state for the observables with continuous eigenvalues. Position representation and momentum representation of wave-functions and operators. Position, momentum and Hamiltonian operators. Non-commuting observables and incompatible measurement, uncertainty relation. Position-momentum uncertainty principle as an example.

Commuting observables and degeneracy; complete set of commuting observables.

# **Schrodinger Equation**

# **12 Lectures**

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for physical acceptability of Wave Functions. Normalization and Linear Superposition Principles of the solutions of Schoedinger equation. Wave Function of a Free Particle. Explanation of wave-particle duality in two slit experiment with microscopic particles from the above formalism.

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; consistency with position-momentum uncertainty principle.

Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier. Tunnelling effect in the case of alpha decay and in scanning tunnel microscopes (qualitative discussion only).

Bound states – continuity of wave function, boundary condition and emergence of discrete energy levels.

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; generalisation for three dimension and degeneracy of energy levels. Quantum dot as example.

Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions; Hermite polynomials; ground state, zero point energy & uncertainty principle. Raising-lowering operator and their applications.

### Quantum theory of hydrogen-like atoms

Time independent Schrodinger equation in spherical polar coordinates with spherically symmetric potential; separation of variables for second order partial differential equation; angular momentum operators, commutation relations, ladder operators & quantum numbers; spherical co-ordinate representation of angular momentum operators. Radial wavefunctions for Coulomb potential; shapes of the probability densities for ground & first excited states. Commuting observables and degeneracy of energy levels. Orbital angular momentum quantum numbers l and m; s, p, d,shells-subshells. Applications for Hydrogen atom, He<sup>+</sup> ion, positronium and alikes.

# **Applications of Quantization Rules in Atomic Physics**

Absence of exact stationary state solutions for relativistic effects and for multi-electron atoms. Approximate description by semi-classical vector model of atoms.

Electron angular momentum quantization rules. Space quantization. Orbital Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr magneton. Electron Spin as relativistic quantum effect (qualitative discussion only), Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Larmor Precession.

Multi-electron atoms. Pauli's Exclusion Principle (statement only). Spectral Notations for atomic States. Aufbau principle, n+l rule (qualitative discussion only). Periodic table.

Spin orbit interaction. Addition of angular momentum (statement only). Total angular momentum of electron. Total energy level correction due to relativistic effects and spin-orbit interaction (statement only). Fine structure splitting.

Normal and Anomalous Zeeman Effect, Lande g factor, Paschen Back effect. Stark Effect (Qualitative Discussion only).

Spin-orbit coupling in atoms – L-S and J-J coupling schemes. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.). Mosley's law and its explanation from Bohr theory.

# **Reference Books**

- > Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education.
- > Quantum Mechanics: Theory and Experiment. M. Beck, 2012, Oxford University Press.
- A Modern Approach to Quantum Mechanics. J.S. Townsend, 2010, Viva Books (Indian Edn.).
- The Principles of Quantum Mechanics. P.A.M. Dirac, 2006, Oxford.
  - A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010,

# **10 Lectures**
McGraw Hill

- > Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
- > Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
- > Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
- > Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- > Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press

Additional Books for Reference

- > Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
- > Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

#### • PHSACOR11P – Quantum Mechanics and Applications Lab

Quantum Mechanics and Applications	
60 class hours	2 Credits

**General Topics:** Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case.

#### **List of Practical**

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2\mu}{\hbar^2}[V(r) - E] \text{ where } V(r) = -\frac{e^2}{r}$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is -13.6 eV. Take  $e = 3.795 (eVÅ)^{1/2}$ ,  $\hbar c = 1973 (eVÅ)$  and  $m = 0.511 \times 10^6 eV/c^2$ .

2. Solve the s-wave radial Schrodinger equation for an atom:

$$\frac{d^2 y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2 \mu}{\hbar^2} [V(r) - E]$$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = -\frac{e^2}{r}e^{-\frac{r}{a}}.$$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take  $e = 3.795 (eVÅ)^{1/2}$ , m = 0.511x106 eV/c2, and a = 3 Å, 5 Å, 7 Å. In these units  $\hbar c = 1973 (eVÅ)$ . The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$\frac{d^2 y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2 \mu}{\hbar^2} [V(r) - E]$$

For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3,$$

for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose  $m = 940 \text{ MeV/c}^2$ ,  $k = 100 \text{ MeV} \text{ fm}^{-2}$ , b = 0, 10, 30 MeV fm<sup>-3</sup> In these units, ch = 197.3 MeV fm. The ground state energy I expected to lie between 90 and

110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$$\frac{d^2 y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2 \mu}{\hbar^2} [V(r) - E]$$

Where  $\mu$  is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D(e^{-2ar'} - e^{-ar'}), \qquad r' = \frac{r - r_0}{r}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of

three significant digits. Also plot the corresponding wave function. Take:  $m = 940 \times 106 \text{eV/C}^2$ , D = 0.755501 eV,  $\alpha = 1.44$ ,  $r_o = 0.131349 \text{ Å}$ 

#### **Reference Books**

An introduction to computational Physics, T.Pang, 2nd Edn., 2006, Cambridge Univ.Press

Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific &

Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer.

## • PHSACOR12T - Solid State Physics

Solid State Physics		
60 Lectures	4 Credits	
Crystal Structure	12 Lectures	
Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Laue's condition and Bragg's Law. Structure Factor.		
Elementary Lattice Dynamics	10 Lectures	
Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, its limitations. Einstein's theories of specific heat of solids, its limitations.		
Magnetic Properties of Matter	8 Lectures	
Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.		
Dielectric Properties of Materials	8 Lectures	
Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena.		
Ferroelectric Properties of Materials	6 Lectures	
Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.		
Drude's theory	6 Lectures	
Free electron gas in metals, effective mass, drift current, mobility and conductive Thermal conductivity. Lorentz number, limitation of Drude's theory	vity, Hall effect in metals.	
Elementary band theory	10 Lectures	

Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient.

#### Superconductivity

**6** Lectures

Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.

- The Oxford Solid State Basics. S. H. Simon, 2013, Oxford.
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
- > Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
- Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
- Solid State Physics, Rita John, 2014, McGraw Hill
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

## • PHSACOR12P – Solid State Physics Lab

Solid State Physics		
60 class hours	2 Credits	
<b>General Topics:</b> Discussion on the operation of the relevant circuits used for the different studies in the following experiments.		
List of Practical		
1. To determine the Coupling Coefficient of a Piezoelectric crystal.		
2. To measure the Dielectric Constant of a dielectric Materials with frequency		
3. To study the characteristics of a Ferroelectric Crystal.		
4. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.		
5. To measure the resistivity of a semiconductor (Ge) with temperature by reverse bias characteristics		
of Ge diode (room temperature to 80 oC) and to determine its band gap.		
6. To determine the Hall coefficient of a semiconductor sample.		
7. To study temperature coefficient of a semiconductor (NTC thermistor)		
8. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)		
9. To measure the Magnetic susceptibility of Solids.		
10. To determine the complex dielectric constant and plasma frequency of me	etal using Surface Plasmon	
resonance (SPR)		
11. To determine the refractive index of a dielectric layer using SPR		
Reference Books		

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

## • PHSACOR13T - Electromagnetic Theory

Electromagnetic Theory	
60 Lectures	4 Credits
Maxwell Equations	12 Lectures

Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. Momentum Density and Angular Momentum Density (statement only).

#### **EM Wave Propagation in Unbounded Media**

Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

#### **EM Wave in Bounded Media**

Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).

#### **Polarization of Electromagnetic Waves**

Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light

Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.

#### **10 Lectures**

#### **17 Lectures**

## 10 Lectures

Wave guides	8 Lectures
Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.	
Optical Fibres	3 Lectures
Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Mult and Definition Only).	iple Mode Fibres (Concept
Reference Books	
Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.	
Optics, E. Hecht, 2016, Pearson.	
Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.	
Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning	
Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill	
Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning	
Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.	
Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer	
Additional Books for Reference	
<ul> <li>Electromagnetic Fields &amp; Waves, P.Lorrain &amp; D.Corson, 1970, W.H.Freen</li> </ul>	nan & Co.
Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hi	11.
Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2	2004, Cambridge University
Press	

## • PHSACOR13P – Electromagnetic Theory Lab

Electromagnetic Theory		
60 clas	ss hours	2 Credits
Genera	al Topics: Discussion on the working principles of polaroids, polarimeter, pl	hotometers etc.
List of	f Practical	
1.	To verify the law of Malus for plane polarized light.	
2.	To determine the specific rotation of sugar solution using Polarimeter.	
3.	To determine the wavelength and velocity of ultrasonic waves in a liquid	d (Kerosene Oil, Xylene,
	etc.) by studying the diffraction through ultrasonic grating.	
4. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.		
5. To verify Fresnel's formula for reflection of polarized light incident on a dielectric interface		
6. To determine the Boltzmann constant using V-I characteristics of PN junction diode.		
7. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a		
Gaussian eyepiece.		
8.	To determine the refractive index of liquid by total internal reflection	on using Wollaston's air-
	film.	
9.	To study the reflection, refraction of microwaves	
10.	. To study Polarization and double slit interference in microwaves.	
11.	. To analyze elliptically polarized Light by using a Babinet's compensator.	
12. To study dependence of radiation on angle for a simple Dipole antenna.		
13.	. To verify the Stefan's law of radiation and to determine Stefan's constant.	
Refere	ence Books	
•	Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 197	1, Asia Publishing House.
	Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th	h Edition, reprinted 1985,
	Heinemann Educational Publishers	
	A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011	l, Kitab Mahal
	Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010,	Springer

## • PHSACOR14T – Statistical Mechanics

Statistical Mechanics		
60 Lectures	4 Credits	
Classical Statistical Mechanics	20 Lectures	
Macrostate & Microstate, concept of time averaging in a macroscopic measur (statement only). Elementary Concept of Ensemble, Liouville's theorem. Micro Space, postulate of equal a priori probability, Entropy and Thermodynamic Proba Partition Function, Density of states: for ideal gas, for standing waves in a cavity. of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equ of Energy (with proof) – Applications to Specific Heat and its Limitations, Ther Two-Energy Levels System, Negative Temperature. Grand canonical ensemble Equivalence of microcanonical, canonical and grand canonical ensemble for discussion only).	ement. Ergodic hypothesis canonical ensemble, Phase bility, Canonical ensemble, Thermodynamic Functions ation, Law of Equipartition modynamic Functions of a e and chemical potential. large systems (qualitative	
Chemical Equilibrium	5 Lectures	
Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical potential for ideal gas, for photon gas. Ionisation potential. Saha's Ionization Formula.		
Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical photon gas. Ionisation potential. Saha's Ionization Formula.	l potential for ideal gas, for	
Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical photon gas. Ionisation potential. Saha's Ionization Formula. Theory of Blackbody Radiation	botential for ideal gas, for	
<ul> <li>Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical photon gas. Ionisation potential. Saha's Ionization Formula.</li> <li><b>Theory of Blackbody Radiation</b></li> <li>Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dep Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Recapitul Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's Planck's Planck's Planck's Planck's Properties of the prop</li></ul>	l potential for ideal gas, for <b>6 Lectures</b> endence. Kirchhoff's law. ation of Planck's Law of ibution Law, (2) Rayleigh- law.	
Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical photon gas. Ionisation potential. Saha's Ionization Formula. Theory of Blackbody Radiation Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dep Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Recapitul Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distributed Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's System of identical particles	bottom bo	

and indistinguishability. Occupation number and MB distribution, emergence of Boltzmann factor. Composite system postulate and symmetry postulate of quantum mechanics (for a pair of particles only). Bosons and Fermions. Spin statistics theorem (statement only). Pauli exclusion principle for Fermions.

#### **Bose-Einstein Statistics:**

B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic

**12 Lectures** 

functions of photon gas. Bose derivation of Planck's law. Phonon gas. Debye theory of specific heat of solids. T3 law

#### **Fermi-Dirac Statistics:**

#### **11 Lectures**

Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Fermi temperature, Fermi momentum, Sommerfield correction to free electron theory in a Metal. Specific Heat of Metals, Wiedemann-Franz law,

- Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford Univ. Press.
- Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2<sup>nd</sup> Ed., 1996, Oxford University Press.
- Statistical Mechanics an elementary outline, A. Lahiri, 2008 (Revised Edition), CRC Press.
- > Intermediate Statistical Mechanics. J. Bhattacharjee and D. Banerjee, 2017, World Scientific (HBA).
- An Introductory Course of Statistical Mechanics. P.B. Pal, 2008, Narosa.
- Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
- An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

## • PHSACOR14P – Statistical Mechanics Lab

Statistical Mechanics	
60 Class Hours	2 Credits

**General Topics:** Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case.

#### List of Practical

- Computational analysis of the behaviour of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
  - a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations
  - b) Study of transient behaviour of the system (approach to equilibrium)
  - c) Relationship of large N and the arrow of time
  - d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution
  - e) Computation and study of mean molecular speed and its dependence on particle mass
  - f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed
- Computation of the partition function Z(β) for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose- Einstein statistics:
  - a) Study of how Z( $\beta$ ), average energy <E>, energy fluctuation  $\Delta E$ , specific heat at constant volume C<sub>V</sub>, depend upon the temperature, total number of particles N and the spectrum of single particle states.
  - b) Ratios of occupation numbers of various states for the systems considered above
  - c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T.
- 3. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature.
- 4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.
- 5. Plot the following functions with energy at different temperatures
  - a) Maxwell-Boltzmann distribution
  - b) Fermi-Dirac distribution
  - c) Bose-Einstein distribution

- Elementary Numerical Analysis, K.E.Atkinson, 3 rd Edn. 2007, Wiley India Edition
- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
- Introduction to Modern Statistical Mechanics, D. Chandler, Oxford University Press, 1987
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
- Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik, Princeton University Press, 2010.
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896

## 4. Syllabi of Department Specific Elective Papers for B.Sc. Honours in Physics

#### • PHSADSE01T - Advanced Mathematical Physics I

Advanced Mathematical Physics I	
60 Lectures	4 Credits
Laplace Transform15	Lectures

Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1st order. Solution of heat flow along infinite bar using Laplace transform.

#### **Linear Vector Spaces**

Abstract Systems. Binary Operations and Relations. Introduction to Groups and Fields. Vector Spaces and Subspaces. Linear Independence and Dependence of Vectors. Basis and Dimensions of a Vector Space. Change of basis. Homomorphism and Isomorphism of Vector Spaces. Linear Transformations. Algebra of Linear Transformations. Non-singular Transformations. Representation of Linear Transformations by Matrices.

Inner products. Gram-Schmidt orthogonalization. Orthogonal and unitary transformations and their matrix representations.

#### **Cartesian Tensors**

Transformation of Co-ordinates. Einstein's Summation Convention. Relation between Direction Cosines. Tensors. Algebra of Tensors. Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti- symmetric Tensors. Invariant Tensors: Kronecker and Alternating Tensors. Association of Antisymmetric Tensor of Order Two and Vectors. Vector Algebra and Calculus using Cartesian Tensors: Scalar and Vector Products, Scalar and Vector Triple Products. Differentiation. Gradient, Divergence and Curl of Tensor Fields. Vector Identities. Tensorial Formulation of Analytical Solid Geometry: Equation of a Line. Angle Between Lines. Projection of a Line on another Line. Condition for Two Lines to be Coplanar. Foot of the Perpendicular from a Point on a Line. Rotation Tensor (No Derivation). Isotropic Tensors. Tensorial Character of Physical Quantities. Moment of Inertia Tensor. Stress and Strain Tensors: Symmetric

#### 15 Lectures

#### **20 Lectures**

Nature. Elasticity Tensor. Generalized Hooke's Law. Maxwell's stress tensor.

#### **General Tensors**

#### **10 Lectures**

Transformation of Co-ordinates. Minkowski Space. Contravariant & Covariant Vectors. Contravariant, Covariant and Mixed Tensors. Kronecker Delta and Permutation Tensors. Algebra of Tensors. Sum, Difference & Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Metric Tensor.

- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, and F.E. Harris, 1970, Elsevier.
- Mathematical Methods. S. Hassani, 2009, Springer Science.
- Modern Mathematical Methods for Physicists and Engineers, C.D. Cantrell, 2011, Cambridge University Press
- Introduction to Matrices and Linear Transformations, D.T. Finkbeiner, 1978, Dover Pub.
- Linear Algebra, W. Cheney, E.W.Cheney & D.R.Kincaid, 2012, Jones & Bartlett Learning
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole
- A Basic Course of Tensor Analysis. S. Mukhopadhyay, 2017, Academic Publishers.
- Matrices and Tensors. A. W. Joshi,
- Mathematical Methods for Physicis & Engineers, K.F.Riley, M.P.Hobson, S.J.Bence, 3rd Ed., 2006, Cambridge University Press

## • PHSADSE01P – Advanced Mathematical Physics I Lab

Advanced Mathematical Physics I	
60 Class Hours	2 Credits
List of Practical	
<ol> <li>Linear algebra:         <ul> <li>Multiplication of two 3 x 3 matrices.</li> <li>Eigenvalue and eigenvectors of                  <ul> <li>(2 1 1)</li> <li>(1 -i 3 + 4i)</li> <li>(2 -i 2i)</li> <li>(1 3 2)</li> <li>(1 +i 2 4)</li> <li>(2 -i 3 5)</li> </ul> </li> </ul> </li> <li>Orthogonal polynomials as eigen functions of Hermitian differential opera</li> <li>Determination of the principal axes of moment of inertia through diagonality operators and their commutator, wave functions for stationary states as eigen differential operator.</li> <li>Lagrangian formulation in Classical Mechanics with constraints.</li> <li>Study of geodesics in Euclidean and other spaces (surface of a sphere, etc)</li> </ol>	tors. ization. Id momentum differential genfunctions of Hermitian
7. Estimation of ground state energy and wave function of a quantum system	

Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896

## • PHSADSE02T – Advanced Dynamics

Advanced Dynamics		
75 Lectures	6 Credits	
Lagrangian & Hamiltonian Dynamics	15 Lectures	
Lagrange's equation for the cases with semi-holonomic constraints. E general. Simple problems with both time-dependent and time independent of	valuation of constraint forces in constraints.	
Idea of canonical transformations. Generating functions. Properties of canonical transformation. Invariance of Poisson bracket. Use of canonical transformations in solving Hamilton's equations; harmonic oscillator problem as test case.		
Rigid Body Mechanics	10 Lectures	
Definition of rigid body. General motion as combination of translation and rotation. Rotation of rigid body and the relation between its angular momentum and angular velocity. Moment of inertia and product of inertia. Kinetic energy of rotation. Principal axis transformation and principal moments of inertia, application in simple cases. Euler equations for free top and their solutions describing the motion of symmetric bodies.		
Small Amplitude Oscillations	10 Lectures	
Minima of potential energy and points of stable equilibrium, expansion of the potential energy around a minimum, small amplitude oscillations about the minimum, normal modes of oscillations example of N identical masses connected in a linear fashion to (N -1) - identical springs.		
Dynamical Systems	25 Lectures	
Definition of a continuous dynamical system. The idea of phase space, flows and trajectories. Autonomous and non-autonomous systems, dimensionality. Linear stability analysis to study the behaviour of an 1-dimensional autonomous system. Illustration of the method using the single particle system described by $v=f(x)$ and comparing it with the exact analytical solution. Extension of the method for simple mechanical		

systems as 2-dimensional dynamical systems, categorisation of equilibrium/fixed points : illustrations for the free particle, particle under uniform gravity, simple and damped harmonic oscillator (both under-damped and over-damped). Sketching flows and trajectories in phase space; sketching variables as functions of time, relating the equations and pictures to the underlying physical intuition. Study on the behaviour of the quartic oscillator with an attractive or repulsive quadratic term in the potential; idea of bifurcation. Phase space

diagram for the general motion of a pendulum and its behaviour. Oscillator with non-linear damping, Vander-Pol oscillator as the example, behaviour in large damping limit, idea of limit cycle.

Discrete time dynamical systems, examples. Description by iterative map. Logistic map: Dynamics from time series. Cobweb iteration (using calculator or simple programs only). Fixed points. Parameter dependence- steady, periodic and chaos states. Idea of chaos and Lyapunov exponent.

#### **Fluid Dynamics**

#### **15 Lectures**

Basic physics of fluids: The continuum hypothesis- concept of fluid element or fluid parcel; Definition of a fluid- shear stress; Fluid properties- viscosity, thermal conductivity, mass diffusivity, other fluid properties and equation of state; Flow phenomena- flow dimensionality, steady and unsteady flows, uniform & non-uniform flows, viscous & inviscid flows, incompressible & compressible flows, laminar and turbulent flows, rotational and irrotational flows. Euler equation and Navier-Stokes equation, qualitative description of turbulence, Reynolds number.

- Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
- Classical Mechanics: A Course of Lectures. A.K. Raychaudhuri, 1983, Oxford University Press.
- Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
- Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
- Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
- Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
- Chaos and Non-linear Dynamics. R.C. Hilborn, 2000, Oxford Univ. Press.
- Nonlinear Dynamics and Chaos.S.H. Strogartz.
- Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press

#### • PHSADSE03T - Nuclear and Particle Physics

Nuclear and Particle Physics	
75 Lectures	6 Credits
General Properties of Nuclei	10 Lectures

Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

#### **Nuclear Models**

Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

#### **Radioactivity decay**

(a) Alpha decay: basics of  $\alpha$ -decay processes, theory of  $\alpha$ - emission, Gamow factor, Geiger Nuttall law,  $\alpha$ -decay spectroscopy. (b) -decay: energy kinematics for -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.

 Nuclear Reactions
 8 Lectures

Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

#### **Interaction of Nuclear Radiation with matter**

Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

#### **Detector for Nuclear Radiations**

Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor

#### **10 Lectures**

**12 Lectures** 

#### **8** Lectures

8 Lectures

Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

Particle Accelerators	5 Lectures

Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

#### **Particle physics**

**14 Lectures** 

Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

- Nuclear Physics. J.S. Lilley, 2001, John Wiley & Sons.
- Nuclear and Particle Physics. B.R. Martin, 2006, John Wiley & Sons.
- Nuclear and Particle Physics, W.F. Burcham and M. Jobes, 1995, Pearson.
- An Introduction to Nuclear Physics. W. N. Cottingham and D.A. Greenwood, 2004, Chambridge.
- > Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- ▶ Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
- Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
- > Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
- Basic ideas and concepts in Nuclear Physics An Introductory Approach by
- K. Heyde (IOP- Institute of Physics Publishing, 2004).
- Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
- Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
- Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)

## • PHSADSE04T - Advanced Mathematical Physics II

Advanced Mathematical Physics II	
75 Lectures	6 Credits
Partial Differential Equations:	20 Lectures
Existence and uniqueness theorem for soutions of partial differential equations PDE's. Solution method for one homogeneous example of each type.	(PDE). Categorisation of
Inhomogeneous PDE. Green's function. General solution in terms of Green's func equation by Green's function method.	tion. Solution of Poisson's
Group Theory	30 Lectures
Review of sets, Mapping and Binary Operations, Relation, Types of Relations.	
Groups: Elementary properties of groups, uniqueness of solution, Subgroup, Centre of a group, Co-sets of a subgroup, cyclic group, Permutation/Transformation. Homomorphism and Isomorphism of group. Normal and conjugate subgroups, Completeness and Kernel.	
Some special groups with operators. Matrix Representations: Reducible and Irreducible representations. Schur's lemma. Orthogonality theorems. Character tables and their uses. Application to small vibrations.	
Continuous groups: Generator of Lie group. Rotation group and angular mo Homomorphism between SO(3) and SU(2).	mentum as its generator.
Advanced Probability Theory:	25 Lectures
Fundamental Probability Theorems. Conditional Probability, Bayes' Theorem, Repeated Trials, Binomial and Multinomial expansions. Random Variables and probability distributions, Expectation and Variance, Special Probability distributions: The binomial distribution, The Poisson distribution, Continuous distribution: The Gaussian (or normal) distribution, The principle of least squares.	
Reference Books	
<ul> <li>Lectures on Partial Differential Equation. V.I. Arnold, 2004, Springer-Verlag.</li> <li>Mathematical Methods for Physicists: Weber and Arfken, 2005, Academic Press.</li> <li>Mathematical Methods. S. Hassani, 2009, Springer Science.</li> <li>Mathematical Methods for Physicists: A Concise Introduction: Tai L. Chow, 2000, Cambridge Univ.</li> </ul>	
Elements of Group Theory for Physicists by A. W. Joshi, 1997, John Wiley	<i>ι</i> .
<ul> <li>Group Theory. P. Ramond, 2010, Chambrdge University Press.</li> <li>Group Theory and its Applications to Physical Problems by Morton Hamer</li> </ul>	rmesh, 1989, Dover

- Introduction to Mathematical Physics: Methods & Concepts: Chun Wa Wong, 2012, Oxford University Press
- Introduction to Mathematical Probability, J. V. Uspensky, 1937, Mc Graw-Hill.

## • PHSADSE05T - Astronomy and Astrophysics

Astronomy and Astrophysics	
75 Lectures	6 Credits
Astronomical Scales	24 Lectures
Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Lu Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, a concepts of positional astronomy: Celestial Sphere, Geometry of a Sph Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon S Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Distance by Parallax Method; Brightness, Radiant Flux and Luminosity, Apparen scale, Distance Modulus; Determination of Temperature and Radius of a star; Dete Binary orbits; Stellar Spectral Classification, Hertzsprung-Russell Diagram.	minosity, Measurement of Stellar Temperature. Basic ere, Spherical Triangle, ystem, Equatorial System, , Sidereal Time, Apparent of Stars: Determination of at and Absolute magnitude ermination of Masses from
Astronomical techniques	5 Lectures
Basic Optical Definitions for Astronomy (Magnification Light Gathering Pow Diffraction Limit, Atmospheric Windows), Optical Telescopes (Types of Reflect Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of I with Telescopes)	ver, Resolving Power and ting Telescopes, Telescope Detectors, detection Limits
Physical principles	4 Lectures
Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Sys Equilibrium.	tems in Thermodynamic
The sun and solar family	11 Lectures
The sun (Solar Daramators, Solar Dhotosphare, Solar Atmosphare, Chromeenhar	a Corona Solar Activity

The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology). The solar family (Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.

Stellar spectra and classification Structure (Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification). Main sequence, red giants and white dwarfs, Chandrashekhar mass limit.

The milky way	14 Lectures	
Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation		
of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral		
Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Gala	ctic Nucleus.	
Galaxies	7 Lectures	

Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms

#### Large scale structure & expanding universe

Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables), Hubble's Law (Distance- Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).

#### **Reference Books**

- Astrophysicsfor Physicists. Arnab Rai Choudhuri, 2010, Chambridge Univ. Press.
- Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer
- Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
- Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory,4<sup>th</sup> Edition, Saunders College Publishing.
- > The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books.
- K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002.
- Baidyanath Basu, 'An introduction to Astro physics', Second printing, Prentice Hall of India Private limited, New Delhi, 2001.
- Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication

#### **10 Lectures**

**12 Lectures** 

**10 Lectures** 

**10 Lectures** 

**10 Lectures** 

**10 Lectures** 

## • PHSADSE06T - Communication Electronics

Communication Electronics	
60 Lectures	4 Credits
Electronic communication	8 Lectures

Introduction to communication – means and modes. Need for modulation. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage. Channels and base-band signals. Concept of Noise, signal-to-noise (S/N) ratio.

#### **Analog Modulation**

Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver

#### **Analog Pulse Modulation**

Channel capacity, Sampling theorem, Basic Principles- PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.

#### **Digital Pulse Modulation**

Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).

#### Introduction to Communication and Navigation systems:

Satellite Communication– Introduction, need, Geosynchronous satellite orbits geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.

#### Mobile Telephony System:

Mobile Telephony System – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data

encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only).

GPS navigation system (qualitative idea only)

- Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
- Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
- Electronic Communication systems, G. Kennedy, 3rd Edn, 1999, Tata McGraw Hill.
- Principles of Electronic communication systems Frenzel, 3rd edition, McGraw Hill
- Communication Systems, S. Haykin, 2006, Wiley India
- Electronic Communication system, Blake, Cengage, 5th edition.
- Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press

## • PHSADSE06P – Communication Electronics Lab

Communication Electronics Lab		
60 Class Hours	2 Credits	
List of Practical		
1. To design an Amplitude Modulator using Transistor		
2. To study envelope detector for demodulation of AM signal		
3. To study FM - Generator and Detector circuit		
4. To study AM Transmitter and Receiver		
5. To study FM Transmitter and Receiver		
6. To study Time Division Multiplexing (TDM)		
7. To study Pulse Amplitude Modulation (PAM)		
8. To study Pulse Width Modulation (PWM)		
9. To study Pulse Position Modulation (PPM)		
<b>10.</b> To study ASK, PSK and FSK modulators		
Reference Books		
Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hil	1.	
Electronic Communication system, Blake, Cengage, 5th edition.		

# 4 Scheme for CBCS Curriculum B.Sc. (General) Program with *Physics* as one of the disciplines

## • Scheme for CBCS Curriculum

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course – I	English communication / Environmental Science	2
	Core course. I (from Dhusics)	PHSGCOR01T : Mechanics	4
	Core course – I (from Filysics)	PHSGCOR01P : Mechanics Lab	2
	Core course – II	DSC 2A (from Discipline 2)	6
	Core course – III	DSC 3A (from Discipline 3)	6
п	Ability Enhancement Compulsory Course – II	English communication / Environmental Science	2
		PHSGCOR02T : Electricity and Magnetism	4
	Core course – IV (from Physics)	<b>PHSGCOR02P</b> : Electricity and Magnetism Lab	2
	Core course – V	DSC 2B (from Discipline 2)	6
	Core course – VI	DSC 3B (from Discipline 3)	6
III	Core course VII (from Physics)	<b>PHSGCOR03T</b> : Thermal Physics and Statistical Mechanics	4
	Core course – vir (from Filysics)	<b>PHSGCOR03P</b> : Thermal Physics and Statistical Mechanics Lab	2
	Core course – VIII	DSC 2C (from Discipline 2)	6
	Core course – IX	DSC 3C (from Discipline 3)	6
	Skill Enhancement Course – 1	TBD	2
IV	Cora coursa V (from Dhusics)	PHSGCOR04T : Waves and Optics	4
	Core course – A (noin Physics)	PHSGCOR04P : Waves and Optics Lab	2
	Core course – XI	DSC 2D (from Discipline 2)	6
	Core course – XII	DSC 3D (from Discipline 3)	6
	Skill Enhancement Course-2	TBD	2
V	Skill Enhancement Course-3	TBD	2

	Discipline Specific Elective – 1	TBD (from Physics)	6
	Discipline Specific Elective – 2	TBD (from Discipline 2)	6
	Discipline Specific Elective – 3	TBD (from Discipline 3)	6
VI	Skill Enhancement Course-4	TBD	2
	Discipline Specific Elective – 4	TBD (from Physics)	6
	Discipline Specific Elective – 5	TBD (from Discipline 2)	6
	Discipline Specific Elective – 6	TBD (from Discipline 3)	6

\*TBD: To be decided by the student among the available choices mentioned below.

## 5. Syllabi of Core Papers (from Physics) for B.Sc. General with Physics

## • PHSGCOR01T - Mechanics

Mechanics	
60 Lectures	4 Credits
Mathematical Methods	10 Lectures
Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with re-	spect to a parameter.
Ordinary Differential Equations: 1 <sup>st</sup> order homogeneous differential equations. 2 inhomogeneous differential equations with constant coefficients.	<sup>nd</sup> order homogeneous and
Particle Dynamics	21 Lectures
Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a of Mass.	system of particles. Centre
Momentum and Energy: Conservation of momentum. Work and energy. Conserv rockets.	ation of energy. Motion of
Rotational Motion: Angular velocity and angular momentum. Torque. Conservation	n of angular momentum.
Gravitation	8 Lectures
Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force angular momentum is conserved, areal velocity is constant). Kepler's Laws (st circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic system (GPS).	field (motion is in a plane, atement only). Satellite in idea of global positioning
Oscillations	6 Lectures
Oscillations: Differential equation of SHM and its solutions. Kinetic and Potentia their time averages. Damped oscillations. Forced harmonic oscillations, resonance.	l Energy, Total Energy and
Elasticity	8 Lectures
Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Work done in str Expression for Poisson's ratio in terms of elastic constants - Work done in str twisting a wire - Twisting couple on a cylinder - Determination of Rigidity m	onstants - Poisson's Ratio- etching and work done in odulus by static torsion –

Torsional pendulum.- Bending of beam.

#### **Special Theory of Relativity**

7 Lectures

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

- Classical Mechanics. T.W.B. Kibble and F.H. Berkshire, 2004, Imp. Col. Press, World Scientific.
- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Classical Dynamics of Particles and Systems. S.T. Thornton and J. B. Marion, 2009, Brooks/Cole.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
- Classical Mechanics and General Properties of Matter. S.N. Maiti and D.P. Raychaudhuri, New Age
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- Special Relativity (MIT Introductory Physics). A.P. French, 2018, CRC Press.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.

## • PHSGCOR01P – Mechanics Lab

Mecha	nics	
60 clas	s hours	2 Credits
Genera	al Topic	
Discuss vernier	sion on random errors in observations. Measurement principles of l caliper, screw gauge and travelling microscope. Discussion on the parts of S	ength (or diameter) using Sextant.
List of	Practical	
1.	To study the random error in observations of time period of some oscillation	on using chronometer.
2.	To determine the Moment of Inertia of a regular body using another a	uxilary body and a cradle
	suspeded by a metalic wire.	
3.	To determine g and velocity for a freely falling body using Digital Timing	Technique
4.	To determine the Young's Modulus by flexure method.	
5.	To determine the Modulus of Rigidity of a Wire by a torsional pendulum.	
6.	To determine the height of a building using a Sextant.	
7.	To determine the elastic Constants of a wire by Searle's method.	
8.	To determine the value of g using Bar Pendulum.	
9.	To determine the value of g using Kater's Pendulum.	
10.	To study the Motion of Spring and calculate, (a) Spring constant, (b) g and	l (c) Modulus of rigidity.

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

#### • PHSGCOR02T - Electricity and Magnetism

Electricity and Magnetism	
60 Lectures	4 Credits
Vector Analysis	12 Lectures

Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

#### Electrostatics

Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field. Electric potential due to an electric dipole. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

#### Magnetism

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

#### **Electromagnetic Induction**

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

#### **Linear Network**

Impedance of L, C, R and their combinations. Thevenin & Norton's Theorem. Maximum power transfer theorem and superposition theorem. Anderson's bridge.

#### Maxwell's Equations and Electromagnetic Wave Propagation

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy

#### 10 Lectures

**18 Lectures** 

#### **6** Lectures

## 5 Lectures

**9** Lectures

density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

- Foundations of Electromagnetic Theory. J.R. Reitz, F.J. Milford and R.W. Christy, 2010, Pearson.
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Electromagnetism. I.S. Grant and W.R. Phillips, 2013, Wiley.
- Classical Electromagnetism. J. Franklin, 2008, Pearson Education.
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

## • PHSGCOR02P – Electricity and Magnetism Lab

	Electricity and Magnetism	
60 class hours     2 Credits	60 class hours	2 Credits

#### **General topic**

Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances (e) Checking electrical fuses and (f) circuit continuity check. Demonstration on Carey Foster's bridge, potentiometer, resistance box, inductor coil, moving coil galvanometer (in dead beat and ballistic mode), etc.

#### **List of Practicals**

- 1. To determine an unknown Low Resistance using Carey Foster's Bridge.
- 2. To verify the Thevenin and Norton theorems.
- 3. To verify the Superposition and Maximum power transfer theorems.
- 4. To determine self-inductance of a coil by Anderson's bridge.
- 5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
- 6. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
- 7. To study the characteristics of a series RC Circuit.
- 8. To determine an unknown Low Resistance using Potentiometer.
- 9. To determine the resistance of a galvanometer using Thomson's method.
- 10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

## • PHSGCOR03T - Thermal Physics and Statistical Mechanics

Thermal Physics and Statistical Mechanics	
60 Lectures	4 Credits
Laws of Thermodynamics	22 Lectures
Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.	
Thermodynamic Potentials	10 Lectures
Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule- Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.	
Kinetic Theory of Gases	10 Lectures
Derivation of Maxwell's law of distribution of velocities and its experimental ve (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (f equipartition of energy (no derivation) and its applications to specific heat of diatomic gases.	erification, Mean free path for vertical case), Law of f gases; mono-atomic and
Theory of Radiation	6 Lectures
Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wie Planck's law.	of Planck's law, Deduction n's displacement law from
Statistical Mechanics	12 Lectures
Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, distribution of velocity - Quantum statistics (qualitative discussion only) - Fer (statement only) - electron gas as an example of Fermi gas - Bose-Einstein distribut photon gas as an example of Bose gas- comparison of three statistics.	Maxwell-Boltzmann law - rmi-Dirac distribution law ution law (statement only) -

#### **Reference Books**

Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford Univ Press.
- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- > Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
- > Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and
- G.L. Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.

# • PHSGCOR03P – Thermal Physics and Statistical Lab

Thermal Physics and Statistical			
60 clas	s hours	2 Credits	
List of	Practical		
1.	Verification of Stefan's law using a torch bulb.		
2.	To determine the Coefficient of Thermal Conductivity of a bad conductor method.	by Lee and Charlton's disc	
3.	<b>3.</b> To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).using constant current source		
4.	<b>4.</b> To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.		
5.	To calibrate a thermocouple to measure temperature in a specified Rang potentiometer.	e by Null Method using a	
6.	To calibrate a thermocouple to measure temperature in a specified Rang using Op-Amp differential amplifier and to determine Neutral Temperat	ge by direct measurement ure	
7.	Measurement of unknown temperature using Diode sensor.		
8.	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's	constant flow method.	
9.	• To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.		
10.	To determine the Coefficient of Thermal Conductivity of Cu by Angstrom	's Method.	
Refere	nce Books		
•	Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971,	Asia Publishing House.	
	Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4	4th Edition, reprinted 1985,	
	Heinemann Educational Publishers		
	A Text Book of Practical Physics, Indu Prakash and Ramakrishna,	11th Edition, 2011, Kitab	
	Mahal, New Delhi.		
	A Laboratory Manual of Physics for Undergraduate Classes, D.P. Publication.	Khandelwal, 1985, Vani	

# • PHSGCOR04T - Waves and Optics

Waves and Optics		
60 Lectures	4 Credits	
Superposition of Two Collinear Harmonic oscillations	4 Lectures	
Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).		
Superposition of Two Perpendicular Harmonic Oscillations	2 Lectures	
Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequer	ncy and their uses.	
Waves Motion- General	7 Lectures	
Transverse waves on a string. Travelling and standing waves on a string. Normal velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.	Modes of a string. Group	
Fluids	6 Lectures	
Surface Tension: Synclastic and anticlastic surface - Excess of pressure - App cylindrical drops and bubbles - variation of surface tension with temperature.	plication to spherical and	
Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication.		
Qualitative discussion on water waves.		
Sound	6 Lectures	
Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem wave and square wave - Intensity and loudness of sound - Decibels - Intensity level scale. Acoustics of buildings: Reverberation and time of reverberation - Absorp formula - measurement of reverberation time - Acoustic aspects of halls and auditor	- Application to saw tooth s - musical notes - musical tion coefficient - Sabine's ria.	
Wave Optics	3 Lectures	

Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

Interference

Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

### **Michelson's Interferometer**

Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.

### Diffraction

Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

### **Polarization**

Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

### **Reference Books**

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Vibrations and Waves. A.P. French, 2003, CBS.
- Vibrations & Waves. G.C. King, 2009, Wiley.
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- General Properties of Matter. B. Brown, 1969, Springer Science.
- Classical Mechanics and General Properties of Matter. S.N. Maiti and D.P. Raychaudhuri, New Age
- > Optics. E. Hecht, 2003, Pearson Education.
- Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
- University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley

### **3** Lectures

**14 Lectures** 

### 5 Lectures

# • PHSGCOR04P – Waves and Optics Lab

Waves and Optics		
60 clas	s hours	2 Credits
List of	Practical	
1. 2. 3. 4. 5. 6.	To determine the frequency of an electric tuning fork by Melde's experime To determine Coefficient of Viscosity of water by Capillary Flow Method To determine refractive index of the Material of a prism using sodium sour To determine the dispersive power and Cauchy constants of the material source. To determine wavelength of sodium light using Fresnel Biprism. To determine wavelength of sodium light using Newton's Rings.	ent and verify $\lambda^2$ –T law. (Poiseuille's method). rce. of a prism using mercury
7. 8.	To determine dispersive power and resolving power of a plane diffraction. To determine the thickness of a thin paper by measuring the width produced by a wedge-shaped Film.	grating. of the interference fringes
9. 10. 11	Familiarization with: Schuster's focusing; determination of angle of prism To determine wavelength of (1) Na source and (2) spectral lines of Hg sou grating. To investigate the motion of coupled oscillators	arce using plane diffraction
11. 12.	To determine the wavelength of sodium source using Michelson's interfere	ometer.
Refere	nce Books	
> >	Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 197 Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4 Heinemann Educational Publishers A Text Book of Practical Physics, Indu Prakash and Ramakrishna,	<ul><li>71, Asia Publishing House.</li><li>th Edition, reprinted 1985,</li><li>11th Edition, 2011, Kitab</li></ul>

Mahal, New Delhi.

# 6. Syllabi of Department Specific Electives Papers (from Physics) for B.Sc. General with Physics

### • PHSGDSE01T - Digital, Analog Circuits and Instrumentation

Digital, Analog Circuits and Instrumentation	
60 Lectures	4 Credits
Digital Circuits	15 Lectures

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map

Binary Addition. Binary Subtraction using 2's Complement Method). Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.

### **Semiconductor Devices and Amplifiers**

### **15 Lectures**

Semiconductor Diodes: P and N type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff & Saturation regions Current gains  $\alpha$  and  $\beta$ . Relations between  $\alpha$  and  $\beta$ . Load Line analysis of Transistors. DC Load line & Q- point. Voltage Divider Bias Circuit for CE Amplifier. H-parameter, Equivalent Circuit. Analysis of single-stage CE amplifier using hybrid Model. Input & output Impedance. Current, Voltage and Power gains. Class A, B & C Amplifiers.

### **Operational Amplifiers (Black Box approach)**

### **14 Lectures**

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop and closed- loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero crossing detector.

Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations. Determination of Frequency of RC Oscillator

Instrumentations	16 Lectures		
Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.			
Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.			
Reference Books			
▶ Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Gra	aw Hill.		
Electronic devices & circuits, S. Salivahanan & N.S. Kumar, 2012, Tata	Mc-Graw Hill		
Microelectronic Circuits, M.H. Rashid, 2nd Edn., 2011, Cengage Learn	ing.		
Modern Electronic Instrumentation and Measurement Tech.,	Helfrick and Cooper, 1990,		
PHI Learning			
Digital Principles and Applications, A.P. Malvino, D.P. Leach and	Saha, 7th Ed., 2011, Tata		
McGraw Hill			
Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandork	ar, 2014, 6th Edn., Oxford		
University Press.			
Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009,	PHI Learning Pvt. Ltd.		
OP-AMP & Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning	ng Pvt. Ltd.		

# • PHSGDSE01P – Digital, Analog Circuits and Instrumentation Lab

Digital, Analog Circuits and Instruments			
60 clas	s hours	2 Credits	
List of	Practical		
1.	To measure (a) Voltage, and (b) Frequency of a periodic waveform using O	CRO	
2.	To verify and design AND, OR, NOT and XOR gates using NAND gates.		
3.	To minimize a given logic circuit.		
4.	4. Half adder, Full adder and 4-bit Binary Adder.		
5.	Adder-Subtractor using Full Adder I.C.		
6.	• To design an astable multivibrator of given specifications using 555 Timer.		
7.	To design a monostable multivibrator of given specifications using 555 Timer.		
8.	To study IV characteristics of PN diode, Zener and Light emitting diode		
9.	To study the characteristics of a Transistor in CE configuration.		
10.	To design a CE amplifier of given gain (mid-gain) using voltage divider be	las.	
11.	To design an inverting amplifier of given gain using Op-amp 741 and stud	y its frequency response.	
12.	12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency		
	Response.		
13.	To study Differential Amplifier of given I/O specification using Op-amp.		
14.	To investigate a differentiator made using op-amp.		
15.	To design a Wien Bridge Oscillator using an op-amp.		
Refere	nce Books		
•	Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Mille	er, 1994, Mc-Graw Hill.	
	Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice H	all.	
	OP-Amps & Linear Integrated Circuit, R.A. Gayakwad, 4th Edn, 2000, Pr	entice Hall.	

Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

# • PHSGDSE02T - Perspectives of Modern Physics

Perspectives of Modern Physics		
75 Lectures	6 Credits	
Relativistic Dynamics	8 Lectures	
Brief summary of Lorentz transformation and time dilation, length contraction, velocity addition etc. (no derivation required). Elastic collision between two particles as observed from two inertial frames with relative velocity, idea of relativistic momentum and relativistic mass. Mass-energy equivalence.		
Quantum Theory of Light	5 Lectures	
Review on the limitations of classical theory of electromagnetic radiation within a cavity and its solution by Planck's quantum hypothesis (no derivation required). Statement of Planck's law of black body radiation. Photoelectric effect. Einstein's postulate on light as a stream of photons. Compton's scattering and its explanation.		
Bohr's model	4 Lectures	
Limitations of Ruherford's model of atomic structure. Bohr's model, its successes and limitations.		
Wave-particle Duality	6 Lectures	
De Broglie's hypothesis – wave particle duality. Davisson-Germer experiment. Connection with Einstein's postulate on photons and with Bohr's quantization postulate for stationary orbits. Heisenberg's uncertainty relation as a consequence of wave-particle duality. Demonstration by $\gamma$ -ray microscope thought experiment. Estimating minimum energy of a confined particle using uncertainty principle.		
Estimating minimum energy of a confined particle using uncertainty principle.	scope thought experiment.	
Estimating minimum energy of a confined particle using uncertainty principle. Wave-function Description	7 Lectures	
Estimating minimum energy of a confined particle using uncertainty principle. Wave-function Description Two slit interference experiment with photons, atoms & particles; linear superposit wave functions as a consequence; Departure from matter wave interpretation and p of wave function; Schroedinger equation for non-relativistic particles; Momenter stationary states. Properties of wave function. Probability and probability current de	<b>7 Lectures</b> tion principle of associated probabilistic interpretation am and Energy operators; ensities in one dimension.	

One Dimensional infinitely rigid box, energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example. Quantum mechanical scattering and tunnelling in one dimension - across a step potential and

across a rectangular potential barrier (qualitative discussion with statements of end results only).

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**15 Lectures** 

Quantization rules energy and orbital angular momentum from Hydrogen and Hydrogen like atoms (no derivation); s, p, d,shells-subshells. Space quantization. Orbital Magnetic Moment and Magnetic Energy of electron, Gyromagnetic Ratio and Bohr magneton. Zeeman effect.

Electron Spin as relativistic quantum effect (qualitative discussion only), Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Larmor Precession. Spin-orbit interaction. Addition of angular momentum (statement only). Energy correction due to relativistic effect and spin-orbit ineraction (statement only). Fine-structure splitting.

Multi-electron atoms. Pauli's Exclusion Principle (statement only). Spectral Notations for atomic States. Aufbau principle, n+l rule (qualitative discussion only). Periodic table.

### **Nuclear Physics**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph. Binding energy curve.

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay, beta decay, gamma emission - basic characteristics.

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Basic principle of a nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and basic principle of thermonuclear reactions

### X-ray and Crystal Structure of Solids

Generation of X-ray. Mosley's law, explanation from Bohr's theory. Amorphous and crystalline solids. Lattice structure of crystalline (no categorisation required). Unit cell and basis vectors of a lattice. Diffraction of X-ray by crystalline solid. Bragg's law.

### **Reference Books**

- $\blacktriangleright$ Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles. R. Eisberg and R. Resnick, 1985, Wiley.
- $\blacktriangleright$ Perspectives of Modern Physics. A. Beiser, 1969, McGraw-Hill.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- $\blacktriangleright$ Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
- Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill ►

**15 Lectures** 

### **10 Lectures**

# • PHSGDSE03T – Solid State Physics

Solid State Physics		
60 Lectures	4 Credits	
Preliminary Topics	4 Lectures	
Review on Schroedinger equation in one dimension, stationary states. Maxy	well-Boltzman distribution law.	
Crystal Structure	12 Lectures	
Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.		
Elementary Lattice Dynamics	8 Lectures	
Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein theories of specific heat of solids. Debye correction (qualitative idea), T3 law (statement only).		
Magnetic Properties of Matter	12 Lectures	
Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.		
Dielectric Properties of Materials	9 Lectures	
Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena.		
Elementary band theory	10 Lectures	
Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.		
Superconductivity	5 Lectures	

Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors.

### **Reference Books**

- The Oxford Solid State Basics. S. H. Simon, 2013, Oxford.
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
- Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
- Solid State Physics, Rita John, 2014, McGraw Hill
- Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

# • PHSGDSE03P – Solid State Physics Lab

Solid State Physics			
60 clas	s hours	2 Credits	
List of	Practical		
1.	To determine the Coupling Coefficient of a Piezoelectric crystal.		
2.	To measure the Dielectric Constant of a dielectric Materials with frequence	у	
3.	3. To study the characteristics of a Ferroelectric Crystal.		
4.	4. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.		
5.	5. To measure the resistivity of a semiconductor (Ge) with temperature by reverse bias characteristics		
	of Ge diode (room temperature to 80 oC) and to determine its band gap.		
6.	To determine the Hall coefficient of a semiconductor sample.		
7.	• To study temperature coefficient of a semiconductor (NTC thermistor)		
8.	3. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)		
9.	9. To measure the Magnetic susceptibility of Solids.		
10.	10. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon		
	resonance (SPR)		
11.	To determine the refractive index of a dielectric layer using SPR		
Refere	nce Books		
	Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 19	71, Asia Publishing House.	
	Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4	th Edition, reprinted 1985,	
	Heinemann Educational Publishers		
	A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn., 20	)11, Kitab Mahal	
	Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-H	Iall of India	

#### **PHSGDSE04T - Nuclear and Particle Physics**

Nuclear And Particle Physics	
75 Lectures	6 Credits
Preliminary Topics 3 Lectures	
Review of mass-energy equivalence, quantum semiconductors.	tunnelling. Qualitative discussion on properties of

### **General Properties of Nuclei**

Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

### **Nuclear Models**

Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

### **Radioactivity decay**

(a) Alpha decay: basics of  $\alpha$ -decay processes, theory of  $\alpha$ - emission, Gamow factor, Geiger Nuttall law,  $\alpha$ decay spectroscopy. (b) -decay: energy kinematics for -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.

### **Nuclear Reactions**

Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering(Rutherford scattering).

### Interaction of Nuclear Radiation with matter

Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction

### **8** Lectures

# **11 Lectures**

9 Lectures

**8** Lectures

# **10 Lectures**

with matter.

### **Detector for Nuclear Radiations**

Basic principles of ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

### **Particle Accelerators**

Linear accelerator, Cyclotron, Synchrotrons.

### **Particle physics**

Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

### **Reference Books**

- Nuclear Physics. J.S. Lilley, 2001, John Wiley & Sons.
- Nuclear and Particle Physics. B.R. Martin, 2006, John Wiley & Sons.
- Nuclear and Particle Physics, W.F. Burcham and M. Jobes, 1995, Pearson.
- An Introduction to Nuclear Physics. W. N. Cottingham and D.A. Greenwood, 2004, Chambridge.
- Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
- Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
- Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
- Basic ideas and concepts in Nuclear Physics An Introductory Approach by
- K. Heyde (IOP- Institute of Physics Publishing, 2004).
- Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
- Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).

### 7 Lectures

## 14 Lectures

**5** Lectures

# 7 Syllabi of Generic Elective Papers (from Physics) forB.Sc. Honours in Subjects Other than Physics

Syllabus for **PHSHGEC01T: Mechanics** is identical with

that of PHSGCOR01T: Mechanics offered for B.Sc. General with Physics

Syllabus for PHSHGEC01P : Mechanics Lab is identical with

that of PHSGCOR01P: Mechanics Lab offered for B.Sc. General with Physics

Syllabus for PHSHGEC02T: Electricity and Magnetism is identical with

that of PHSGCOR02T: Electricity and Magnetism offered for B.Sc. General with Physics

Syllabus for PHSHGEC02P: Electricity and Magnetism Lab is identical with

that of PHSGCOR02P: Electricity and Magnetism Lab offered for B.Sc. General with Physics

Syllabus for PHSHGEC03T: Thermal Physics and Statistical Mechanics is identical with

that of PHSGCOR03T : Thermal Physics and Statistical Mechanics offered for B.Sc. General with Physics

Syllabus for PHSHGEC03P: Thermal Physics and Statistical Mechanics Lab is identical with

that of PHSGCOR03P: Thermal Physics and Statistical Mechanics Lab offered for B.Sc. General with Physics

Syllabus for PHSHGEC04T: Waves and Optics is identical with

that of PHSGCOR04T: Waves and Optics offered for B.Sc. General with Physics

Syllabus for PHSHGEC04P: Waves and Optics Lab is identical with

that of PHSGCOR04P: Waves and Optics Lab offered for B.Sc. General with Physics

# 8 Skill Enhancement Courses

### • PHSSSEC01M - Basic Instrumentation Skills

Basic of Measurement	
30 class hours	2 Credits

### **Basic of Measurement**

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

### **Electronic Voltmeter**

Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier-rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

### **Cathode Ray Oscilloscope**

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

### Signal Generators and Analysis Instruments

Block diagram, explanation and specifications of low frequency signal generators. Pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

### **Impedance Bridges & Q-Meters**

Block diagram of bridge: working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

### **Digital Instruments**

Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

### **Digital Multimeter**

Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

### The test of lab skills will be of the following test items:

- 1. Use of an oscilloscope.
- 2. CRO as a versatile measuring device.
- 3. Circuit tracing of Laboratory electronic equipment,
- 4. Use of Digital multimeter/VTVM for measuring voltages
- 5. Circuit tracing of Laboratory electronic equipment,
- 6. Winding a coil / transformer.
- 7. Study the layout of receiver circuit.
- 8. Trouble shooting a circuit
- 9. Balancing of bridges

### Laboratory Exercises

- 1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
- 2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
- 3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
- 4. Measurement of voltage, frequency, time period and phase angle using CRO.
- 5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
- 6. Measurement of rise, fall and delay times using a CRO.
- 7. Measurement of distortion of a RF signal generator using distortion factor meter.
- 8. Measurement of R, L and C using a LCR bridge/ universal bridge.

### **Open Ended Experiments**

- 1. Using a Dual Trace Oscilloscope
- 2. Converting the range of a given measuring instrument (voltmeter, ammeter)

### **Reference Books**

- A text book in Electrical Technology B L Theraja S Chand and Co.
- Performance and design of AC machines M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

## • PHSSSEC02M - Computational Physics Skills

Computational Physics	
30 class hours	2 Credits

### Introduction

Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

### **Scientific Programming**

Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN/ C++, Basic elements of FORTRAN 90/95 or C++: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran 90/95 or C++ Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

### **Control Statements**

Types of Logic (Sequential, Selection, Repetition), Branching Statements, Looping Statements, Jumping Statements, Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

### Programming

- 1. Exercises on syntax on usage of FORTRAN 90/95 or C++
- 2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN 90/95 or C++.
- 3. To print out all natural even/ odd numbers between given limits.
- 4. To find maximum, minimum and range of a given set of numbers.

5. Calculating Euler number using exp(x) series evaluated at x=1

### Scientific word processing: Introduction to LaTeX

TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

### Visualization

Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

### Hands on exercises

- 1. To compile a frequency distribution and evaluate mean, standard deviation etc.
- 2. To evaluate sum of finite series and the area under a curve.
- 3. To find the product of two matrices
- 4. To find a set of prime numbers and Fibonacci series.
- 5. To write program to open a file and generate data for plotting using Gnuplot.
- 6. Plotting trajectory of a projectile projected horizontally.
- 7. Plotting trajectory of a projectile projected making an angle with the horizontally.
- 8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
- 9. To find the roots of a quadratic equation.
- 10. Motion of a projectile using simulation and plot the output for visualization.
- 11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
- 12. Motion of particle in a central force field and plot the output for visualization.

#### **Reference Books**

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 90 and 95. V. Rajaraman, 1997 (Publisher: PHI).
- b Object Oriented Programming with C++. E. Balaguruswamy, 2017. McGraw Hill, India.
- LaTeX-A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)

- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R.C. Verma, et al. New Age International Publishers, New Delhi(1999)
- A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
- Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn., 2007, Wiley India Edition.

# WEST BENGAL STATE UNIVERSITY

# DRAFT SYLLABUS IN CHEMISTRY (GENERAL)

# UNDER

# **CHOICE BASED CREDIT SYSTEM**

2018

# Scheme for CBCS Curriculum for BSc. Chemistry

### **Credit Distribution across Courses**

	Credits			
Course Type		Total Papers	Theory + Practical	
Core Courses	4 papers each from 3 disciplines of choice	12	12X4 =48 12X2 =24	
Elective Courses	2 papers each from 3 discipline of choice including interdisciplinary papers	6	6X4=24 6X2=12	
Ability Enhancement Language Courses		2	2X2=4	
Skill Enhancement Courses		4	4X2=8	
Totals		24	120	

# Scheme for CBCS Curriculum

Semester	Course Name	Course Detail	Credits	Marks
Ι	Ability Enhancement Compulsory			
	Course–I	English communication / Environmental Science	2	25
	Core course–I	CEMGCOR01T	4	50
	Core course–I Practical	CEMGCOR01P	2	25
	Core course–II	Core Course 2A from other chosen discipline	4	50
	Core course–II Practical	Core Course 2A Practical from other chosen discipline	2	25
	Core course – III	Core Course 3A from other chosen discipline	4	50
	Core course – III Practical	Core Course 3A Practical from other chosen discipline	2	25

II	Ability Enhancement Compulsory			
	Course–II	English communication / Environmental Science	2	25
	Core course–IV	CEMGCOR02T	4	50
	Core course–IV Practical	CEMGCOR02P	2	25
	Core course–V	Core Course 2B from other chosen discipline	4	50
	Core course– V Practical	Core Course 2B Practical from other chosen discipline	2	25
	Core course – VI	Core Course 3B from other chosen discipline	4	50
	Core course – VI Practical	Core Course 3B Practical from other chosen discipline	2	25
Ш	Core course VII	CEMGCOR03T	4	50
	Core course–VII Practical	CEMGCOR03P	2	25
	Core course – VIII	Core Course 2C from other chosen discipline	4	50
	Core course – VIII Practical	Core Course 2C Practical from other chosen discipline	2	25
	Core course–IX	Core Course 3C from other chosen discipline	4	50

	Core course–IX Practical	Core Course 3C Practical from other chosen discipline	2	25
	Skill Enhancement Course-1		2	25
IV	Core course–X	CEMGCOR04T	4	50
	Core course – X Practical	CEMGCOR04P	2	25
	Core course–XI	Core Course 2D from other chosen discipline	4	50
	Core course–XI Practical	Core Course 2D Practical from other chosen discipline	2	25
	Core course–XII	Core Course 3D from other chosen discipline	4	50
	Core course–XII Practical	Core Course 3D Practical from other chosen discipline	2	25
	Skill Enhancement Course-2		2	25
V	Skill Enhancement Course – 3		2	25
	Discipline Specific Elective 1	DSE is to be chosen from CEMGDSE01T and CEMGDSE02T	4	50

	Discipline Specific Elective 1 Practical	<b>DSE</b> is to be chosen from <b>CEMGDSE01P and CEMGDSE02P</b>	2	25
	Discipline Specific Elective 2	DSE 2A from other chosen discipline	4	50
	Discipline Specific Elective 2 Practical	DSE 2A Practical from other chosen discipline	2	25
	Discipline Specific Elective 3	DSE 3A from other chosen discipline	4	50
	Discipline Specific Elective 3 Practical	DSE 3A Practical from other chosen discipline	2	25
VI	Skill Enhancement Course – 4		2	25
	Discipline Specific Elective 4	DSE is to be chosen from CEMGDSE03T and CEMGDSE04T	4	50
	Discipline Specific Elective 4 Practical	DSE is to be chosen from CEMGDSE03P and CEMGDSE04P	2	25
	Discipline Specific Elective 5	DSE 2B from other chosen discipline	4	50
	Discipline Specific Elective 5 Practical	DSE 2B Practical from other chosen discipline	2	25
	Discipline Specific Elective 6	DSE 3B from other chosen discipline	4	50
	Discipline Specific Elective 6 Practical	DSE 3B Practical from other chosen discipline	2	25
		Total	120	1500

# Discipline Specific Elective papers (Credit: 06 each) (DSE 1, DSE 2):

## Chemistry

- CEMGDSE01T : Polymer Chemistry (4)
   CEMGDSE01P : Polymer Chemistry Lab (2)
- CEMGDSE02T: Green Chemistry (4)
   CEMGDSE02P: Green Chemistry Lab (2)
- 3. **CEMGDSE03T:** Inorganic Materials of Industrial Importance (4) **CEMGDSE03T:** Inorganic Materials of Industrial Importance Lab (2)
- 4. **CEMGDSE04:** ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY (4)

CEMGDSE04: ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY Lab (2)

### SEMESTER-I

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# CEMGCOR01T: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES, REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC

### **HYDROCARBONS**

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Section A: Inorganic Chemistry-I (30 Lectures) Marks: 25

### **Atomic Structure**

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, *Aufbau* principle and its limitations.

### **Chemical Periodicity**

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements.

### Acids and bases (10 Lectures)

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

### **Redox reactions**

Balancing of equations by oxidation number and ion-electron method oxidimetry and reductimetry.

Section B: Organic Chemistry-I

(30 Lectures) Marks: 25

### **Fundamentals of Organic Chemistry**

*Electronic displacements*: inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles electrophiles; reactive intermediates: carbocations, carbanions and free radicals.

### (05 Lectures)

(10 Lectures)

### (05 Lectures)

# (5 Lectures)

# (plane and centre); interconversion of Fischer and Newman representations; enantiomerism and diastereomerism, *meso* compounds; *threo* and *erythro*, D and L, *cis* and *trans* nomenclature; CIP Rules: *R/S* (upto 2 chiral carbon atoms) and *E/Z* nomenclature.

# Nucleophilic Substitution and Elimination Reactions (5 Lectures)

*Nucleophilic substitutions*:  $S_N1$  and  $S_N2$  reactions; eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations; elimination *vs* substitution.

# Aliphatic Hydrocarbons

Stereochemistry

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures.

*Alkanes:* (up to 5 Carbons). *Preparation:* catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* mechanism forfree radical substitution: halogenation.

*Alkenes:* (up to 5 Carbons). *Preparation:* elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; *cis* alkenes (partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions: cis*-addition (alkaline KMnO<sub>4</sub>) and *trans*-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and antiMarkownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction.

*Alkynes:* (up to 5 Carbons). *Preparation:* acetylene from  $CaC_2$  and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO<sub>4</sub>, ozonolysis and oxidation with hot alkaline KMnO<sub>4</sub>.

# **Reference Books:**

- 1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
- 2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3<sup>rd</sup> ed., Wiley.
- 3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in *InorganicChemistry*, John Wiley & Sons.
- 4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry:Principles* of Structure and Reactivity, Pearson Education India, 2006.
- 5. Sethi, A. Conceptual Organic Chemistry; New Age International Publisher.
- 6. Parmar, V. S. A Text Book of Organic Chemistry, S. Chand & Sons.
- 7. Madan, R. L. Organic Chemistry, S. Chand & Sons.

# 7

Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (up to two carbon atoms); asymmetric carbon atom; elements of symmetry

# (12 Lectures)

# (8 Lectures)

- 8. Wade, L. G., Singh, M. S., Organic Chemistry.
- 9. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 10. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 11. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
- 12. Sen Gupta, Subrata. Basic Stereochemistry of Organic molecules.
- 13. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, Eighth edition, New Age International, 2014.
- 14. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

# CEMGCOR01P: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES, REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC

### HYDROCARBONS LAB

(60 Lectures/Contact Hours) Marks: 25

### Section A: Inorganic Chemistry -LAB

### (30 Lectures)

- 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
- 2. Estimation of oxalic acid by titrating it with KMnO<sub>4</sub>.
- 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.
- 4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
- 5. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.

### Section B: Organic Chemistry- LAB (30 Lectures)

*Qualitative Analysis of Single Solid Organic Compound(s)* 

Experiment A: Detection of special elements (N, Cl, and S) in organic compounds.

Experiment B: Solubility and Classification (solvents: H<sub>2</sub>O, dil. HCl, dil. NaOH)

Experiment C: Detection of functional groups: Aromatic- $NO_2$ , Aromatic - $NH_2$ , -COOH, carbonyl (no distinction of -CHO and >C=O needed), -OH (phenolic) in solid organic compounds.

Experiments A - C with unknown (at least 6) solid samples containing not more than two of the above type of functional groups should be done.

### **Reference Books:**

- 1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Das, S. C., Chakraborty, S. B., Practical Chemistry.
- 3. Mukherjee, K. S. Text book on Practical Chemistry, New Oriental Book Agency.
- 4. Ghosal, Mahapatra & Nad, An Advanced course in practical Chemistry, New Central Book Agency.
- 5. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 2: *Qualitative Organic Analysis*, CBS Publishers and Distributors.
- 6. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- 7. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

### **SEMESTER-II**

# CEMGCOR02T: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

### Section A: Physical Chemistry-I

(30 Lectures) Marks: 25

### Kinetic Theory of Gases and Real gases

### (10 Lectures)

Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of effusion

Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy; Average velocity, root mean square velocity and most probable velocity; Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour; Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states

Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only)

### Liquids

### (06 Lectures)

Definition of Surface tension, its dimension and principle of its determination using stalagmometer; Viscosity of a liquid and principle of determination of coefficient of viscosity using Ostwald viscometer; Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

### Solids

# (06 Lectures)

Forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry elements; Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices; Miller indices

of different planes and interplanar distance, Bragg's law; Structures of NaCl, KCl and CsCl (qualitative treatment only); Defects in crystals; Glasses and liquid crystals. Chemical Kinetics (08 Lectures)

# Introduction of rate law, Order and molecularity; Extent of reaction; rate constants; Rates of First, second and nth order reactions and their Differential and integrated forms (with

derivation); Pseudo first order reactions; Determination of order of a reaction by half-life and differential method; Opposing reactions, consecutive reactions and parallel reactions

Temperature dependence of rate constant; Arrhenius equation, energy of activation; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)

### **Reference Books:**

- 1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- 2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- 3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- 4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- 5. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- 6. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., Essentials of Physical Chemistry S. Chand & Co. ltd.
- 8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
- 9. Mandal, A. K. Degree Physical and General Chemistry Sarat Book House
- 10. Pahari, S., Physical Chemistry New Central Book Agency
- 11. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency

### Section B: Inorganic Chemistry-II

(30 Lectures) Marks: 25

### **Chemical Bonding and Molecular Structure**

### (16 Lectures)

*Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionicbonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, BornHaber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

*Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions on the basisof VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s*-*s*, *s*-*p* and *p*-*p*combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods. (including idea of *s*- *p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>. Comparison of VB and MO approaches.

### Comparative study of p-block elements:

### (14 Lectures)

Group trends in electronic configuration, modification of pure elements, common oxidation states, inert pair effect, and their important compounds in respect of the following groups of elements:

i)B-Al-Ga-In-Tl ii)C-Si-Ge-Sn-Pb iii)N-P-As-Sb-Bi iv)O-S-Se-Te v)F-Cl-Br-I

### **Reference Books:**

- 1. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
- 2. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
- 3. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
- 4. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd.,

2008. -----

### CEMGCOR02P: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS LAB

### (60 Lectures/Contact Hours) Marks: 25

### Section A: Physical Chemistry-LAB

### (15x2=30 Lectures)

(Minimum five experiments to complete)

- (I) Surface tension measurement (use of organic solvents excluded)
  - a) Determination of the surface tension of a liquid or a dilute solution using a Stalagmometer
  - b) Study of the variation of surface tension of a detergent solution with concentration
- (II) Viscosity measurement (use of organic solvents excluded)
  - a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer
  - b) Study of the variation of viscosity of an aqueous solution with concentration of solute

(III) Study the kinetics of the following reactions

- a) Initial rate method: Iodide-persulphate reaction
- b) Integrated rate method:
  - (i) Acid hydrolysis of methyl acetate with hydrochloric acid
  - (ii) Compare the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying kinetics of hydrolysis of methyl acetate

### **Reference Books:**

- 1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Palit, S.R., Practical Physical Chemistry Science Book Agency
- 3. Mukherjee, N.G., Selected Experiments in Physical Chemistry J. N. Ghose & Sons
- 4. Dutta, S.K., Physical Chemistry Experiments Bharati Book Stall

### Section B: Inorganic Chemistry-LAB

Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions.

(30 Lectures)

Acid Radicals: Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, S<sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, H<sub>3</sub>BO<sub>3</sub>. Basic Radicals: Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Sr<sup>2+</sup>, Ba<sup>2+</sup>, Cr<sup>3+</sup>, Mn<sup>2+</sup>, Fe<sup>3+</sup>, Ni<sup>2+</sup>, Cu<sup>2+</sup>, NH<sub>4</sub><sup>+</sup>.

### **Reference Books:**

- 1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- 2. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
#### SEMESTER-III

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# **CEMGCOR03T: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY-II** (Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Section A: Physical Chemistry-II

(30 Lectures) Marks: 25

#### **Chemical Energetics**

#### (14 Lectures)

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases

Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature

Statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine, refrigerator and efficiency; Entropy change of systems and surroundings for various processes and transformations; Auxiliary state functions (G and A) and Criteria for spontaneity and equilibrium.

#### **Chemical Equilibrium:**

Thermodynamic conditions for equilibrium, degree of advancement; Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs' free energy change; Definitions of  $K_P$ ,  $K_C$  and  $K_X$  and relation among them; van't Hoff's reaction isotherm, isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle

#### Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts; Buffer solutions; Solubility and solubility product of sparingly soluble salts – applications of solubility product principle

#### (08 Lectures)

(08 Lectures)

# **Reference Books:**

- 1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- 2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- 3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- 4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- 5. Ekambaram, S. General Chemistry, Pearson.
- 6. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- 7. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry Kalyani Publishers8.Bahl, B.S., Bahl, A., Tuli, G.D., Essentials of Physical Chemistry S. Chand & Co. ltd.
- 9. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
- 10. Mandal, A. K. Degree Physical and General Chemistry Sarat Book House
- 11. Pahari, S., Physical Chemistry New Central Book Agency
- 12. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency

## Section-B: Organic Chemistry-II

#### (30 Lectures) Marks: 25

Functional group app roach for the following reactions (preparations & reactions) to be studied in context to their structures.

## Aromatic Hydrocarbons

*Benzene:Preparation*: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: electrophilic substitution (general mechanism); nitration (with mechanism), halogenations (chlorination and bromination), sulphonation and Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene); side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

## **Organometallic Compounds**

Introduction; *Grignard reagents: Preparations* (from alkyl and aryl halide); concept of *umpolung;* Reformatsky reaction.

# **Aryl Halides**

*Preparation:* (chloro-, bromo- and iodobenzene): from phenol, Sandmeyer reactions. *Reactions (Chlorobenzene):* nucleophilic aromatic substitution (replacement by –OH group) and effect of nitro substituent (activated nucleophilic substitution).

# **06 Lectures)**

# (3 Lectures)

(2 Lectures)

### Alcohols, Phenols and Ethers

## (11 Lectures)

*Alcohols:* (up to 5 Carbons). *Preparation:*  $1^{\circ}$ -,  $2^{\circ}$ - and  $3^{\circ}$ - alcohols: using Grignard reagent, reduction of aldehydes, ketones, carboxylic acid and esters; *Reactions:* With sodium, HX (Lucas test), oxidation (alkaline KMnO<sub>4</sub>, acidic dichromate, concentrated HNO<sub>3</sub>);

Oppenauer oxidation;

*Diols: Preparation* (with OsO<sub>4</sub>); pinacol- pinacolone rearrangement (with mechanism) (*with symmetrical diols* only).

*Phenols:Preparation:* cumene hydroperoxide method, from diazonium salts; acidic nature of phenols; *Reactions:* electrophilic substitution: nitration and halogenations; Reimer -Tiemann reaction, Houben–Hoesch condensation, Schotten –Baumann reaction, Fries rearrangement and Claisen rearrangement.

Ethers: Preparation: Williamson's ether synthesis; Reaction: cleavage of ethers with HI.

#### **Carbonyl Compounds**

#### (08 Lectures)

*Aldehydes and Ketones (aliphatic and aromatic):* (Formaldehye, acetaldehyde, acetone and benzaldehyde): *Preparation:* from acid chlorides, from nitriles and from Grignard reagents; general properties of aldehydes and ketones; *Reactions:* with HCN, ROH, NaHSO<sub>3</sub>, NH<sub>2</sub>-G derivatives and with Tollens' and Fehling's reagents; iodoform test; aldol condensation (with mechanism); Cannizzaro reaction (with mechanism), Wittig reaction, benzoin condensation; Clemmensen reduction, Wolff- Kishner reduction and Meerwein-Pondorff-Verley (MPV) reduction.

#### **Reference Books:**

- 1. Sethi, A. Conceptual Organic Chemistry; New Age International Publisher.
- 2. Parmar, V. S. A Text Book of Organic Chemistry, S. Chand & Sons.
- 3. Madan, R. L. Organic Chemistry, S. Chand & Sons.
- 4. Wade, L. G., Singh, M. S., Organic Chemistry, Pearson.
- 5. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 6. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

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# CEMGCOR03P: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY LAB (60 Lectures/Contact Hours) Marks: 25

#### Section A: Physical Chemistry-LAB

(15x2=30 Lectures)

(Minimum <u>five</u> experiments to complete)

- (I) Thermochemistry (Any <u>three</u>)
  - 1. Determination of heat capacity of calorimeter for different volumes
  - 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
  - 3. Determination of enthalpy of ionization of acetic acid
  - 4. Determination of enthalpy of hydration of copper sulphate
- (II) Ionic Equilibria (Any <u>two</u>)
  - a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter and compare it with the indicator method
  - b) Preparation of buffer solutions and find the pH of an unknown buffer solution by colour matching method (using following buffers)
    - (i) Sodium acetate-acetic acid
    - (ii) Ammonium chloride-ammonium hydroxide

c)Study of the solubility of benzoic acid in water

#### **Reference Books:**

- 1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
- 3. Mukherjee, N.G., Selected Experiments in Physical Chemistry J. N. Ghose & Sons
- 4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

#### Section B: Organic Chemistry-LAB

## Identification of a pure organic compound

*Solid compounds*: oxalic acid, tartaric acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid.

*Liquid Compounds*: methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene

#### **Reference Books:**

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbookof Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.

3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

#### **SEMESTER-IV**

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#### CEMGCOR04T: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE,

#### **ELECTROCHEMISTRY & ANALYTICAL AND ENVIORNMETAL CHEMISTRY-I**

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Section A: Physical Chemistry-III (30 Lectures) Marks: 25

#### Solutions

Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions; Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions; Distillation of solutions; Lever rule; Azeotropes

Critical solution temperature; effect of impurity on partial miscibility of liquids; Immiscibility of liquids- Principle of steam distillation; Nernst distribution law and its applications, solvent extraction

#### Phase Equilibria

Phases, components and degrees of freedom of a system, criteria of phase equilibrium; Gibbs' Phase Rule and its thermodynamic derivation; Derivation of Clausius – Clapeyron equation and its importance in phase equilibria; Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (leadsilver, FeCl<sub>3</sub>-H<sub>2</sub>O and Na-K only)

#### Conductance

Conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes; Ostwald's dilution law; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations (acid-base)

Transport Number and principles of Hittorf's and Moving-boundary method

#### **Electromotive force**

Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry; Chemical cells, reversible

#### (08 Lectures)

#### (08 Lectures)

(08 Lectures)

# (06 Lectures)

and irreversible cells with examples; Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential; Electrochemical series;

Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data

Concentration cells with and without transference, liquid junction potential; pH determination using hydrogen electrode and quinhydrone; Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)

#### **Reference Books:**

- 1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- 2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- 3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- 4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- 5. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- 6. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., Essentials of Physical Chemistry S. Chand & Co. ltd.
- 8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
- 9. Pahari, S., Physical Chemistry New Central Book Agency
- 10. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency

### Section B: Analytical and Environmental Chemistry (30 Lectures) Marks: 25

#### **Chemical Analysis**

## (15 Lectures)

*Gravimetric analysis*: solubility product and common ion effect; requirements of gravimetry; gravimetric estimation of chloride, sulphate, lead, barium, nickel, copper and zinc.

*Volumetric analysis*: primary and secondary standard substances; principles of acid-base, oxidation –reduction and complexometric titrations; indicators: acid-base, redox and metal ion; principles of estimation of mixtures: NaHCO<sub>3</sub> and Na<sub>2</sub>CO<sub>3</sub> (by acidimetry); iron, copper, manganese and chromium (by redox titration); zinc, aluminum, calcium and magnesium (by complexometric EDTA titration).

*Chromatography*: chromatographic methods of analysis: column chromatography and thin layer chromatography.

#### **Environmental Chemistry**

*The Atmosphere*: composition and structure of the atmosphere; troposphere, stratosphere, mesosphere and thermosphere; ozone layer and its role; major air pollutants: CO,  $SO_2$ ,  $NO_x$  and particulate matters – their origin and harmful effects; problem of ozone layer depletion; green house effect; acid rain and photochemical smog; air pollution episodes: air quality

(15 Lectures)

standard; air pollution control measures: cyclone collector, electrostatic precipitator, catalytic converter.

*The Hydrosphere*: environmental role of water, natural water sources, water treatment for industrial, domestic and laboratory uses; water pollutants; action of soaps and detergents, phosphates, industrial effluents, agricultural runoff, domestic wastes; thermal pollution, radioactive pollution and their effects on animal and plant life; water pollution episodes: water pollution control measures : waste water treatment; chemical treatment and microbial treatment; water quality standards: DO, BOD, COD, TDS and hardness parameters; desalination of sea water : reverse osmosis, electrodialysis.

*The Lithosphere*: water and air in soil, waste matters and pollutants in soil, waste classification, treatment and disposal; soil pollution and control measures.

#### **Reference Books:**

- 1. Banerjee, S. P. A Text Book of Analytical Chemistry, The New Book Stall.
- 2. Gangopadhyay, P. K. Application Oriented Chemistry, Book Syndicate.
- 3. Mondal, A. K & Mondal, S. Degree Applied Chemistry, Sreedhar Publications.
- 4. Banerjee, S. P. A Text Book of Analytical Chemistry, The New Book Stall.

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#### CEMGCOR04P: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE,

#### **ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-II LAB**

#### (60 Lectures/Contact Hours) Marks: 25

#### Section A: Physical Chemistry-LAB

(15x2=30 Lectures)

(Minimum six experiments to complete)

(I) Distribution Law (Any **one**)

Study of the equilibrium of <u>one of the following reactions</u> by the distribution method:

$$I_2(aq) + I(aq) = I_3(aq)$$

$$Cu^{2+}(aq) + xNH_2(aq) = [Cu(NH_3)x]^{2+}$$

- (II) Phase equilibria (Any **one**)
  - a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves
  - b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it
- (III) Conductance
  - a) Determination of dissociation constant of a weak acid (cell constant, equivalent conductance are also determined)
  - b) Perform the following conductometric titrations: (Any one)
    - (i) Strong acid vs. strong base
    - (ii) Weak acid vs. strong base
- (IV) Potentiometry

Perform the following potentiometric titrations:

- (i) Weak acid vs. strong base
- (ii) Potassium dichromate vs. Mohr's salt

#### **Reference Books:**

- 1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Palit, S.R., Practical Physical Chemistry Science Book Agency

- 3. Mukherjee, N.G., Selected Experiments in Physical Chemistry J. N. Ghose & Sons
- 4. Dutta, S.K., Physical Chemistry Experiments Bharati Book Stall

#### Section B: Analytic and Environmental Chemistry-LAB (30 Lectures)

- 1. To find the total hardness of water by EDTA titration.
- 2. To find the PH of an unknown solution by comparing color of a series of HCl solutions + 1 drop of methyl orange, and a similar series of NaOH solutions + 1 drop of phenolphthalein.
- 3. To determine the rate constant for the acid catalysed hydrolysis of an ester.
- 4. Determination of the strength of the H2O2 sample.
- 5. To determine the solubility of a sparingly soluble salt, e.g. KHTa (one bottle)

#### **Reference Books:**

- 1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- 2. Ghosal, Mahapatra & Nad, An Advanced Course in Practical Chemistry, New Central Book Agency.
- 3. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N. University of Calcutta, 2003.
- 4. Das, S. C., Chakraborty, S. B., Practical Chemistry.

# **Discipline Specific Electives**

CHEMISTRY-DSE I-IV (ELECTIVES) CEMGDSE01T: POLYMER CHEMISTRY (Credits: Theory-06, Practicals-02) Theory: 60 Lectures Marks:50

#### Introduction and history of polymeric materials:

#### (4 Lectures) Marks:04

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of polymers.

#### Functionality and its importance:

#### (8 Lectures) Marks:06

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

#### **Kinetics of Polymerization:**

#### (8 lectures) Marks:06

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

#### **Crystallization and crystallinity:**

#### (4 Lectures) Marks:04

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

#### Nature and structure of polymers-

#### (2 Lectures) Marks:04

Structure Property relationships.

#### Determination of molecular weight of polymers

(8 Lectures) Marks:06

 $(M_n, M_w, \text{etc})$  by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

### Glass transition temperature (Tg) and determination of Tg,

#### (8 Lectures) Marks:06

Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

#### **Polymer Solution** –

#### (8 Lectures) Marks:06

Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory-Huggins theory, Lower and Upper critical solution temperatures.

#### **Properties of Polymers**

#### (10 Lectures) Marks:08

(Physical, thermal, flow & mechanical properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes,

Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

#### **Reference Books:**

- Seymour, R.B.& Carraher, C.E. *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
- Odian, G. Principles of Polymerization, 4th Ed. Wiley, 2004.
- Billmeyer, F.W. *Textbook of Polymer Science*, 2<sup>nd</sup> Ed. Wiley Interscience, 1971. □Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.
- Lenz, R.W. Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967.

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## **CEMGDSE01P: POLYMER CHEMISTRY**

# (60 Lectures/Contact Hours) Marks: 25

### 1. Polymer synthesis

- 1.Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
  - a. Purification of monomer
  - b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile (AIBN)
- 2. Preparation of nylon 66/6
- 1.Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
  - a. Preparation of IPC
  - b. Purification of IPC
  - c. Interfacial polymerization
- 3. Redox polymerization of acrylamide
- 4. Precipitation polymerization of acrylonitrile
- 5. Preparation of urea-formaldehyde resin
- 6. Preparations of novalac resin/resold resin.
- 7. Microscale Emulsion Polymerization of Poly(methylacrylate).

#### **Polymer characterization**

- 1. Determination of molecular weight by viscometry:
  - (a) Polyacrylamide-aq.NaNO<sub>2</sub> solution
  - (b) (Poly vinyl proplylidine (PVP) in water
- 2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
- 3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
- 4. Testing of mechanical properties of polymers.
- 5. Determination of hydroxyl number of a polymer using colorimetric method.

#### **Polymer analysis**

- 1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
- 2. Instrumental Techniques
- 3. IR studies of polymers
- 4. DSC analysis of polymers
- 5. Preparation of polyacrylamide and its electrophoresis \*at least 7 experiments to be

carried out.

#### **Reference Books:**

- M.P. Stevens, *Polymer Chemistry: An Introduction*, 3<sup>rd</sup> Ed., Oxford University Press, 1999.
- H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3<sup>rd</sup> ed. Prentice-Hall (2003)
- F.W. Billmeyer, *Textbook of Polymer Science*, 3<sup>rd</sup> ed.Wiley-Interscience (1984)
- J.R. Fried, *Polymer Science and Technology*, 2<sup>nd</sup> ed.Prentice-Hall (2003)
- P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2<sup>nd</sup> ed.John Wiley & Sons (2002)
- L. H. Sperling, Introduction to Physical Polymer Science, 4<sup>th</sup> ed.John Wiley & Sons (2005)
- M.P. Stevens, *Polymer Chemistry: An Introduction* 3<sup>rd</sup> ed.Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9<sup>th</sup> ed.by Charles E. Carraher, Jr. (2013).

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# **CEMGDSE02T: GREEN CHEMISTRY**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Introduction to Green Chemistry

(4 Lectures) Marks: 05

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

#### Principles of Green Chemistry and Designing a Chemical synthesis

#### (30 Lectures) Marks: 25

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:

• Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.

- Prevention/ minimization of hazardous/ toxic products reducing toxicity.
  risk = (function) hazard × exposure; waste or pollution prevention hierarchy.
- Green solvents- supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.
- Energy requirements for reactions alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization careful use of blocking/protecting groups.
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
- Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.
- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

## Examples of Green Synthesis/ Reactions and some real world cases

#### (16 Lectures) Marks: 12

- 1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
- 2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
- 3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction

(Ultrasonic alternative to Iodine)

- 4 Surfactants for carbon dioxide replacing smog producing and ozone depleting solvents with CO<sub>2</sub> for precision cleaning and dry cleaning of garments.
- 5 Designing of Environmentally safe marine antifoulant.
- 6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
- 7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
- 8 Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils
- 9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

#### **Future Trends in Green Chemistry**

#### (10 Lectures) Marks: 08

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis  $(C^2S^3)$ ; Green chemistry in sustainable development.

#### **Reference Books**:

- Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).
- Anastas, P.T. & Warner, J.K.: *Green Chemistry Theory and Practical*, Oxford University Press (1998).
- Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2<sup>nd</sup> Edition, 2010.

## **CEMGDSE02P: GREEN CHEMISTRY**

# (60 Lectures/Contact Hours) Marks: 25

#### **1.** Safer starting materials

• Preparation and characterization of nanoparticles of gold using tea leaves.

#### 2. Using renewable resources

• Preparation of biodiesel from vegetable/ waste cooking oil.

#### 3. Avoiding waste

Principle of atom economy.

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
- Preparation of propene by two methods can be studied
- (I) Triethylamine ion +  $OH^- \rightarrow propene + trimethylpropene + water H_2SO_4/\Box$
- (II) 1-propanol  $\longrightarrow$  propene + water

• Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

#### 4. Use of enzymes as catalysts

• Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

#### 5. Alternative Green solvents

Extraction of D-limonene from orange peel using liquid CO<sub>2</sub> prepared form dry ice.

Mechanochemical solvent free synthesis of azomethines

#### 6. Alternative sources of energy

- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

#### **Reference Books:**

- Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice*, Oxford University Press (1998).
- Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC (2002).
- Ryan, M.A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).
- Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi.* Bangalore CISBN 978-93-81141-55-7 (2013).
- Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).
- Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society (2008).
- Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2<sup>nd</sup> Edition, 2010.
- Pavia, D.L., Lampman, G.M., Kriz, G.S. & Engel, R.G. Introduction to Organic Laboratory Techniques: A Microscale and Macro Scale Approach, W.B.Saunders, 1995.

# CEMGDSE03T: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

#### Silicate Industries

(16 Lectures) Marks: 12

*Glass:*Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

*Ceramics*:Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

*Cements*:Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

#### **Fertilizers:**

#### (10 Lectures) Marks: 10

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

#### Surface Coatings: (8 Lectures) Marks: 06

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

#### **Batteries:**

#### (8 Lectures) Marks: 06

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

#### Alloys:

#### (8 Lectures) Marks: 06

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

#### **Catalysis:**

#### (6 Lectures) Marks: 06

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts.

Phase transfer catalysts, application of zeolites as catalysts.

#### **Chemical explosives:**

#### (4 Lectures) Marks: 04

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

#### **Reference Books:**

- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- P. C. Jain & M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut

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# CEMGDSE03P: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE (60 Lectures/Contact Hours) Marks: 25

- 1. Determination of free acidity in ammonium sulphate fertilizer.
- 2. Estimation of calcium in calcium ammonium nitrate fertilizer.
- 3. Estimation of phosphoric acid in superphosphate fertilizer.
- 4. Electroless metallic coatings on ceramic and plastic material.

5. Determination of composition of dolomite (by complexometric titration).

- 6. Analysis of (Cu, Ni); (Cu, Zn ) in alloy or synthetic samples.
- 7. Analysis of Cement.
- 8. Preparation of pigment (zinc oxide).

#### **Reference Books:**

- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

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# CEMGDSE04T: ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY (Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Section A: Inorganic Chemistry-4 (30 Lectures) Marks: 25

#### Chemistry of 3d metals (6 Lectures)

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr,  $K_2Cr_2O_7$ ,  $KMnO_4$ ,  $K_4[Fe(CN)_6]$ , sodium nitroprusside,  $[Co(NH_3)_6]Cl_3$ ,  $Na_3[Co(NO_2)_6]$ .

#### **Organometallic Compounds (12 Lectures)**

Definition and Classification with appropriate examples based on nature of metalcarbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-

acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

#### **Bio-Inorganic Chemistry (12 Lectures)**

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to  $Na^+$ ,  $K^+$  and  $Mg^{2+}$  ions: Na/K pump; Role of  $Mg^{2+}$  ions in energy production and chlorophyll. Role of  $Ca^{2+}$  in blood clotting, stabilization of protein structures and structural role (bones).

#### Section B: Organic Chemistry-4 (30 Lectures) Marks: 25

#### Polynuclear and heteronuclear aromatic compounds: (6 Lectures)

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

#### Active methylene compounds: (6 Lectures)

Preparation: Claisen ester condensation. Keto-enol tautomerism.

*Reactions:* Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

#### **Application of Spectroscopy to Simple Organic Molecules (18 Lectures)**

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions,  $\lambda_{max} \& \epsilon_{max}$ , chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and  $\alpha,\beta$  – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

#### **Reference Books:**

- James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
- G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
- J.D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
- F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley & Sons.
- I.L. Finar: Organic Chemistry (Vol. I & II), E.L.B.S.
- John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall.

- R.M. Silverstein, G.C. Bassler & T.C. Morrill: Spectroscopic Identification of Organic Compounds, John Wiley& Sons.
- R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

# CEMGDSE04P: (60 Lectures/Contact Hours) Marks: 25

#### Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the  $R_f$  value in each case. (Combination of two ions to be given)

Paper chromatographic separation of  $Fe^{3+}$ ,  $A1^{3+}$  and  $Cr^{3+}$  or

Paper chromatographic separation of  $Ni^{2+}$ ,  $Co^{2+}$ ,  $Mn^{2+}$  and  $Zn^{2+}$ 

2. Preparation of any two of the following complexes and measurement of their conductivity:

- (i) tetraamminecarbonatocobalt (III) nitrate
- (ii) tetraamminecopper (II) sulphate
- (iii) potassium trioxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl,  $MgCl_2$  and  $LiCl_3$ .

#### Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

#### **Reference Books:**

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

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# **WEST BENGAL STATE UNIVERSITY**

# DRAFT SYLLABUS IN CHEMISTRY (HONOURS)

# UNDER

# **CHOICE BASED CREDIT SYSTEM**

# Scheme for CBCS Curriculum

Sem	ester Course with Code	Course Detail	Credits	Marks
Ι	Ability Enhancement Compulsory Course – I	Environmental Science	2	25
	Core course – I CEMACOR01T	Organic Chemistry I	4	50
	Core course – I Practical <b>CEMACOR01P</b>	Organic Chemistry I	2	25
	Core course – II <b>CEMACOR02T</b>	Physical Chemistry I	4	50
	Core course – II Practical CEMACOR02P	Physical Chemistry I	2	25
	Genetic Elective – 1		4	50
	Generic Elective – 1 Practical		2	25
II	Ability Enhancement Compulsory Course – II	English / MIL communication	2	25
	Core course – III CEMACOR03T	Inorganic Chemistry I	4	50
	Core course – III Practical <b>CEMACOR03P</b>	Inorganic Chemistry I	2	25
	Core course – IV <b>CEMACOR04T</b>	Organic Chemistry II	4	50
	Core course – IV Practical CEMACOR04P	Organic Chemistry II	2	25
	Generic Elective – 2		4	50
	Generic Elective – 2 Practical		2	25
III	Core course – V CEMACOR05T	Physical Chemistry II	4	50
	Core course – V Practical <b>CEMACOR05P</b>	Physical Chemistry II	2	25
	Core course – VI CEMACOR06T	Inorganic Chemistry II	4	50
	Core course – VI Practical CEMACOR06P	Inorganic Chemistry II	2	25
	Core course – VII <b>CEMACOR07T</b>	Organic Chemistry III	4	50
	Core course – VII Practical CEMACOR07P	Organic Chemistry III	2	25

	Skill Enhancement Course – 1		2	25
	Generic Elective – 3		4	50
	Generic Elective – 3 Practical		2	25
IV	Core course – VIII CEMACOR08T	Physical Chemistry III	4	50
	Core course – VIII Practical CEMACOR08P	Physical Chemistry III	2	25
	Core course – IX <b>CEMACOR09T</b>	Inorganic Chemistry III	4	50
	Core course – IX Practical <b>CEMACOR09P</b>	Inorganic Chemistry III	2	25
	Core course – X CEMACOR10T	Organic Chemistry IV	4	50
	Core course – X Practical <b>CEMACOR10P</b>	Organic Chemistry IV	2	25
	Skill Enhancement Course-2		2	25
	Generic Elective – 4		4	50
	Generic Elective – 4 Practical		2	25
V	Core course – XI CEMACOR11T	Inorganic Chemistry IV	4	50
	Core course – XI Practical <b>CEMACOR11P</b>	Inorganic Chemistry IV	2	25
	Core course – XII CEMACOR12T	Organic Chemistry V	4	50
	Core course – XII Practical <b>CEMACOR12P</b>	Organic Chemistry V	2	25
	Discipline Specific Elective – 1		4	50
	Discipline Specific Elective – 1 Practical		2	25
	Discipline Specific Elective – 2		4	50
	Discipline Specific Elective – 2 Practical		2	25
VI	Core course – XIII CEMACOR13T	Inorganic Chemistry V	4	50
	Core course – XIII Practical <b>CEMACOR13P</b>	Inorganic Chemistry V	2	25
	Core course – XIV CEMACOR14T	Physical Chemistry IV	4	50

Core course – XIV Practical <b>CEMACOR14P</b>	Physical Chemistry IV	2	25
Discipline Specific Elective – 3		4	50
Discipline Specific Elective – 3 Practical		2	25
Discipline Specific Elective – 4		4	50
Discipline Specific Elective – 4 Practical		2	25
	Total:	140	1750

# **Choices for Discipline Specific Electives**

Discipline Specific Elective – 1-3 Choose any two (2) for Sem - V	Discipline Specific Elective – 4-6 Choose any two (2) for Sem - VI
Advanced Physical Chemistry CEMADSE01	
	Green Chemistry CEMADSE04
Analytical Methods in Chemistry CEMADSE02	Inorganic Materials of Industrial Importance CEMADSE05
Instrumental Methods of Chemical Analysis CEMADSE03	Polymer Chemistry CEMADSE06

# Choices for Skill Enhancement Courses

Skill Enhancement Course-1	Skill Enhancement Course-2
Basic Analytical Chemistry	Analytical Clinical
CEMSSEC001	Biochemistry CEMSSEC002

# **CORE COURSE (HONOURS) IN CHEMISTRY**

**SEMESTER-I** 

CEMACOR01T: ORGANIC CHEMISTRY-I

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Basics of Organic Chemistry Bonding and Physical Properties (25 Lectures) Marks: 20

*Valence Bond Theory:* concept of hybridisation, shapes of molecules, resonance (including hyperconjugation); calculation of formal charges and double bond equivalent (DBE); orbital pictures of bonding  $(sp^3, sp^2, sp: C-C, C-N \& C-O systems and$ *s*-*cis*and*s*-*trans*geometry for suitable cases).

*Electronic displacements:* inductive effect, field effect, mesomeric effect, resonance energy; bond polarization and bond polarizability; electromeric effect; steric effect, steric inhibition of resonance.

*MO theory:* qualitative idea about molecular orbitals, bonding and antibonding interactions, idea about  $\sigma$ ,  $\sigma^*$ ,  $\pi$ ,  $\pi^*$ , n - MOs; basic idea about Frontier MOs (FMO); concept of HOMO, LUMO and SOMO; interpretation of chemical reactivity in terms of

FMO interactions; sketch and energy levels of  $\pi$  MOs of i) acyclic p orbital system (C=C, conjugated diene, triene, allyl and pentadienyl systems) ii) cyclic p orbital system (neutral systems: [4], [6]-annulenes; charged systems: 3-,4-,5-membered ring systems); Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring); concept of antiaromaticity and homoaromaticity; non-aromatic molecules; Frost diagram; elementary idea about  $\alpha$  and  $\beta$ ; measurement of delocalization energies in terms of  $\beta$  for buta-1,3-diene, cyclobutadiene, hexa-1,3,5-triene and benzene.

*Physical properties:* influence of hybridization on bond properties: bond dissociation energy (BDE) and bond energy; bond distances, bond angles; concept of bond angle strain (Baeyer's strain theory); melting point/boiling point and solubility of common organic compounds in terms of covalent & non-covalent intermolecular forces; polarity of molecules and dipole moments; relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of formation.

# General Treatment of Reaction Mechanism I (10 Lectures)

Marks: 10

*Mechanistic classification:* ionic, radical and pericyclic (definition and example); reaction type: addition, elimination and substitution reactions (definition and example); nature of bond cleavage and bond formation: homolytic and heterolytic bond fission, homogenic and heterogenic bond formation; curly arrow rules in representation of mechanistic steps; reagent type: electrophiles and nucleophiles (elementary idea); electrophilicity and nucleophilicity in terms of FMO approach.

*Reactive intermediates:* carbocations (carbenium and carbonium ions), carbanions, carbon radicals, carbenes: generation and stability, structure using orbital picture and electrophilic/nucleophilic behavior of reactive intermediates (elementary idea).

# Stereochemistry I (25 Lectures)

#### Marks: 20

Bonding geometries of carbon compounds and representation of molecules: tetrahedral nature of carbon and concept of asymmetry; Fischer, sawhorse, flying-wedge and Newman projection formulae and their inter translations.

Concept of chirality and symmetry: symmetry elements and point groups ( $C_{\alpha\nu}$ ,  $C_{nh}$ ,  $C_{n\nu}$ ,  $C_n$ ,  $D_{\alpha h}$ ,  $D_{nh}$ ,  $D_{nd}$ ,  $D_n$ ,  $S_n(C_s, C_i)$ ; molecular chirality and centre of chirality; asymmetric and dissymmetric molecules; enantiomers and diastereomers; concept of epimers; concept of stereogenicity, chirotopicity and pseudoasymmetry; chiral centres and number of stereoisomerism: systems involving 1/2/3-chiral centre(s) (AA, AB, ABA and ABC types).

*Relative and absolute configuration:* D/L and *R/S* descriptors; *erythro/threo* and *meso* nomenclature of compounds; *syn/anti* nomenclatures for aldols; E/Z descriptors for C=C, conjugated diene, triene, C=N and N=N systems; combination of *R/S-* and *E/ Z-* isomerisms.

*Optical activity of chiral compounds:* optical rotation, specific rotation and molar rotation; racemic compounds, racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates); resolution of acids, bases and alcohols via diastereomeric salt formation; optical purity and enantiomeric excess; invertomerism of chiral trialkylamines.

## <u>Reference Books</u>

1. Clayden, J., Greeves, N. & Warren, S. *Organic Chemistry*, Second edition, Oxford University Press, 2012.

2. Keeler, J., Wothers, P. *Chemical Structure and Reactivity – An Integrated approach*, Oxford University Press.

3. Sykes, P., A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.

 Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
 Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.

6. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.

- 7. Nasipuri, D. Stereochemistry of Organic Compounds, Wiley Eastern Limited.
- 8. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 9. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.
- (Pearson Education)
- 10. Fleming, I. *Molecular Orbitals and Organic Chemical Reactions*, Reference/Student Edition, Wiley, 2009.
- 11. James, J., Peach, J. M. *Stereochemistry at a Glance*, Blackwell Publishing, 2003. 12. Robinson, M. J. T., *Stereochemistry*, Oxford Chemistry Primer, Oxford University Press, 2005.

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# *CEMACOR01P:* ORGANIC CHEMISTRY-I LAB (60 Lectures/Contact Hours)

## Marks: 25

**1. Separation**, based upon solubility, by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. NaHCO<sub>3</sub>, *etc.*, of components of a binary solid mixture; purification of **any one** of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types: Benzoic acid/*p*-Toluidine; *p*-Nitrobenzoic acid/*p*-Aminobenzoic acid; *p*-Nitrotoluene/*p*-Anisidine; *etc*.

2. Determination of boiling point of common organic liquid compounds e.g., ethanol, cyclohexane, chloroform, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide, *etc*. [Boiling point of the chosen organic compounds should preferably be less than 160  $^{\circ}$ C]

#### 3. Identification of a Pure Organic Compound

*Solid compounds*: oxalic acid, tartaric acid, citric acid, succinic acid, resorcinol, urea, glucose, cane sugar, benzoic acid and salicylic acid

*Liquid Compounds*: formic acid, acetic acid, methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene

#### **Reference Books**

- 1. Bhattacharyya, R. C, A Manual of Practical Chemistry.
- 2. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 2: *Qualitative Organic Analysis*, CBS Publishers and Distributors.
- 3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
- 4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. *Practical Organic Chemistry,5th Ed.*, Pearson (2012).
- 5. Dutta, S, B. Sc. Honours Practical Chemistry, Bharati Book Stall.

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### CEMACOR02T: PHYSICAL CHEMISTRY-I

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Kinetic Theory and Gaseous state (20 Lectures)

#### Marks: 16

<u>Kinetic Theory of gases</u>: Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of collision on wall and rate of effusion.

<u>Maxwell's distribution of speed and energy</u>: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case; Calculation of number of molecules having energy  $\geq \varepsilon$ , Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

<u>Real gas and virial equation</u>: Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour, other equations of state (Berthelot, Dietrici); Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states; virial equation of state; van der Waals equation expressed in virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; LennardJones potential - elementary idea)

# Chemical Thermodynamics (25 Lectures)

#### Marks: 20

Zeroth and  $1^{st}$  law of Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics;Concept of heat, work, internal energy and statement of first law; enthalpy, *H*; relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions; Joule's experiment and its consequence

<u>Thermochemistry</u>:Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature <u>Second Law</u>:Need for a Second law; statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine and refrigerator; Kelvin – Planck and Clausius statements and equivalence of the two statements with entropic formulation; Carnot's theorem; Values of  $\oint dQ/T$  and Clausius inequality; Entropy change of systems and surroundings for various processes and transformations; Entropy and unavailable work; Auxiliary state functions (G and A) and their variation with T, P and V. Criteria for spontaneity and equilibrium.

<u>Thermodynamic relations</u>: Maxwell's relations; Gibbs- Helmholtz equation, JouleThomson experiment and its consequences; inversion temperature; Joule-Thomson coefficient for a van der Waals gas; General heat capacity relations

# Chemical kinetics (15 Lectures)

# Marks: 14

<u>Rate law, order and molecularity</u>: Introduction of rate law, Extent of reaction; rate constants, order; Forms of rates of First, second and n-th order reactions; Pseudo first order reactions (example using acid catalyzed hydrolysis of methyl acetate); Determination of order of a reaction by half-life and differential method; Opposing reactions, parallel reactions and consecutive reactions (with explanation of kinetic and thermodynamic control of products; all steps first order) ; Rate equation for the fast reaction

<u>Role of T and theories of reaction rate</u>: Temperature dependence of rate constant; Arrhenius equation, energy of activation; Rate-determining step and steady-state approximation – explanation with suitable examples; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)

<u>Homogeneous catalysis</u>: Homogeneous catalysis with reference to acid-base catalysis; Primary kinetic salt effect; Enzyme catalysis; Michaelis-Menten equation, LineweaverBurk plot, turn-over number

Autocatalysis; periodic reactions

## **Reference Books**

- 1. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press
- 2. Castellan, G. W. Physical Chemistry, Narosa
- 3. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry: A Molecular Approach*, Viva Press
- 4. Engel, T. & Reid, P. Physical Chemistry, Pearson
- 5. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
- 6. Maron, S. & Prutton Physical Chemistry
- 7. Ball, D. W. Physical Chemistry, Thomson Press
- 8. Mortimer, R. G. Physical Chemistry, Elsevier
- 9. Laidler, K. J. Chemical Kinetics, Pearson
- 10. Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry
- 11. Rakshit, P.C., *Physical Chemistry* Sarat Book House

- 12. Zemansky, M. W. & Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
- 13. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas
- 14. Klotz, I. M. & Rosenberg, R. M. Chemical Thermodynamics, Wiley

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#### CEMACOR02T: PHYSICAL CHEMISTRY-I LAB

(60 Lectures/Contact Hours)

#### Marks: 25

Experiment 1: Determination of pH of unknown solution (buffer), by color matching method

Experiment 2: Determination of heat of neutralization of a strong acid by a strong base

Experiment 3: Study of kinetics of acid-catalyzed hydrolysis of methyl acetate

Experiment 4: Study of kinetics of decomposition of H<sub>2</sub>O<sub>2</sub>

Experiment 5: Determination of heat of solution of oxalic acid from solubility measurement

#### **Reference Books**

- 1. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
- 2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
- 3. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
- 4. Palit, S.R., De, S. K. *Practical Physical Chemistry* Science Book Agency
- 5. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta
- 6. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
- 7. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

#### **SEMESTER-II**

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# CEMACOR03T: INORGANIC CHEMISTRY-I

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Extra nuclear Structure of atom (18 Lectures) Marks: 14

Bohr's theory, its limitations and atomic spectrum of hydrogen atom; Sommerfeld's Theory. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of  $\psi$  and  $\psi^2$ . Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rules and multiplicity, Exchange energy, Aufbau principle and its limitations, Ground state Term symbols of atoms and ions for atomic number upto 30.

# Chemical periodicity (8 Lectures) Marks: 10

Modern IUPAC Periodic table, Effective nuclear charge, screening effects and penetration, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction. Ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. Secondary periodicity, Relativistic Effect, Inert pair effect.

# Acid-Base reactions (16 Lectures) Marks: 12

Acid-Base concept: Arrhenius concept, theory of solvent system ( $H_2O$ ,  $NH_3$ ,  $SO_2$  and HF), Bronsted-Lowry's concept, relative strength of acids, Pauling's rules. Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects. Thermodynamic acidity parameters, Drago-Wayland equation. Superacids, Gas phase acidity and proton affinity; HSAB principle. Acid-base equilibria in aqueous solution (Proton transfer equilibria in water), pH, buffer. Acidbase neutralisation curves; indicator, choice of indicators.

# **Redox Reactions and precipitation reactions** (18 Lectures) Marks: 14

Ion-electron method of balancing equation of redox reaction. Elementary idea on standard redox potentials with sign conventions, Nernst equation (without derivation). Influence of complex formation, precipitation and change of pH on redox potentials; formal potential. Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. Redox potential diagram (Latimer and Frost diagrams) of common elements and their applications. Disproportionation and comproportionation reactions.

Solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides.

#### **Reference Books**

- 1. Lee, J. D. Concise Inorganic Chemistry,5<sup>th</sup> Ed., Wiley India Pvt. Ltd., 2008.
- 2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.
- 3. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962.
- 4. Atkin, P. Shriver & Atkins' Inorganic Chemistry, 5<sup>th</sup> Ed., Oxford University Press (2010).
- 5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., *Basic Inorganic Chemistry* 3<sup>rd</sup>Ed.; Wiley India.
- 6. Sharpe, A.G., *Inorganic Chemistry*, 4<sup>th</sup> Indian Reprint (Pearson Education) 2005.
- 7. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles* of Structure and Reactivity 4<sup>th</sup> Ed., Harper Collins 1993, Pearson, 2006.
- 8. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
- 9. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998).
- 10. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
- 11. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).

#### CEMACOR01P: INORGANIC CHEMISTRY-I LAB

60 (Lectures/Contact Hours) Marks: 25

### Acid and Base Titrations:

1.Estimation of carbonate and hydroxide present together in mixture2.Estimation of carbonate and bicarbonate present together in a mixture.

3.Estimation of free alkali present in different soaps/detergents. **Oxidation-Reduction Titrimetric** 

- 1. Estimation of Fe(II) using standardized KMnO<sub>4</sub> solution
- 2. Estimation of oxalic acid and sodium oxalate in a given mixture
- 3. Estimation of Fe(II) and Fe(III) in a given mixture using  $K_2Cr_2O_7$  solution.
- 4. Estimation of Fe(III) and Mn(II) in a mixture usingstandardized KMnO<sub>4</sub> solution
- 5. Estimation of Fe(III) and Cu(II) in a mixture using  $K_2Cr_2O_7$ .
- 6. Estimation of Fe(III) and Cr(III) in a mixture using K<sub>2</sub>Cr<sub>2</sub>O<sub>7. *Reference Books*</sub>

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

#### CEMACOR04T: ORGANIC CHEMISTRY-II

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Stereochemistry II (20 Lectures) Marks: 16

*Chirality arising out of stereoaxis*: stereoisomerism of substituted cumulenes with even and odd number of double bonds; chiral axis in allenes, spiro compounds, alkylidenecycloalkanes and biphenyls; related configurational descriptors ( $R_a/S_a$  and P/M); atropisomerism; racemisation of chiral biphenyls; *buttressing* effect.

*Concept of prostereoisomerism*: prostereogenic centre; concept of  $(pro)^n$ -chirality: topicity of ligands and faces (elementary idea); pro-R/pro-S, pro-E/pro-Z and Re/Si descriptors; pro-r and pro-s descriptors of ligands on propseudoasymmetric centre.

*Conformation:* conformational nomenclature: eclipsed, staggered, *gauche*, *syn* and *anti*; dihedral angle, torsion angle; Klyne-Prelog terminology; *P/M* descriptors; energy barrier of rotation, concept of torsional and steric strains; relative stability of conformers on the basis of steric effect, dipole-dipole interaction and H-bonding; *butane gauche* interaction; conformational analysis of ethane, propane, *n*-butane, 2methylbutane and 2,3-dimethylbutane; haloalkane, 1,2-dihaloalkanes and 1,2-diols (up to four carbons); 1,2-halohydrin; conformation of conjugated systems (*s-cis* and *s-trans*).

#### General Treatment of Reaction Mechanism II (22 Lectures) Marks: 18
*Reaction thermodynamics:* free energy and equilibrium, enthalpy and entropy factor, calculation of enthalpy change via BDE, intermolecular & intramolecular reactions.

*Concept of organic acids and bases:* effect of structure, substituent and solvent on acidity and basicity; proton sponge; gas-phase acidity and basicity; comparison between nucleophlicity and basicity; HSAB principle; application of thermodynamic principles in acid-base equilibria.

*Tautomerism:* prototropy (keto-enol, nitro - *aci*-nitro, nitroso-oximino, diazo-amino and enamine-imine systems); valence tautomerism and ring-chain tautomerism; composition of the equilibrium in different systems (simple carbonyl; 1,2- and 1,3dicarbonyl systems, phenols and related systems), factors affecting keto-enol tautomerism; application of thermodynamic principles in tautomeric equilibria.

*Reaction kinetics:* rate constant and free energy of activation; concept of order and molecularity; free energy profiles for one-step, two-step and three-step reactions; catalyzed reactions: electrophilic and nucleophilic catalysis; kinetic control and thermodynamic control of reactions; isotope effect: primary and secondary kinetic isotopic effect ( $k_{\rm H}/k_{\rm D}$ ); principle of microscopic reversibility; Hammond's postulate.

# Substitution and Elimination Reactions (18 Lectures) Marks: 16

*Free-radical substitution reaction:* halogentaion of alkanes, mechanism (with evidence) and stereochemical features; reactivity-selectivity principle in the light of Hammond's postulate.

*Nucleophilic substitution reactions:* substitution at  $sp^3$  centre: mechanisms (with evidence), relative rates & stereochemical features:  $S_N1$ ,  $S_N2$ ,  $S_N2'$ ,  $S_N1'$  (allylic rearrangement) and  $S_Ni$ ; effects of solvent, substrate structure, leaving group and nucleophiles (including ambident nucleophiles, cyanide & nitrite); substitutions involving NGP; role of crown ethers and phase transfer catalysts; [systems: alkyl halides, allyl halides, benzyl halides, ethers, epoxides].

*Elimination reactions:* E1, E2, E1cB and Ei (pyrolytic *syn* eliminations); formation of alkenes and alkynes; mechanisms (with evidence), reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity; comparison between substitution and elimination; importance of Bredt's rule relating to the formation of C=C.

### <u>Reference Books</u>

- 1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry*, Second edition, Oxford University Press 2012.
- 2. Sykes, P., A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
- 3. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.

- 4. Carey, F. A. & Guiliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
- 5. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
- 6. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
- 7. Nasipuri, D. Stereochemistry of Organic Compounds, Wiley Eastern Limited.
- 8. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 9. Finar, I. L. Organic Chemistry (Volume 1) Pearson Education.
- 10. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
- 11. James, J., Peach, J. M. Stereochemistry at a Glance, Blackwell Publishing, 2003.
- 12. Robinson, M. J. T., *Stereochemistry*, Oxford Chemistry Primer, Oxford University Press, 2005.
- 13. Maskill, H., *Mechanisms of Organic Reactions*, Oxford Chemistry Primer, Oxford University Press.

# CEMACOR04P: ORGANIC CHEMISTRY-II LAB

# 60 (Lectures/Contact Hours) Marks: 25

#### **Organic Preparations**

A. The following reactions are to be performed, noting the yield of the crude product:

- 1. Nitration of aromatic compounds
- 2. Condensation reactions
- 3. Hydrolysis of amides/imides/esters
- 4. Acetylation of phenols/aromatic amines
- 5. Benzoylation of phenols/aromatic amines
- 6. Side chain oxidation of aromatic compounds
- 7. Diazo coupling reactions of aromatic amines
- 8. Bromination of anilides using green approach (Bromate-Bromide method)
- 9. Redox reaction including solid-phase method
- 10. Green 'multi-component-coupling' reaction
- 11. Selective reduction of *m*-dinitrobenzene to *m*-nitroaniline

# Students must also calculate percentage yield, based upon isolated yield (crude) and theoretical yield.

- B. Purification of the crude product is to be made by crystallisation from water/alcohol, crystallization after charcoal treatment, or sublimation, whichever is applicable.
- C. Melting point of the purified product is to be noted.

#### **Reference Books**

- 1. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 1: *Small scale Preparations*, CBS Publishers and Distributors.
- 2. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N. University of Calcutta, 2003.
- 3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
- 4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.* Pearson (2012).
- 5. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
- 6. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015.

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#### **SEMESTER-III**

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#### CEMACOR05T: PHYSICAL CHEMISTRY-II

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Transport processes (15 Lectures) Marks: 14

<u>Fick's law</u>: Flux, force, phenomenological coefficients & their inter-relationship (general form), different examples of transport properties

<u>Viscosity</u>:General features of fluid flow (streamline flow and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation; principle of determination of viscosity coefficient of liquids by falling sphere method; Temperature variation of viscosity of liquids and comparison with that of gases

<u>Conductance and transport number</u>: Ion conductance; Conductance and measurement of conductance, cell constant, specific conductance, equivalent conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak

electrolytes; Debye –Huckel theory of Ion atmosphere (qualitative)-asymmetric effect, relaxation effect and electrophoretic effect; Ostwald's dilution law; Ionic mobility; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations

Transport number, Principles of Hittorf's and Moving-boundary method; Wien effect, Debye-Falkenhagen effect, Walden's rule

### Applications of Thermodynamics – I (25 Lectures) Marks: 20

Partial properties and Chemical potential: Chemical potential and activity, partial molar quantities, relation between Chemical potential and Gibbs' free energy and other thermodynamic state functions; variation of Chemical potential ( $\mu$ ) with temperature and pressure; Gibbs-Duhem equation; fugacity and fugacity coefficient; Variation of thermodynamic functions for systems with variable composition; Equations of states for these systems, Change in G, S, H and V during mixing for binary solutions

<u>Chemical Equilibrium</u>: Thermodynamic conditions for equilibrium, degree of advancement; van't Hoff's reaction isotherm (deduction from chemical potential); Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs' free energy change; Definitions of  $K_P$ ,  $K_C$  and  $K_X$ ; van't Hoff's reaction isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle and its derivation

Nernst's distribution law; Application- (finding out  $K_{eq}$  using Nernst dist law for  $KI+I_2 = KI_3$  and dimerization of benzene)

<u>Chemical potential and other properties of ideal substances- pure and mixtures</u>: a) Pure ideal gas-its Chemical potential and other thermodynamic functions and their changes during a change of Thermodynamic parameters of mixing; Chemical potential of an ideal gas in an ideal gas mixture; Concept of standard states and choice of standard states of ideal gases

b) Condensed Phase – Chemical potential of pure solid and pure liquids, Ideal solution – Definition, Raoult's law; Mixing properties of ideal solutions, chemical potential of a component in an ideal solution; Choice of standard states of solids and liquids

# Foundation of Quantum Mechanics (20 Lectures) Marks: 16

<u>Beginning of Quantum Mechanics</u>: Black-body radiation and Planck's theory of radiation; Light as particles: photoelectric and Compton effects; electrons as waves; Wave-particle duality: de Broglie hypothesis, Uncertainty relations (without proof) <u>Wave function</u>: Schrödinger time-independent equation; nature of the equation, acceptability conditions imposed on the wave functions and probability interpretations of wave function; Orthogonal and normal functions; Schmidt's orthogonalization

<u>Concept of Operators</u>: Elementary concepts of operators, eigenfunctions and eigenvalues; Linear operators; Commutation of operators, commutator and uncertainty relation; Expectation value; Hermitian operator; Postulates of Quantum Mechanics; General structure of Schrodinger equation (S.E.) and time dependency; Stationary state

<u>Particle in a box</u>: Setting up of S.E. for one-dimensional well and its solution; Comparison with free particle eigenfunctions and eigenvalues. Properties of PB wave functions (normalisation, orthogonality, probability distribution); Expectation values of x,  $x^2$ ,  $p_x$  and  $p_x^2$  and their significance in relation to the uncertainty principle; Extension of the problem to two and three dimensions and the concept of degenerate energy levels; Accidental degeneracy

<u>Simple Harmonic Oscillator</u>: setting up of the Schrodinger stationary equation, energy expression (without derivation), expression of wave function for n = 0 and n = 1 (without derivation) and their characteristic features

#### <u>Reference Books</u>

- 1. Atkins, P. W. & Paula, J. de Atkins', Physical Chemistry, Oxford University Press
- 2. Castellan, G. W. Physical Chemistry, Narosa
- 3. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry: A Molecular Approach*, Viva Press
- 4. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
- 5. Rakshit, P.C., Physical Chemistry, Sarat Book House
- 6. Moore, W. J. Physical Chemistry, Orient Longman
- 7. Mortimer, R. G. Physical Chemistry, Elsevier
- 8. Denbigh, K. The Principles of Chemical Equilibrium Cambridge University Press
- 9. Engel, T. & Reid, P. Physical Chemistry, Pearson
- 10. Levine, I. N. Quantum Chemistry, PHI
- 11. Atkins, P. W. Molecular Quantum Mechanics, Oxford
- 12. Zemansky, M. W. & Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
- 13. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas
- 14. Klotz, I.M., Rosenberg, R. M. Chemical Thermodynamics: Basic Concepts and Methods Wiley
- 15. Glasstone, S. An Introduction to Electrochemistry, East-West Press

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#### CEMACOR05P: PHYSICAL CHEMISTRY-II LAB

#### 60 (Lectures/Contact Hours) Marks: 25

Experiment 1: Study of viscosity of unknown liquid (glycerol, sugar) with respect to water

Experiment 2: Determination of partition coefficient for the distribution of  $I_2$  between water and  $CCl_4$ 

Experiment 3: Determination of  $K_{eq}$  for  $KI + I_2 = KI_3$ , using partition coefficient between water and  $CCl_4$ 

Experiment 4: Conductometric titration of an acid (strong, weak/ monobasic, dibasic) against base strong

Experiment 5: Study of saponification reaction conductometrically

Experiment 6: Verification of Ostwald's dilution law and determination of  $K_a$  of weak acid

#### **Reference Books**

- 1. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
- 2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
- 3. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
- 4. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
- 5. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta
- 6. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
- 7. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

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### CEMACOR06T: INORGANIC CHEMISTRY-II

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Chemical Bonding-I (24 Lectures) Marks: 20

(i) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elemementary idea). Solubility energetics of dissolution process.

(ii) *Covalent bond:* Polarizing power and polarizability, ionic potential,Fazan's rules. Lewis structures, formal charge. Valence Bond Theory. The hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, Dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding ( $\sigma$  and  $\pi$  bond approach).

# **Chemical Bonding-II**

## (24 Lectures) Marks: 20

(i) Molecular orbital concept of bonding (The approximations of the theory, Linear combination of atomic orbitals (LCAO)) (elementary pictorial approach): sigma and pibonds and delta interaction, multiple bonding. Orbital designations: *gerade*, *ungerade*, HOMO, LUMO. Orbital mixing, MO diagrams of H<sub>2</sub>, Li<sub>2</sub>, Be<sub>2</sub>, B<sub>2</sub>, C<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO<sup>+</sup>, CN<sup>-</sup>, HF, BeH<sub>2</sub>, CO<sub>2</sub> and H<sub>2</sub>O. Bond properties: bond orders, bond lengths.

(ii) *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

(iii) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Intermolecular forces: Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points.

#### Radioactivity

### (12 Lectures) Marks: 10

Nuclear stability and nuclear binding energy. Nuclear forces: meson exchange theory. Nuclear models (elementary idea): Concept of nuclear quantum number, magic numbers. Nuclear Reactions: Artificial radioactivity, transmutation of elements, fission, fusion and spallation. Nuclear energy and power generation. Separation and uses of isotopes. Radio chemical methods: principles of determination of age of rocks and minerals, radio carbon dating, hazards of radiation and safety measures.

- 1. Lee, J. D. Concise Inorganic Chemistry, 5<sup>th</sup>Ed., Wiley India Pvt. Ltd., 2008.
- 2. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles* of Structure and Reactivity 4<sup>th</sup> Ed., Harper Collins 1993, Pearson, 2006.
- 3. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.
- 4. Porterfield, H. W., Inorganic Chemistry, Second Edition, Academic Press, 2005.
- 5. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
- 6. Cotton, F.A., Wilkinson, G., & Gaus, P.L. *Basic Inorganic Chemistry* 3<sup>rd</sup>Ed.; Wiley India.
- 7. Gillespie, R. J. and Hargittai, I., The VSEPR Model of Molecular Geometry, Prentice Hall (1992).
- 8. Albright, T., Orbital interactions in chemistry, John Wiley and Sons (2005).
- 9. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998).

- 10. Miessler, G. L., Fischer, P. J., Tarr, D. A., *Inorganic Chemistry*, Pearson, 5<sup>th</sup> Edition.
- 11. Kaplan, I., *Nuclear Physics*, Addison-Wesley Publishing Company Inc. London, 1964.
- 12. Friedlander, G., Kennedy, J. W., Macias, E. S. And Miller, J. M., *Nuclear and Radiochemistry*, Wiley, 1981.

### *CEMACOR06P:* INORGANIC CHEMISTRY-II LAB **60 (Lectures/Contact Hours)** Marks: 25

#### **Iodo-/ Iodimetric Titrations**

- 1. Estimation of Cu(II)
- 2. Estimation of Vitamin C
- 3. Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically
- 4. Estimation of available chlorine in bleaching powder. Estimation of metal

#### content in some selective samples

- 1. Estimation of Cu in brass.
- 2. Estimation of Cr and Mn in Steel.
- 3. Estimation of Fe in cement.

#### **Reference Books**

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

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#### CEMACOR07T: ORGANIC CHEMISTRY-III

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Chemistry of alkenes and alkynes (15 Lectures) Marks: 12

Addition to C=C: mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity; reactions: hydrogenation, halogenations, iodolactonisation, hydrohalogenation, hydration, oxymercuration-demercuration, hydroboration-oxidation, epoxidation, syn and anti-hydroxylation, ozonolysis, addition of singlet and triplet carbenes; electrophilic addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylic bromination in competition with brominations across C=C; use of

NBS; Birch reduction of benzenoid aromatics; interconversion of E - and Z - alkenes; contra-thermodynamic isomerization of internal alkenes.

Addition to C=C (in comparison to C=C): mechanism, reactivity, regioselectivity (Markownikoff and anti-Markownikoff addition) and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercurationdemercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; interconversion of terminal and non-terminal alkynes.

## Aromatic Substitution (10 Lectures) Marks: 08

*Electrophilic aromatic substitution:* mechanisms and evidences in favour of it; orientation and reactivity; reactions: nitration, nitrosation, sulfonation, halogenation, Friedel-Crafts reaction; one-carbon electrophiles (reactions: chloromethylation, Gatterman-Koch, Gatterman, Houben-Hoesch, Vilsmeier-Haack, Reimer-Tiemann, Kolbe-Schmidt); *Ipso* substitution.

*Nucleophilic aromatic substitution:* addition-elimination mechanism and evidences in favour of it;  $S_N1$  mechanism; cine substitution (benzyne mechanism), structure of benzyne.

# Carbonyl and Related Compounds (30 Lectures) Marks: 22

Addition to C=O: structure, reactivity and preparation of carbonyl compounds; mechanism (with evidence), reactivity, equilibrium and kinetic control; Burgi-Dunitz trajectory in nucleophilic additions; formation of hydrates, cyano hydrins and bisulphite adduct; nucleophilic addition-elimination reactions with alcohols, thiols and nitrogenbased nucleophiles; reactions: benzoin condensation, Cannizzaro and Tischenko reactions, reactions with ylides: Wittig and Corey-Chaykovsky reaction; Rupe rearrangement, oxidations and reductions: Clemmensen, Wolff-Kishner, LiAlH<sub>4</sub>, NaBH<sub>4</sub>, MPV, Oppenauer, Bouveault-Blanc, acyloin condensation; oxidation of alcohols with PDC and PCC; periodic acid and lead tetraacetate oxidation of 1,2-diols.

*Exploitation of acidity of*  $\alpha$ -*H of* C=O: formation of enols and enolates; kinetic and thermodynamic enolates; reactions (mechanism with evidence): halogenation of carbonyl compounds under acidic and basic conditions, Hell-Volhard-Zelinsky (H. V. Z.) reaction, nitrosation, SeO<sub>2</sub> (Riley) oxidation; condensations (mechanism with evidence): Aldol, Tollens', Knoevenagel, Claisen-Schmidt, Claisen ester including Dieckmann, Stobbe; Mannich reaction, Perkin reaction, Favorskii rearrangement; alkylation of active methylene compounds; preparation and synthetic applications of diethyl malonate and ethyl acetoacetate; specific enol equivalents (lithium enolates, enamines, aza-enolates and silyl enol ethers) in connection with alkylation, acylation and aldol type reaction.

*Elementary ideas of Green Chemistry:* Twelve (12) principles of green chemistry; planning of green synthesis; common organic reactions and their counterparts: reactions:

Aldol, Friedel-Crafts, Michael, Knoevenagel, Cannizzaro, benzoin condensation and Dieckmann condensation.

*Nucleophilic addition to*  $\alpha,\beta$ *-unsaturated carbonyl system:* general principle and mechanism (with evidence); direct and conjugate addition, addition of enolates (Michael reaction), Stetter reaction, Robinson annulation.

Substitution at  $sp^2$  carbon (C=O system): mechanism (with evidence):  $B_{AC}2$ ,  $A_{AC}2$ ,  $A_{AC}1$ ,  $A_{AL}1$  (in connection to acid and ester); acid derivatives: amides, anhydrides & acyl halides (formation and hydrolysis including comparison).

### Organometallics (5 Lectures) Marks: 08

*Grignard reagent; Organolithiums; Gilman cuprates:* preparation and reactions (mechanism with evidence); addition of Grignard and organolithium to carbonyl compounds; substitution on -COX; directed ortho metalation of arenes using organolithiums, conjugate addition by Gilman cuprates; Corey-House synthesis; abnormal behavior of Grignard reagents; comparison of reactivity among Grignard, organolithiums and organocopper reagents; Reformatsky reaction; Blaise reaction; concept of *umpolung* and base-nucleophile dichotomy in case of organometallic reagents.

- 1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry*, Second edition, Oxford University Press 2012.
- 2. Sykes, P., A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
- 3. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
- 4. Carey, F. A., Guiliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
- 5. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
- 6. Norman, R.O. C., Coxon, J. M. *Principles of Organic Synthesis*, Third Edition, Nelson Thornes, 2003.
- 7. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 8. Finar, I. L. Organic Chemistry (Volume 1), Pearson Education.
- 9. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
- 10. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
- 11. Jenkins, P. R., *Organometallic Reagents in Synthesis*, Oxford Chemistry Primer, Oxford University Press.
- 12. Ward, R. S., *Bifunctional Compounds*, Oxford Chemistry Primer, Oxford University Press.
- 13. Ahluwalia, V. K. Strategies for Green Organic Synthesis, ANE Books Pvt. Ltd.

# *CEMACOR07P:* ORGANIC CHEMISTRY-III LAB 60 (Lectures/Contact Hours) Marks: 25

## Experiment -1: Qualitative Analysis of Single Solid Organic Compounds

A. Detection of special elements (N, S, Cl, Br) by Lassaigne's test

B. Solubility and classification (solvents: H<sub>2</sub>O, 5% HCl, 5% NaOH and 5% NaHCO<sub>3</sub>)

C. Detection of the following functional groups by systematic chemical tests: aromatic amino (-NH<sub>2</sub>), aromatic nitro (-NO<sub>2</sub>), amido (-CONH<sub>2</sub>, including imide), phenolic –OH, carboxylic acid (-COOH), carbonyl (-CHO and >C=O); only one test for each functional group is to be reported.

- D. Melting point of the given compound
- E. Preparation, purification and melting point determination of a crystalline derivative of the given compound
- F. Identification of the compound through literature survey.

Each student, during laboratory session, is required to carry out qualitative chemical tests for all the special elements and the functional groups with relevant derivatisation in known and unknown (**at leastsix**) organic compounds.

- 1. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 2: *Qualitative Organic Analysis*, CBS Publishers and Distributors.
- 2. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N. University of Calcutta, 2003.
- 3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
- 4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed., Pearson (2012).
- 5. Clarke, H. T., *A Handbook of Organic Analysis (Qualitative and Quantitative)*, Fourth Edition, CBS Publishers and Distributors (2007).
- 6. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015.

#### **SEMESTER-IV**

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CEMACOR08T: PHYSICAL CHEMISTRY-III

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

# Application of Thermodynamics – II (20 lectures) Marks: 18

<u>Colligative properties</u>: Vapour pressure of solution; Ideal solutions, ideally diluted solutions and colligative properties; Raoult's law; Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) Osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution; Abnormal colligative properties

<u>Phase rule</u>: Definitions of phase, component and degrees of freedom; Phase rule and its derivations; Definition of phase diagram; Phase diagram for water, CO<sub>2</sub>, Sulphur

First order phase transition and Clapeyron equation; Clausius-Clapeyron equation - derivation and use; Liquid vapour equilibrium for two component systems; Phenolwater system

Three component systems, water-chloroform-acetic acid system, triangular plots

<u>Binary solutions</u>: Ideal solution at fixed temperature and pressure; Principle of fractional distillation; Duhem-Margules equation; Henry's law; Konowaloff's rule; Positive and negative deviations from ideal behavior; Azeotropic solution; Liquidliquid phase diagram using phenol- water system; Solid-liquid phase diagram; Eutectic mixture

# **Electrical Properties of molecules** (20 Lectures) Marks: 18

<u>Ionic equilibria</u>: Chemical potential of an ion in solution; Activity and activity coefficients of ions in solution; Debye-Huckel limiting law-brief qualitative description of the postulates involved, qualitative idea of the model, the equation (without derivation) for ion-ion atmosphere interaction potential. Estimation of activity coefficient for electrolytes using Debye-Huckel limiting law; Derivation of mean ionic activity coefficient from the expression of ion-atmosphere interaction potential; Applications of the equation and its limitations

<u>Electromotive Force</u>: Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry; Chemical cells, reversible and irreversible cells with examples; Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb<sub>2</sub>O<sub>3</sub> electrodes

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers; Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)

<u>Dipole moment and polarizability</u>: Polarizability of atoms and molecules, dielectric constant and polarisation, molar polarisation for polar and non-polar molecules; Clausius-Mosotti equation and Debye equation (both without derivation) and their application; Determination of dipole moments

# Quantum Chemistry (20 Lectures) Marks: 16

<u>Angular momentum</u>: Commutation rules, quantization of square of total angular momentum and z-component; Properties of angular momentum operators;

Eigenfunctions of  $L_Z$  and  $L_Z^2$ ; Rigid rotator model of rotation of diatomic molecule and Schrödinger equation; Transformation to spherical polar coordinates; Separation of variables; Spherical harmonics; Discussion of solution

<u>Qualitative treatment of hydrogen atom and hydrogen-like ions</u>: Setting up of S.E. in spherical polar coordinates, radial part, quantization of energy (only final energy expression); Plots of polar parts and radial distributions; Wave –function of one electron atoms; Average and most probable distances of electron from nucleus; Setting up of Schrödinger equation for many-electron atoms (He, Li)

### <u>LCAO and HF-SCF</u>: Born-Oppenheimer approximation; LCAO-MO treatment of $H_2^+$ ;

Bonding and antibonding orbitals; Qualitative extension to  $H_2$ ; Comparison of LCAOMO and VB treatments of  $H_2$  and their limitations; Covalent bonding, valence bond and molecular orbital approaches, Hartree-Fock method development, SCF and configuration interaction (only basics)

- 1. Castellan, G. W. Physical Chemistry, Narosa
- 2. Atkins, P. W. & Paula, J. de Atkins', Physical Chemistry, Oxford University Press
- 3. McQuarrie, D. A. &Simons, J. D. *Physical Chemistry: A Molecular Approach*, Viva Press
- 4. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
- 5. Moore, W. J. Physical Chemistry, Orient Longman

- 6. Mortimer, R. G. Physical Chemistry, Elsevier
- 7. Engel, T. & Reid, P. Physical Chemistry, Pearson
- 8. Levine, I. N. Quantum Chemistry, PHI
- 9. Atkins, P. W. Molecular Quantum Mechanics, Oxford
- 10. Engel, T. & Reid, P. Physical Chemistry, Pearson
- 11. Maron, S.H., Prutton, C. F., Principles of Physical Chemistry, McMillan
- 12. Klotz, I.M., Rosenberg, R. M. Chemical Thermodynamics: Basic Concepts and Methods Wiley
- 13. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas
- 14. Glasstone, S. An Introduction to Electrochemistry, East-West Press

# CEMACOR08P: PHYSICAL CHEMISTRY-III LAB 60 (Lectures/Contact Hours) Marks: 25

Experiment 1: Determination of solubility of sparingly soluble salt in water, in electrolyte with common ions and in neutral electrolyte (using common indicator)

Experiment 2: Potentiometric titration of Mohr's salt solution against standard  $K_2Cr_2O_7$  solution

Experiment 3: Determination of  $K_{sp}$  for AgCl by potentiometric titration of AgNO<sub>3</sub> solution against standard KCl solution

Experiment 4: Effect of ionic strength on the rate of Persulphate – Iodide reaction

Experiment 5: Study of phenol-water phase diagram

Experiment 6: pH-metric titration of acid (mono- and di-basic) against strong base

- 1. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
- 2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
- 3. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
- 4. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
- 5. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta
- 6. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
- 7. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

#### CEMACOR09T: INORGANIC CHEMISTRY-III

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

## General Principles of Metallurgy (6 Lectures) Marks: 12

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

# Chemistry of *s* and *p* Block Elements (30 Lectures) Marks: 26

Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Beryllium hydrides and halides. Boric acid and borates, boron nitrides, borohydrides (diborane) and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, phosphorus, sulphur and chlorine. Peroxo acids of sulphur, sulphur-nitrogen compounds, interhalogen compounds, polyhalide ions, pseudohalogens, fluorocarbons and basic properties of halogens.

#### Noble Gases:

Occurrence and uses, rationalization of inertness of noble gases, peculiar behaviour of liquid helium, Clathrates; preparation and properties of  $XeF_2$ ,  $XeF_4$  and  $XeF_6$ ; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for  $XeF_2$  and  $XeF_4$ ). Xenon-oxygen compounds. Molecular shapes of noble gas compounds (VSEPR theory).

#### **Inorganic Polymers:**

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes.

# Coordination Chemistry-I (24 Lectures) Marks: 12

Coordinate bonding: double and complex salts. Werner's theory of coordination complexes, Classification of ligands, Ambidentate ligands, chelates, Coordination

numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, Geometrical and optical isomerism in square planar and octahedral complexes.

#### **Reference Books**

- 1. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles* of Structure and Reactivity 4<sup>th</sup> Ed., Harper Collins 1993, Pearson, 2006.
- 2. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, ButterworthHeinemann, 1997.
- Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., Advanced Inorganic Chemistry 6<sup>th</sup> Ed. 1999., Wiley.
- 4. Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4<sup>th</sup> Ed., Pearson, 2010.
- 5. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
- 6. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998).

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# *CEMACOR09P:* INORGANIC CHEMISTRY-III LAB 60 (Lectures/Contact Hours) Marks: 25

### **Complexometric titration**

- 1. Zn(II)
- 2. Zn(II) in a Zn(II) and Cu(II) mixture.
- 3. Ca(II) and Mg(II) in a mixture.
- 4. Hardness of water.

#### **Inorganic preparations**

- 1.  $[Cu(CH_3CN)_4]PF_6/ClO_4$
- 2. *Cis* and *trans*  $K[Cr(C_2O_4)_2 (H_2O)_2]$
- 3. Tetraamminecarbonatocobalt (III) ion
- 4. Potassium tris(oxalato)ferrate(III)5.Tris-(ethylenediamine) nickel(II) chloride.

 $6.[Mn(acac)_3]$  and  $Fe(acac)_3]$  (acac= acetylacetonate)

### **Reference Books**

- 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
- 2. *Inorganic Synthesis*, Vol. 1-10.

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# *CEMACOR10T:* ORGANIC CHEMISTRY-IV (Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

### Nitrogen compounds (12 Lectures) Marks: 08

*Amines: Aliphatic & Aromatic:* preparation, separation (Hinsberg's method) and identification of primary, secondary and tertiary amines; reaction (with mechanism): Eschweiler–Clarke methylation, diazo coupling reaction, Mannich reaction; formation and reactions of phenylenediamines, diazomethane and diazoacetic ester.

*Nitro compounds (aliphatic and aromatic):* preparation and reaction (with mechanism): reduction under different conditions; Nef carbonyl synthesis, Henry reaction and conjugate addition of nitroalkane anion.

Alkylnitrile and isonitrile: preparation and reaction (with mechanism): Thorpe nitrile condensation, von Richter reaction.

*Diazonium salts and their related compounds*: reactions (with mechanism) involving replacement of diazo group; reactions: Gomberg, Meerwein, Japp-Klingermann.

# Rearrangements (14 Lectures) Marks: 10

Mechanism with evidence and stereochemical features for the following

*Rearrangement to electron-deficient carbon:* Wagner-Meerwein rearrangement, pinacol rearrangement, dienone-phenol; Wolff rearrangement in Arndt-Eistert synthesis, benzilbenzilic acid rearrangement, Demjanov rearrangement, Tiffeneau–Demjanov rearrangement.

*Rearrangement to electron-deficient nitrogen:* rearrangements: Hofmann, Curtius, Lossen, Schmidt and Beckmann.

*Rearrangement to electron-deficient oxygen:* Baeyer-Villiger oxidation, cumene hydroperoxide-phenol rearrangement and Dakin reaction.

Aromatic rearrangements: Migration from oxygen to ring carbon: Fries rearrangement and Claisen rearrangement.

*Migration from nitrogen to ring carbon*: Hofmann-Martius rearrangement, FischerHepp rearrangement, *N*-azo to *C*-azo rearrangement, Bamberger rearrangement, Orton rearrangement and benzidine rearrangement.

*Rearrangement reactions by green approach*: Fries rearrangement, Claisen rearrangement, Beckmann rearrangement, Baeyer-Villiger oxidation.

# The Logic of Organic Synthesis (14 Lectures) Marks: 12

*Retrosynthetic analysis:* disconnections; synthons, donor and acceptor synthons; natural reactivity and *umpolung*; latent polarity in bifunctional compounds: consonant and dissonant polarity; illogical electrophiles and nucleophiles; synthetic equivalents; functional group interconversion and addition (FGI and FGA); C-C disconnections and synthesis: one-group and two-group (1,2- to 1,5-dioxygenated compounds), reconnection (1,6-dicarbonyl);protection-deprotection strategy (alcohol, amine, carbonyl, acid).

*Strategy of ring synthesis:* thermodynamic and kinetic factors; synthesis of large rings, application of high dilution technique.

*Asymmetric synthesis*: stereoselective and stereospecific reactions; diastereoselectivity and enantioselectivity (only definition); enantioselectivity: kinetically controlled MPV reduction; diastereoselectivity: addition of nucleophiles to C=O adjacent to a stereogenic centre: Felkin-Anh and Zimmermann-Traxler models.

# Organic Spectroscopy (20 Lectures) Marks: 20

*UV Spectroscopy:* introduction;types of electronic transitions, end absorption; transition dipole moment and allowed/forbidden transitions; chromophores and auxochromes; Bathochromic and Hypsochromic shifts; intensity of absorptions (Hyper/Hypochromic effects); application of Woodward's Rules for calculation of  $\lambda_{max}$  for the following systems: conjugated diene,  $\alpha,\beta$ -unsaturated aldehydes and ketones (alicyclic, homoannular and heteroannular); extended conjugated systems (dienes, aldehydes and

ketones); relative positions of  $\lambda_{max}$  considering conjugative effect, steric effect, solvent effect, effect of pH; effective chromophore concentration: keto-enol systems; benzenoid transitions.

*IR Spectroscopy:* introduction;modes of molecular vibrations(fundamental and nonfundamental); IR active molecules; application of Hooke's law, force constant; *fingerprint region* and its significance; effect of deuteration; overtone bands; vibrational coupling in IR; characteristic and diagnostic stretching frequencies of C-H, N-H, O-H, C-O, C-N, C-X, C=C (including skeletal vibrations of aromatic compounds), C=O, C=N, N=O, C=C, C=N; characteristic/diagnostic bending vibrations are included; factors affecting stretching frequencies: effect of conjugation, electronic effects, mass effect, bond multiplicity, ring-size, solvent effect, H-bonding on IR absorptions; application in functional group analysis.

*NMR Spectroscopy:* introduction;nuclear spin;NMR active molecules;basic principles of Proton Magnetic Resonance; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of *first-order* multiplets: Pascal's triangle; chemical and magnetic equivalence in NMR ; elementary idea about *non-first-order* splitting; anisotropic effects in alkene, alkyne, aldehydes and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds (both aliphatic and benzenoid-aromatic); rapid proton exchange; interpretation of NMR spectra of simple compounds.

Applications of IR, UV and NMR spectroscopy for identification of simple organic molecules.

- 1. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 2. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of *Natural Products*), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
- 3. Norman, R.O. C., Coxon, J. M. *Principles of Organic Synthesis*, Third Edition, Nelson Thornes, 2003.
- 4. Clayden, J., Greeves, N., Warren, S., *Organic Chemistry*, Second edition, Oxford University Press 2012.
- 5. Silverstein, R. M., Bassler, G. C., Morrill, T. C. *Spectrometric Identification of Organic Compounds*, John Wiley and Sons, INC, Fifth edition.
- 6. Kemp, W. Organic Spectroscopy, Palgrave.
- 7. Pavia, D. L. *et al. Introduction to Spectroscopy*, 5th Ed. Cengage Learning India Ed. (2015).
- 8. Dyer, J. Application of Absorption Spectroscopy of Organic Compounds, PHI Private Limited
- 9. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
- 10. Harwood, L. M., *Polar Rearrangements*, Oxford Chemistry Primer, Oxford University Press.
- 11. Bailey, Morgan, Organonitrogen Chemistry, Oxford Chemistry Primer, Oxford University Press.

- Ahluwalia, V. K. Strategies for Green Organic Synthesis, ANE Books Pvt. Ltd.
  Warren, S. Organic Synthesis the Disconnection Approach, John Wiley and Sons.
- 14. Warren, S., Designing Organic Synthesis, Wiley India, 2009.
- 15. Carruthers, W. Modern methods of Organic Synthesis, Cambridge University Press.
- 16. Willis, C. A., Wills, M., *Organic Synthesis*, Oxford Chemistry Primer, Oxford University Press.

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# *CEMACOR10P:* ORGANIC CHEMISTRY-IV LAB 60 (Lectures/Contact Hours) Marks: 25

Quantitative Estimations: Each student is required to perform all the experiments.

- 1. Estimation of glycine by Sörensen's formol method
- 2. Estimation of glucose by titration using Fehling's solution
- 3. Estimation of sucrose by titration using Fehling's solution
- 4. Estimation of vitamin-C (reduced)
- 5. Estimation of aromatic amine (aniline) by bromination (Bromate-Bromide) method
- 6. Estimation of phenol by bromination (Bromate-Bromide) method
- 7. Estimation of formaldehyde (Formalin)
- 8. Estimation of acetic acid in commercial vinegar
- 9. Estimation of urea (hypobromite method)
- 10. Estimation of saponification value of oil/fat/ester

- 1. Arthur, I. V. Quantitative Organic Analysis, Pearson
- 2. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta

#### **SEMESTER-V**

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#### CEMACOR11T: INORGANIC CHEMISTRY-IV

(Credits: Theory-04, Practicals-02)

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Theory: 60 Lectures Marks: 50

Coordination Chemistry-II (36 Lectures) Marks: 30

VB description and its limitations. Elementary Crystal Field Theory: splitting of d<sup>n</sup> configurations in octahedral, square planar and tetrahedral fields, crystal field stabilization energy (CFSE) in weak and strong fields; pairing energy. Spectrochemical series. Jahn-Teller distortion. Octahedral site stabilization energy (OSSE). Metalligand bonding (MO concept, elementary idea), sigma- and pi-bonding in octahedral complexes (qualitative pictorial approach) and their effects on the oxidation states of transitional metals (examples). Magnetism and Colour: Orbital and spin magnetic moments, spin only moments of d<sup>n</sup> ions and their correlation with effective magnetic moments, including orbital contribution; quenching of magnetic moment: super exchange and antiferromagnetic interactions (elementary idea with examples only); d-d transitions; L-S coupling; qualitative Orgel diagrams for 3d<sup>1</sup> to 3d<sup>9</sup> ions. Racah parameter. Selection rules for electronic spectral transitions; spectrochemical series of ligands; charge transfer spectra (elementary idea).

# Chemistry of d- and f- block elements (24 Lectures) Marks: 20

#### **Transition Elements:**

General comparison of 3d, 4d and 5d elements in term of electronic configuration, oxidation states, redox properties, coordination chemistry.

#### Lanthanoids and Actinoids:

General Comparison on Electronic configuration, oxidation states, colour, spectral and magnetic properties; lanthanide contraction, separation of lanthanides (ion-exchange method only).

#### **Reference Books**

1. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles* of *Structure and Reactivity* 4<sup>th</sup> Ed., Harper Collins 1993, Pearson, 2006.

- 2. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, ButterworthHeinemann. 1997.
- 3. Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., Advanced Inorganic Chemistry 6<sup>th</sup> Ed. 1999., Wiley.
- 4. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5<sup>th</sup> Ed. Oxford University Press (2010).
- 5. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
- 6. Sinha, S. P., Ed., Lanthanide and Actinide Research (Journal, Vol. 1, 1986).
- 7. Wulfsberg, G., Principles of Descriptive Inorganic Chemistry, Brooks/Cole: Monterey, CA, 1987.
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# *CEMACOR11P:* INORGANIC CHEMISTRY-IV LAB (60 Lectures/Contact Hours) Marks: 25

#### Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

- 1. Ni (II) and Co (II)
- 2. Fe (III) and Al (III)

#### Gravimetry

- 1. Estimation of Ni(II) using Dimethylglyoxime (DMG).
- 2. Estimation of copper as CuSCN.
- 3. Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)<sub>3</sub> (aluminium oxinate).
- 4. Estimation of chloride. Spectrophotometry
- 1. Measurement of 10Dq by spectrophotometric method.
- 2. Determination of  $\lambda_{max}$  of [Mn(acac)<sub>3</sub>] and [Fe(acac)<sub>3</sub>] complexes.

### <u>Reference Books</u>

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

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### CEMACOR12T: ORGANIC CHEMISTRY-V

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Theory: 60 Lectures Marks: 5

**Carbocycles and Heterocycles** 

(16 Lectures) Marks: 12

*Polynuclear hydrocarbons and their derivatives:* synthetic methods include Haworth, Bardhan-Sengupta, Bogert-Cook and other useful syntheses (with mechanistic details); fixation of double bonds and Fries rule; reactions (with mechanism) of naphthalene, anthracene, phenanthrene and their derivatives.

*Heterocyclic compounds:* 5- and 6-membered rings with one heteroatom; reactivity, orientation and important reactions (with mechanism) of furan, pyrrole, thiophene and pyridine; synthesis (including retrosynthetic approach and mechanistic details): pyrrole: Knorr synthesis, Paal-Knorr synthesis, Hantzsch synthesis; furan: Paal-Knorr synthesis, Feist-Benary synthesis and its variation; thiophenes: Paal-Knorr synthesis, Hinsberg synthesis; pyridine: Hantzsch synthesis; benzo-fused 5- and 6-membered rings with one heteroatom: reactivity, orientation and important reactions (with mechanistic details) of indole, quinoline and isoquinoline; synthesis (including retrosynthetic approach and mechanistic details): indole: Fischer, Madelung and Reissert; quinoline: Skraup, Doebner-Miller, Friedlander; isoquinoline: Bischler-Napieralski synthesis.

#### Cyclic Stereochemistry (10 Lectures) Marks: 08

Alicyclic compounds: concept of I-strain; conformational analysis: cyclohexane, mono and disubstituted cyclohexane; symmetry properties and optical activity; topomerisation; ring-size and ease of cyclisation; conformation & reactivity in cyclohexane system: consideration of steric and stereoelectronic requirements; elimination (E2, E1), nucleophilic substitution ( $S_N 1$ ,  $S_N 2$ ,  $S_N i$ , NGP), merged substitution-elimination; rearrangements; oxidation of cyclohexanol, esterification, saponification, lactonisation, epoxidation, pyrolytic *syn* elimination and fragmentation reactions.

### Pericyclic reactions (8 Lectures) Marks: 08

Mechanism, stereochemistry, regioselectivity in case of

*Electrocyclic reactions:* FMO approach involving  $4\pi$ - and  $6\pi$ -electrons (thermal and photochemical) and corresponding cycloreversion reactions.

*Cycloaddition reactions:* FMO approach, Diels-Alder reaction, photochemical [2+2] cycloadditions.

*Sigmatropic reactions:* FMO approach, sigmatropic shifts and their order; [1,3]- and [1,5]- H shifts and [3,3]-shifts with reference to Claisen and Cope rearrangements.

### Carbohydrates (14 Lectures) Marks: 10

Monosaccharides: Aldoses up to 6 carbons; structure of D-glucose & D-fructose (configuration & conformation); ring structure of monosaccharides (furanose and pyranose forms): Haworth representations and non-planar conformations; anomeric effect stereoelectronic explanation); mutarotation; epimerization; (including reactions (mechanisms in relevant cases): Fischer glycosidation, osazone formation, brominewater oxidation, HNO<sub>3</sub> oxidation, selective oxidation of terminal -CH<sub>2</sub>OH of aldoses, reduction to alditols, Lobry de Bruyn-van Ekenstein rearrangement; stepping-up (Kiliani-Fischer method) and stepping-down (Ruff's & Wohl's methods) of aldoses; end-groupinterchange of aldoses; acetonide (isopropylidene) and benzylidene protections; ring-size determination; Fischer's proof of configuration of (+)-glucose.

*Disaccharides:* Glycosidic linkages, concept of glycosidic bond formation by glycosyl donor-acceptor; structure of sucrose, inversion of cane sugar. *Polysaccharides*: starch (structure and its use as an indicator in titrimetric analysis).

Biomolecules

(12 Lectures) Marks: 12

*Amino acids:* synthesis with mechanistic details: Strecker, Gabriel, acetamido malonic ester, azlactone, Bücherer hydantoin synthesis, synthesis involving diketopiperazine; isoelectric point, zwitterions; electrophoresis, reaction (with mechanism): ninhydrin reaction, Dakin-West reaction; resolution of racemic amino acids.

*Peptides:* peptide linkage and its geometry; syntheses (with mechanistic details) of peptides using *N*-protection & C-protection, solid-phase (Merrifield) synthesis; peptide sequence: *C*-terminal and *N*-terminal unit determination (Edman, Sanger & 'dansyl' methods); partial hydrolysis; specific cleavage of peptides: use of CNBr.

*Nucleic acids:* pyrimidine and purine bases (only structure & nomenclature); nucleosides and nucleotides corresponding to DNA and RNA; mechanism for acid catalysed hydrolysis of nucleosides (both pyrimidine and purine types); comparison of alkaline hydrolysis of DNA and RNA; elementary idea of double helical structure of DNA (Watson-Crick model); complimentary base–pairing in DNA.

# <u>Reference Books</u>

1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry*, Second edition, Oxford University Press 2012.

- 2. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London.
- 3. Nasipuri, D. Stereochemistry of Organic Compounds, Wiley Eastern Limited.
- 4. Fleming, I. *Molecular Orbitals and Organic Chemical reactions*, Reference/Student Edition, Wiley, 2009.
- 5. Fleming, I. *Pericyclic Reactions*, Oxford Chemistry Primer, Oxford University Press.
- 6. Gilchrist, T. L. & Storr, R. C. *Organic Reactions and Orbital symmetry*, Cambridge University Press.
- 7. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
- 8. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 9. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 10. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press.
- 11. James, J., Peach, J. M. Stereochemistry at a Glance, Blackwell Publishing, 2003.
- 12. Robinson, M. J. T., *Stereochemistry*, Oxford Chemistry Primer, Oxford University Press, 2005.
- 13. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press.
- 14. Joule, J. A. Mills, K. Heterocyclic Chemistry, Blackwell Science.
- 15. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Wiely & Sons (1976).
- 16. Gilchrist, T. L. Heterocyclic Chemistry, 3rd edition, Pearson.
- 17. Davies, D. T., *Heterocyclic Chemistry*, Oxford Chemistry Primer, Oxford University Press.

# *CEMACOR12P:* ORGANIC CHEMISTRY-V LAB (60 Lectures/Contact Hours) Marks: 25

#### A. Chromatographic Separations

- 1. TLC separation of a mixture containing 2/3 amino acids
- 2. TLC separation of a mixture of dyes (fluorescein and methylene blue)
- 3. Column chromatographic separation of leaf pigments from spinach leaves
- 4. Column chromatographic separation of mixture of dyes
- 5. Paper chromatographic separation of a mixture containing 2/3 amino acids
- 6. Paper chromatographic separation of a mixture containing 2/3 sugars

#### **B. Spectroscopic Analysis of Organic Compounds**

1. Assignment of labelled peaks in the <sup>1</sup>H NMR spectra of the known organic compounds explaining the relative  $\delta$ -values and splitting pattern.

2. Assignment of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (C-H, O-H, N-H, C-O, C-N, C-X, C=C, C=O,

N=O, C=C, C=N stretching frequencies; characteristic bending vibrations are included).

3. The students must record full spectral analysis of **at least 15 (fifteen)** compounds from the following list:

(i) 4'-Bromoacetanilide (ii) 2-Bromo-4'-methylacetophenone (iii) Vanillin (iv) 2'-

Methoxyacetophenone 4-Aminobenzoic acid (vi) Salicylamide (v) (vii) 2'Hydroxyacetophenone (viii) 1,3-Dinitrobenzene (ix) trans-Cinnamic acid (x) trans-4Nitrocinnamaldehyde (xi) Diethyl fumarate (xii) 4-Nitrobenzaldehyde (xiii) 4'Methylacetanilide (xiv) Mesityl oxide (xv) 2-Hydroxybenzaldehyde (xvi) 4Nitroaniline (xvii) 2-Hydroxy-3-nitrobenzaldehyde (xviii) 2,3-Dimethylbenzonitrile

(xix) Pent-1-yn-3-ol (xx) 3-Nitrobenzaldehyde (xxi) 3-Ethoxy-4-hydroxybenzaldehyde (xxii) 2-Methoxybenzaldehyde (xxiii) Methyl 4-hydroxybenzoate (xxiv) Methyl 3hydroxybenzoate (xxv) 3-Aminobenzoic acid (xxvi) Ethyl 3-aminobenzoate (xxvii) Ethyl 4-aminobenzoate (xxviii) 3-Nitroanisole (xxix) 5-Methyl-2-nitroanisole

(xxx) 3'-Methylacetanilide

- 1. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N. University of Calcutta, 2003.
- 2. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015
- 3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012).
- 4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education.

#### **SEMESTER-VI**

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CEMACOR13T: INORGANIC CHEMISTRY-V

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Bioinorganic Chemistry (24 Lectures) Marks: 20

Elements of life: essential and beneficial elements, major, trace and ultratrace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>, Fe<sup>3+/2+</sup>, Cu<sup>2+/+</sup>, and Zn<sup>2+</sup>). Metal ion transport across biological membrane Na<sup>+</sup>/ K<sup>+</sup>-ion pump. Dioxygen molecule in life. Dioxygen management proteins: Haemoglobin, Myoglobin, Hemocyanine and Hemerythrin. Electron transfer proteins: Cytochromes and Ferredoxins. Hydrlytic enzymes: carbonate bicarbonate buffering system and carbonic anhydrase and carboxyanhydrase A. Biological nitrogen fixation, Photosynthesis: Photosystem-I and Photosystem-II. Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases (examples only)

Organometallic Chemistry (24 Lectures) Marks: 20

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. 18-electron and 16-electron rules (pictorial MO approach). Applications of 18-electron rule to metal carbonyls, nitrosyls, cyanides. General methods of preparation of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls. pi-acceptor behaviour of CO, synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation, structure, evidences of synergic effect. Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Reactions of organometallic complexes: substitution, oxidative addition, reductive elimination and insertion reactions.

#### Catalysis by Organometallic Compounds

Study of the following industrial processes

- 1. Alkene hydrogenation (Wilkinson's Catalyst)
- 2. Hydroformylation
- 3. Wacker Process
- 4. Synthetic gasoline (Fischer Tropsch reaction)
- 5. Ziegler-Natta catalysis for olefin polymerization.

# Reaction Kinetics and Mechanism (12 Lectures) Marks: 10

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect and its application in complex synthesis, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

#### **Reference Books**

- 1. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
- 2. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. *Inorganic Chemistry, Principles* of Structure and Reactivity 4<sup>th</sup> Ed., Harper Collins 1993, Pearson, 2006.
- 3. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, ButterworthHeinemann, 1997.
- Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., Advanced Inorganic Chemistry 6<sup>th</sup> Ed. 1999., Wiley.
- 5. Bertini, I., Gray, H. B., Lippard, S.J., Valentine, J. S., Viva, 2007.
- 6. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
- 7. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
- 8. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
- 9. Collman, J. P. et al. Principles and Applications of Organotransition MetalChemistry. Mill Valley, CA: University Science Books, 1987.
- 10. Crabtree, R. H. *The Organometallic Chemistry of the Transition Metals*. New York, NY: John Wiley, 2000.

# CEMACOR13P:: INORGANIC CHEMISTRY-V LAB

# (60 Lectures/Contact Hours) Marks: 25

Qualitative semimicro analysis of mixtures containing four radicals. Emphasis should be given to the understanding of the chemistry of different reactions and to assign the most probable composition.

Cation Radicals: Na<sup>+</sup>,K<sup>+</sup>, Ca<sup>2+</sup>, Sr<sup>2+</sup>, Ba<sup>2+</sup>, Al<sup>3+</sup>, Cr<sup>3+</sup>, Mn<sup>2+</sup>/Mn<sup>4+</sup>, Fe<sup>3+</sup>, Co<sup>2+</sup>/Co<sup>3+</sup>, Ni<sup>2+</sup>, Cu<sub>2+</sub>, Zn<sub>2+</sub>, Pb<sub>2+</sub>, Cd<sub>2+</sub>, Bi<sub>3+</sub>, Sn<sub>2+</sub>/Sn<sub>4+</sub>, As<sub>3+</sub>/As<sub>5+</sub>, Sb<sub>3+/5+</sub>, NH<sub>4+</sub>, Mg<sub>2+</sub>. Anion Radicals: F<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, BrO<sub>3</sub><sup>-</sup>, I<sup>-</sup>, IO<sub>3</sub><sup>-</sup>, SCN<sup>-</sup>, S<sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup>, AsO<sub>4</sub><sup>3--</sup>, BO<sub>3</sub><sup>3-</sup>, CrO<sub>4</sub><sup>2-</sup> / Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>, Fe(CN)<sub>6</sub><sup>4-</sup>, Fe(CN)<sub>6</sub><sup>3-</sup>.

Insoluble Materials: Al<sub>2</sub>O<sub>3</sub>(ig), Fe<sub>2</sub>O<sub>3</sub>(ig), Cr<sub>2</sub>O<sub>3</sub>(ig), SnO<sub>2</sub>, SrSO<sub>4</sub>, BaSO<sub>4</sub>, CaF<sub>2</sub>, PbSO<sub>4</sub>.

# <u>Reference Books</u>

1. Svehla, G., Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

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# CEMACOR14T: PHYSICAL CHEMISTRY- IV

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Molecular Spectroscopy (25 Lectures) Marks: 20

Interaction of electromagnetic radiation with molecules; Transition between two states and time-dependent S.E.; Transition moment integral and selection rules; Various types of spectra

<u>Rotation spectroscopy</u>: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution

<u>Vibrational spectroscopy</u>: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies; Diatomic vibrating rotator, P, Q, R branches

<u>Raman spectroscopy</u>: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion

<u>Nuclear Magnetic Resonance (NMR) spectroscopy</u>: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules

<u>Electron Spin Resonance (ESR) spectroscopy</u>: Its principle, hyperfine structure, ESR of simple radicals

Photochemistry (15 Lectures) Marks: 14

Lambert-Beer's law: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients; Laws of photochemistry,

Stark-Einstein law of photochemical equivalence, quantum yield, actinometry, examples of low and high quantum yields

<u>Photochemical Processes</u>: Potential energy curves (diatomic molecules), Frank-Condon principle and vibrational structure of electronic spectra; Bond dissociation and principle of determination of dissociation energy (ground state); Decay of excited states by radiative and non-radiative paths; Pre-dissociation; Fluorescence and phosphorescence, Jablonskii diagram

Rate of Photochemical processes: Photochemical equilibrium and the differential rate of photochemical reactions, Photostationary state; HI decomposition, H<sub>2</sub>-Br<sub>2</sub> reaction, dimerisation of anthracene; photosensitised reactions, quenching; Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence

#### Surface phenomenon (20 Lectures) Marks: 16

<u>Surface tension and energy</u>: Surface tension, surface energy, excess pressure, capillary rise and surface tension; Work of cohesion and adhesion, spreading of liquid over other surface; Vapour pressure over curved surface; Temperature dependence of surface tension

<u>Adsorption</u>: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs' adsorption isotherm and surface excess; Heterogenous catalysis (single reactant); Zero order and fractional order reactions

<u>Colloids</u>: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Determination of Avogadro number by Perrin's method; Stability of colloids and zeta potential; Micelle formation

- 1. Castellan, G. W. Physical Chemistry, Narosa
- 2. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
- 3. Atkins, P. W. & Paula, J. de Atkin's, Physical Chemistry, Oxford University Press
- 4. McQuarrie, D. A. & Simons, J. D. Physical Chemistry: A Molecular Approach, Viva Press
- 5. Mortimer, R. G. Physical Chemistry, Elsevier
- 6. Laidler, K. J. Chemical Kinetics, Pearson
- 7. Banwell, C. N. Fundamentals of Molecular Spectroscopy, Tata-McGraw-Hill
- 8. Barrow, G. M. Molecular Spectroscopy, McGraw-Hill
- 9. Hollas, J.M. Modern Spectroscopy, Wiley India
- 10. McHale, J. L. Molecular Spectroscopy, Pearson Education
- 11. Wayne, C. E. & Wayne, R. P. Photochemistry, OUP
- 12. Brown, J. M. Molecular Spectroscopy, OUP

Levine, I. N. Quantum Chemistry, PHI
 Atkins, P. W. Molecular Quantum Mechanics, Oxford

# CEMACOR14P: PHYSICAL CHEMISTRY- IV LAB (60 Lectures/Contact Hours) Marks: 25

Experiment 1: Determination of surface tension of a liquid using Stalagmometer

Experiment 2: Determination of CMC from surface tension measurements

Experiment 3: Verification of Beer and Lambert's Law for KMnO<sub>4</sub> and K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution

Experiment 4: Study of kinetics of  $K_2S_2O_8 + KI$  reaction, spectrophotometrically

Experiment 5: Determination of pH of unknown buffer, spectrophotometrically

Experiment 6: Spectrophotometric determination of CMC

#### **Reference Books**

- 1. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
- 2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
- 3. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007)
- 4. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
- 5. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta
- 6. Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd.
- 7. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

# DISCIPLINE SPECIFIC ELECTIVE COURSE (HONOURS) IN CHEMISTRY

# *CEMADSE01T:* ADVANCED PHYSICAL CHEMISTRY (Credits: Theory-04, Practicals-02)

<u>Theory</u> (60 Lecturers) Crystal Structure (20 Lectures) Marks: 18

<u>Bravais Lattice and Laws of Crystallography</u>: Types of solid, Bragg's law of diffraction; Laws of crystallography; Permissible symmetry axes in crystals; Lattice, space lattice, unit cell, crystal planes, Bravais lattice. Packing of uniform hard sphere, close packed arrangements (fcc and hcp); Tetrahedral and octahedral voids. Void space in p-type, Ftype and I-type cubic systems

<u>Crystal planes</u>: Distance between consecutive planes [cubic, tetragonal and orthorhombic lattices]; Indexing of planes, Miller indices; calculation of  $d_{hkl}$ ; Relation between molar mass and unit cell dimension for cubic system; Laue's diffraction; Bragg's law (derivation)

Determination of crystal structure: Powder method; Structure of NaCl and KCl crystals

Statistical Thermodynamics (20 Lectures) Marks: 16

<u>Configuration</u>: Macrostates, microstates and configuration; calculation of microstates with harmonic oscillator and tossing of coins; variation of W with E; equilibrium configuration

<u>Boltzmann distribution</u>: Thermodynamic probability, entropy and probability, Boltzmann distribution formula (with derivation); Applications to barometric distribution; Concept of ensemble - canonical ensemble and grand canonical ensembles

<u>Partition function</u>: molecular partition function and thermodynamic properties (U, H, S,  $C_V$ , q, P); Partition function correlating – Chemical equilibrium and Maxwell's speed distribution; Gibbs' paradox; Ideal gas equation

Special selected topics (20 Lectures) Marks: 16

<u>Specific heat of solid</u>: Coefficient of thermal expansion, thermal compressibility of solids; Dulong –Petit's law; Perfect Crystal model, Einstein's theory – derivation from partition function, limitations; Debye's  $T^3$  law – analysis at the two extremes <u>3</u><sup>rd</sup><u>1aw</u>: Absolute entropy, Plank's law, Calculation of entropy, Nernst heat theorem <u>Adiabatic demagnetization</u>: Approach to zero Kelvin, adiabatic cooling, demagnetization, adiabatic demagnetization – involved curves

<u>Polymers</u>: Classification of polymers, nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers; Criteria for synthetic polymer formation; Relationships between functionality, extent of reaction and degree of polymerization; Mechanism and kinetics of step growth and copolymerization; Conducting polymers

#### **Reference Books**

- 1. Castellan, G. W. Physical Chemistry, Narosa
- 2. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
- 3. Moore, W. J. Physical Chemistry, Orient Longman
- 4. Atkins, P. W. & Paula, J. de Atkins', Physical Chemistry, Oxford University Press
- 5. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry*: A Molecular Approach, Viva Press
- 6. Engel, T. & Reid, P. Physical Chemistry, Pearson
- 7. Nash, L. K. Elements of Statistical Thermodynamics, Dover
- 8. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas
- 9. Zemansky, M. W. & Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
- 10. Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc.
- 11. Seymour, R. B. & Carraher, C. E. Polymer Chemistry: An Introduction, Marcel Dekker, Inc.
- 12. Odian, G. Principles of Polymerization, Wiley
- 13. Billmeyer, F. W. Textbook of Polymer Science, Wiley Interscience, 1971.

# CEMADSE01P: ADVANCED PHYSICAL CHEMISTRY LAB (60 Lectures/Contact Hours) Marks: 25

Computer programs based on numerical methods for

Programming 1: Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid)

Programming 2: Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations)

Programming 3: Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values

Programming 4: Matrix operations (Application of Gauss-Siedel method in colourimetry)

Programming 5: Simple exercises using molecular visualization software

## <u>Reference Books</u>

- 1. McQuarrie, D. A. *Mathematics for Physical Chemistry* University Science Books (2008)
- 2. Mortimer, R. *Mathematics for Physical Chemistry*. 3rd Ed. Elsevier (2005)
- 3. Yates, P. Chemical Calculations. 2nd Ed. CRC Press (2007)
- 4. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5
- 5. Noggle, J. H. Physical Chemistry on a Microcomputer. Little Brown & Co. (1985)

# *CEMADSE02T:* ANALYTICAL METHODS IN CHEMISTRY (Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

#### Qualitative and quantitative aspects of analysis: (05 Lectures) Marks: 06

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

# Optical methods of analysis: (25 Lectures) Marks: 16

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

*UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

*Basic principles of quantitative analysis:* estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. *Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation(choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background

correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

## Thermal methods of analysis: (05 Lectures) Marks: 06

Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

# Electroanalytical methods: (10 Lectures) Marks: 08

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

# Separation techniques: (15 Lectures) Marks: 14

Solvent extraction: Classification, principle and efficiency of the technique.

Mechanism of extraction: extraction by solvation and chelation.

Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.

Chromatography: Classification, principle and efficiency of the technique.

Mechanism of separation: adsorption, partition & ion exchange.

Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).

Role of computers in instrumental methods of analysis.

# **Reference Books**

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6<sup>th</sup>Ed., Pearson,

2009.

2. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth

3. Publishing Company, Belmont, California, USA, 1988. Christian, G.D. Analytical

Chemistry, 6th Ed. John Wiley & Sons, New York,

2004.

- 4. Harris, D.C.: *Exploring Chemical Analysis*, 9<sup>th</sup> Ed. New York, W.H. Freeman, 2016.
- 5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
- 6. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- 7. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- 8. Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.
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# *CEMADSE02P:* ANALYTICAL METHODS IN CHEMISTRY LAB (60 Lectures/Contact Hours) Marks: 25

### I. Separation Techniques

Chromatography:

(a) Separation of mixtures

Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the  $R_f$  values.

- (b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.
- (c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

### II. Solvent Extractions:

To separate a mixture of  $Ni^{2+}$  & Fe<sup>2+</sup> by complexation with DMG and extracting the  $Ni^{2+}$ -DMG complex in chloroform, and determine its concentration by spectrophotometry.

Analysis of soil:

(i) Determination of pH of soil.
(ii) Estimation of calcium, magnesium, phosphate

Ion exchange:

Determination of exchange capacity of cation exchange resins and anion exchange resins.

#### **III. Spectrophotometry**

- 1. Determination of pKa values of indicator using spectrophotometry.
- 2. Determination of chemical oxygen demand (COD).
- 3. Determination of Biological oxygen demand (BOD).

#### **Reference Books**

- 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6<sup>th</sup>Ed., Pearson, 2009.
- 2. Willard, H.H. et al.: Instrumental Methods of Analysis, 7<sup>th</sup> Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
- 3. Christian, G.D. Analytical Chemistry, 6<sup>th</sup> Ed. John Wiley & Sons, New York, 2004.
- 4. Harris, D.C. *Exploring Chemical Analysis*, 9<sup>th</sup> Ed. New York, W.H. Freeman, 2016.
- 5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
- 6. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.
- 7. Mikes, O. & Chalmes, R.A. *Laboratory Handbook of Chromatographic & AlliedMethods*, Elles Harwood Ltd. London.
- 8. Ditts, R.V. Analytical Chemistry: Methods of separation. Van Nostrand, New York, 1974.

CEMADSE03T: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

#### Introduction to spectroscopic methods of analysis: (04 Lectures) Marks: 04

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

#### Molecular spectroscopy: (16 Lectures) Marks: 12 Infrared spectroscopy:

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

*UV-Visible/ Near IR* – emission, absorption, fluorescence and photoaccoustic. Excitationsources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

#### Separation techniques: (16 Lectures) Marks: 12

*Chromatography:* Gas chromatography, liquid chromatography, supercritical fluids,Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

#### Elemental analysis: (08 Lectures) Marks: 06

Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence.

Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

NMR spectroscopy:
(04 Lectures) Marks: 04
Principle, Instrumentation, Factors affecting chemical shift, Spin-coupling, Applications.

**Electroanalytical Methods:** 

(04 Lectures) Marks: 04

Potentiometry & Voltammetry

Radiochemical Methods: (04 Lectures) Marks: 04 Elementary idea

X-ray analysis and electron spectroscopy (surface analysis): (04 Lectures) Marks: 04 Elementary idea

#### **Reference books**

- 1. D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) *Principles of InstrumentalAnalysis*, Cengage Learning India Edition, 2007.
- 2. Willard, Merritt, Dean, Settle, *Instrumental Methods of Analysis*, 7th ed, IBH Book House, New Delhi.
- 3. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10<sup>th</sup> Ed., Oxford University Press (2014).
- 4. Kakkar, R. *Atomic and Molecular Spectroscopy: Concepts and Applications*. Cambridge University Press, 2015.
- 5. Castellan, G. W. *Physical Chemistry* 4<sup>th</sup>Ed., Narosa (2004).
- 6. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4<sup>th</sup> Ed.
- 7. Smith, B.C. Infrared Spectral Interpretations: A Systematic Approach. CRC Press, 1998.
- 8. Moore, W.J., *Physical Chemistry* Orient Blackswan, 1999.

#### CEMADSE03T: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS LAB

#### (60 Lectures/Contact Hours) Marks: 25

1.Safety Practices in the Chemistry Laboratory

2.Determination of the isoelectric pH of a protein.3. Titration curve of an amino acid.

- 4. Determination of the void volume of a gel filtration column.
- 5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
- 6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
- 7. IR Absorption Spectra (Study of Aldehydes and Ketones)
- 8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption

9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride) 10.Separation of Carbohydrates by HPLC

11. Determination of Caffeine in Beverages by HPLC

12. Potentiometric Titration of a Chloride-Iodide Mixture

13. Cyclic Voltammetry of the Ferrocyanide/ Ferricyanide Couple

14. Nuclear Magnetic Resonance

15. Use of fluorescence to do "presumptive tests" to identify blood or other body fluids.

16. Use of "presumptive tests" for anthrax or cocaine

17. Collection, preservation, and control of blood evidence being used for DNA testing

18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)

- 19. Use of sequencing for the analysis of mitochondrial DNA
- 20. Laboratory analysis to confirm anthrax or cocaine

21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives

- 22. Detection of illegal drugs or steroids in athletes
- 23. Detection of pollutants or illegal dumping
- 24. Fibre analysis

At least 10 experiments to be performed.

#### <u>Reference Books</u>

- 1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7<sup>th</sup> Ed. Wadsworth Publishing Company Ltd., Belmont, California,USA, 1988

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#### CEMADSE04T: GREEN CHEMISTRY

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Introduction to Green Chemistry: (04 Lectures) Marks: 06 What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

#### Principles of Green Chemistry and Designing a Chemical synthesis: (30 Lectures) Marks: 22

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:

 Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.

• Green solvents- supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized

□ solvents and how to compare greenness of solvents.

- Energy requirements for reactions alternative sources of energy: use of microwaves and ultrasonic energy. □
- Selection of starting materials; avoidance of unnecessary derivatization careful □ use of blocking/protecting groups. □
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and

 $\Box$ homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.  $\Box$ 

• Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization,

 $\Box$  simplification, substitution, moderation and limitation.  $\Box$ 

■ Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. □

# Examples of Green Synthesis/ Reactions and some real world cases: (16 Lectures) Marks: 12

- 1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
- 2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions

in organic solvents Diels-Alder reaction and Decarboxylation reaction

3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction

(Ultrasonic alternative to Iodine)

- 4 Surfactants for carbon dioxide replacing smog producing and ozone depleting solvents with CO<sub>2</sub> for precision cleaning and dry cleaning of garments.
- 5 Designing of Environmentally safe marine antifoulant.
- 6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
- 7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
- 8 Healthier Fats and oil by Green Chemistry: Enzymatic Inter esterification for production of no Trans-Fats and Oils
- 9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

#### Future Trends in Green Chemistry: (10 Lectures) Marks:10

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis ( $C^2S^3$ ); Green chemistry in sustainable development.

#### **Reference Books**

- 1. Anastas, P.T. & Warner, J.K.: *Green Chemistry Theory and Practical*, Oxford University Press (1998).
- 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
- 3. Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- 4. Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002).
- 5. Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2<sup>nd</sup> Edition, 2010.

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#### *CEMADSE04P:* GREEN CHEMISTRY LAB (60 Lectures/Contact Hours) Marks: 25

#### 1. Safer starting materials

• Preparation and characterization of nanoparticles of gold using tea leaves.

#### 2. Using renewable resources

• Preparation of biodiesel from vegetable/ waste cooking oil.

#### **3.**Avoiding waste

Principle of atom economy

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
- Preparation of propene by two methods can be studied

Triethylamine ion +  $OH^- \rightarrow propene + trimethylpropene + water$ 

 $\begin{array}{c} H_2SO_4/\Delta\\ 1\text{-propanol} & \longrightarrow \end{array} propene + water \end{array}$ 

• Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

#### 4.Use of enzymes as catalysts

•Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

#### **5.**Alternative Green solvents

•Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice.

Mechanochemical solvent free synthesis of azomethines

#### 6. Alternative sources of energy

- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

#### **Reference Books**

1. Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice*, Oxford University Press (1998).

2. Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistryexperiment*. American Chemical Society, Washington DC (2002).

3. Ryan, M.A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).

4. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment:A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN978-93-81141-55-7 (2013).

5. Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).

6. Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society (2008).

7. Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2<sup>nd</sup>Edition, 2010.

8. Pavia, D.L., Lampman, G.M., Kriz, G.S. & Engel, R.G. *Introduction to* 

OrganicLaboratory Techniques: A Microscale and Macro Scale Approach, W.B.Saunders, 1995.

## *CEMADSE05T:* INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE (Credits: Theory-06, Practicals-02)

60 Lectures Marks: 50

#### Silicate Industries: (16 Lectures) Marks: 12

*Glass:* Glassy state and its properties, classification (silicate and non-silicate glasses).Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

*Ceramics:* Important clays and feldspar, ceramic, their types and manufacture. Hightechnology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

*Cements:* Classification of cement, ingredients and their role, Manufacture of cement and thesetting process, quick setting cements.

#### Fertilizers: (8 Lectures) Marks: 06

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

#### Surface Coatings: (10 Lectures) Marks: 06

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint,

Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

#### Batteries: (6 Lectures) Marks: 06

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

#### Alloys: (10 Lectures) Marks: 08

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (Ar and heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

#### Catalysis: (6 Lectures) Marks: 06

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts.

Phase transfer catalysts, application of zeolites as catalysts.

#### Chemical explosives: (4 Lectures) Marks: 06

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

#### <u>Reference Books</u>

- 1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- 2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- 3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- 4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- 5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- 6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.

7. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

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#### *CEMADSE05P:* INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE LAB (60 Lectures/Contact Hours) Marks: 25

- 1. Determination of free acidity in ammonium sulphate fertilizer.
- 2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
- 3. Estimation of phosphoric acid in superphosphate fertilizer.
- 4. Electroless metallic coatings on ceramic and plastic material.
- 5. Determination of composition of dolomite (by complexometric titration).
- 6. Analysis of (Cu, Ni); (Cu, Zn ) in alloy or synthetic samples.
- 7. Analysis of Cement.
- 8. Preparation of pigment (zinc oxide).

#### <u>Reference Books</u>

- 1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- 2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- 3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- 4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- 5. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas
- 7. Publications, New Delhi.
- 8. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

#### **CEMADSE06T: POLYMER CHEMISTRY**

(Credits: Theory-06, Practicals-02)

Theory: 60 Lectures Marks: 50

#### Introduction and history of polymeric materials:

(04 Lectures) Marks: 04

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

## Functionality and its importance: (08 Lectures) Marks: 06

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

Kinetics of Polymerization: (08 Lectures) Marks: 06

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

## Crystallization and crystallinity: (04 Lectures) Marks: 04

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers: (04 Lectures) Marks: 04

Structure Property relationships.

## **Determination of molecular weight of polymers:** (08 Lectures) Marks: 06

(Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

## Glass transition temperature (Tg) and determination of Tg: (08 Lectures) Marks: 04

Free volume theory, WLFequation, Factors affecting glass transition temperature (Tg).

Polymer Solution: (08 Lectures) Marks: 06

Criteria for polymer solubility, Solubility parameter, Thermodynamicsof polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

Properties of Polymer: (10 Lectures) Marks: 10 (Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes,

Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

#### <u>Reference Books</u>

1.R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981.* 

2.3.G. Odian: F.W. Billmeyer: *Principles of PolymerizationTextbook of Polymer Science*, 4<sup>th</sup> Ed. Wiley, 2004. , 2nd Ed. Wiley Interscience, 1971.

- 4. P. Ghosh: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
- 5. R.W. Lenz: Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967.

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# *CEMADSE06P:* POLYMER CHEMISTRY LAB (60 Lectures/Contact Hours) Marks: 25

- 1.Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
  - a) Purification of monomer
  - b) Polymerization using benzoyl peroxide (BPO) / 2,2'-azobisisobutylonitrile (AIBN)
  - 2. Preparation of nylon 66/6
  - 3. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
  - 4. Redox polymerization of acrylamide
  - 5. Precipitation polymerization of acrylonitrile
  - 6. Preparation of urea-formaldehyde resin
  - 7. Preparations of novalac resin/ resold resin.

8. Microscale Emulsion Polymerization of Poly(methylacrylate).

#### Polymer characterization

- 1. Determination of molecular weight by viscometry:
  - (a) Polyacrylamide-aq.NaNO<sub>2</sub> solution
  - (b) (Poly vinyl proplylidine (PVP) in water
- 2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
- 3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
- 4. Testing of mechanical properties of polymers.
- 5. Determination of hydroxyl number of a polymer using colorimetric method.

#### **Polymer analysis**

- 1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
- 2. Instrumental Techniques
- 3. IR studies of polymers
- 4. DSC analysis of polymers
- 5. Preparation of polyacrylamide and its electrophoresis

\*at least 7 experiments to be carried out.

#### <u>Reference Books</u>

- 1. M.P. Stevens, *Polymer Chemistry: An Introduction*, 3<sup>rd</sup> Ed., Oxford University Press, 1999.
- 2. H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3<sup>rd</sup> ed. Prentice-Hall (2003)
- 3. F.W. Billmeyer, *Textbook of Polymer Science*, 3<sup>rd</sup> ed. Wiley-Interscience (1984)
- 4. J.R. Fried, *Polymer Science and Technology*, 2<sup>nd</sup> ed. Prentice-Hall (2003)
- 5. P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2<sup>nd</sup> ed. John Wiley & Sons (2002)
- L. H. Sperling, *Introduction to Physical Polymer Science*, 4<sup>th</sup> ed. John Wiley & Sons (2005)
- 7. M.P. Stevens, *Polymer Chemistry: An Introduction* 3<sup>rd</sup> ed. Oxford University Press (2005).
- 8. Seymour/ Carraher's Polymer Chemistry, 9<sup>th</sup> ed. by Charles E. Carraher, Jr. (2013).

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## GENERIC ELECTIVE COURSE (HONOURS) IN CHEMISTRY

## CHEMISTRY

## **Core papers Chemistry (Credit: 06 each) :**

SEM-I	SEM-II	SEM-III	SEM-IV
CEMHGEC01	CEMHGEC02	CEMHGEC03	CEMHGEC04

#### **SEMESTER-I**

#### **CEMHGEC01T: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES, REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS**

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

Section A: Inorganic Chemistry-I (30 Lectures) Marks: 25

#### **Atomic Structure**

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations.

#### **Chemical Periodicity**

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements.

#### Acids and bases (10 Lectures)

Brönsted-Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

#### **Redox reactions**

Balancing of equations by oxidation number and ion-electron method oxidimetry and reductimetry.

Section B: Organic Chemistry-I (30 Lectures) Marks: 25

#### **Fundamentals of Organic Chemistry**

*Electronic displacements*: inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles electrophiles; reactive intermediates: carbocations, carbanions and free radicals.

#### Stereochemistry

Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (up to two carbon atoms); asymmetric carbon atom; elements of symmetry (plane and centre); interconversion of Fischer and Newman representations; enantiomerism

#### (10 Lectures)

(05 Lectures)

#### (05 Lectures)

(8 Lectures)

#### (5 Lectures)

and diastereomerism, *meso* compounds; *threo* and *erythro*, D and L, *cis* and *trans* nomenclature; CIP Rules: *R/S* (upto 2 chiral carbon atoms) and *E/Z* nomenclature.

#### Nucleophilic Substitution and Elimination Reactions(5 Lectures)

*Nucleophilic substitutions*:  $S_N1$  and  $S_N2$  reactions; eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations; elimination *vs* substitution.

#### **Aliphatic Hydrocarbons**

#### (12 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures.

*Alkanes:*(up to 5 Carbons). *Preparation:* catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* mechanism forfree radical substitution: halogenation.

*Alkenes:* (up to 5 Carbons). *Preparation:* elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; *cis* alkenes (partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions: cis*-addition (alkaline KMnO<sub>4</sub>) and *trans*-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and antiMarkownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction.

*Alkynes:* (up to 5 Carbons). *Preparation:* acetylene from  $CaC_2$  and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO<sub>4</sub>, ozonolysis and oxidation with hot alkaline KMnO<sub>4</sub>.

- 1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
- 2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3<sup>rd</sup> ed., Wiley.
- 3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in *InorganicChemistry*, John Wiley & Sons.
- 4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry:Principles* of Structure and Reactivity, Pearson Education India, 2006.
- 5. Sethi, A. Conceptual Organic Chemistry; New Age International Publisher.
- 6. Parmar, V. S. A Text Book of Organic Chemistry, S. Chand & Sons.
- 7. Madan, R. L. Organic Chemistry, S. Chand & Sons.
- 8. Wade, L. G., Singh, M. S., Organic Chemistry.
- 9. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 10. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

- 11. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
- 12. Sen Gupta, Subrata. Basic Stereochemistry of Organic molecules.
- 13. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, Eighth edition, New Age International, 2014.
- 14. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

#### CEMHGEC01P: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES, REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB (60 Lectures/Contact Hours) Marks: 25

#### Section A: Inorganic Chemistry –LAB

(30 Lectures)

- 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
- 2. Estimation of oxalic acid by titrating it with KMnO<sub>4</sub>.
- 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.
- 4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
- 5. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.

#### Section B: Organic Chemistry- LAB (30 Lectures)

#### *Qualitative Analysis of Single Solid Organic Compound(s)*

Experiment A: Detection of special elements (N, Cl, and S) in organic compounds.

Experiment B: Solubility and Classification (solvents: H<sub>2</sub>O, dil. HCl, dil. NaOH)

Experiment C: Detection of functional groups: Aromatic- $NO_2$ , Aromatic - $NH_2$ , -COOH, carbonyl (no distinction of -CHO and >C=O needed), -OH (phenolic) in solid organic compounds.

Experiments A - C with unknown (at least 6) solid samples containing not more than two of the above type of functional groups should be done.

- 1. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Das, S. C., Chakraborty, S. B., Practical Chemistry.
- 3. Mukherjee, K. S. Text book on Practical Chemistry, New Oriental Book Agency.
- 4. Ghosal, Mahapatra & Nad, *An Advanced course in practical Chemistry*, New Central Book Agency.
- 5. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 2: *Qualitative Organic Analysis*, CBS Publishers and Distributors.
- 6. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- 7. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

#### Definition of Surface tension, its dimension and principle of its determination using stalagmometer; Viscosity of a liquid and principle of determination of coefficient of viscosity using Ostwald viscometer; Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

#### Solids

Liquids

treatment only)

Forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry elements; Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices; Miller indices of different planes and interplanar distance, Bragg's law; Structures of NaCl, KCl and CsCl (qualitative treatment only); Defects in crystals; Glasses and liquid crystals. **Chemical Kinetics** (08 Lectures)

#### (06 Lectures)

Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of effusion

Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy; Average velocity, root mean square velocity and most probable velocity; Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour; Existence of critical state, Critical constants in terms of van der

Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative

**CEMHGEC02T: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS** (Credits: Theory-04, Practicals-02)

**Theory: 60 Lectures** Marks: 50

Marks: 25

**Kinetic Theory of Gases and Real gases** 

Waals constants; Law of corresponding states

Section A: Physical Chemistry-I

(30 Lectures)

**SEMESTER-II** \_\_\_\_\_

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(06 Lectures)

(10 Lectures)

Introduction of rate law, Order and molecularity; Extent of reaction; rate constants; Rates of First, second and nth order reactions and their Differential and integrated forms (with derivation); Pseudo first order reactions; Determination of order of a reaction by half-life and differential method; Opposing reactions, consecutive reactions and parallel reactions

Temperature dependence of rate constant; Arrhenius equation, energy of activation; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)

#### **Reference Books:**

- 1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- 2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- 3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- 4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- 5. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- 6. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., Essentials of Physical Chemistry S. Chand & Co. ltd.
- 8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
- 9. Mandal, A. K. Degree Physical and General Chemistry Sarat Book House
- 10. Pahari, S., Physical Chemistry New Central Book Agency
- 11. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency

#### Section B: Inorganic Chemistry-II (30 Lectures) Marks: 25

#### **Chemical Bonding and Molecular Structure**

#### (16 Lectures)

*Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionicbonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, BornHaber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

*Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions on the basisof VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s*-*s*, *s*-*p* and *p*-*p*combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods. (including idea of *s*- *p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>. Comparison of VB and MO approaches.

#### **Comparative study of p-block elements:**

#### (14 Lectures)

Group trends in electronic configuration, modification of pure elements, common oxidation states, inert pair effect, and their important compounds in respect of the following groups of elements:

i)B-Al-Ga-In-Tl ii)C-Si-Ge-Sn-Pb iii)N-P-As-Sb-Bi iv)O-S-Se-Te v)F-Cl-Br-I

#### **Reference Books:**

- 1. Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
- 2. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
- 3. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
- 4. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd.,

2008. -----

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#### CEMHGEC01P: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS LAB

#### (60 Lectures/Contact Hours) Marks: 25

#### Section A: Physical Chemistry-LAB

#### (15x2=30 Lectures)

(Minimum <u>five</u> experiments to complete)

- (I) Surface tension measurement (use of organic solvents excluded)
  - a) Determination of the surface tension of a liquid or a dilute solution using a Stalagmometer
  - b) Study of the variation of surface tension of a detergent solution with concentration
- (II) Viscosity measurement (use of organic solvents excluded)
  - a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer
  - b) Study of the variation of viscosity of an aqueous solution with concentration of solute
- (III) Study the kinetics of the following reactions
  - a) Initial rate method: Iodide-persulphate reaction
  - b) Integrated rate method:
    - (i) Acid hydrolysis of methyl acetate with hydrochloric acid
    - (ii) Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis of methyl acetate

#### **Reference Books:**

- 1. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
- 3. Mukherjee, N.G., Selected Experiments in Physical Chemistry J. N. Ghose & Sons
- 4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

#### Section B: Inorganic Chemistry-LAB

(30 Lectures)

Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions. Acid Radicals: Cl<sup>-</sup>, Br<sup>-</sup>, I, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, S<sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, H<sub>3</sub>BO<sub>3</sub>. Basic Radicals: Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Sr<sup>2+</sup>, Ba<sup>2+</sup>, Cr<sup>3+</sup>, Mn<sup>2+</sup>, Fe<sup>3+</sup>, Ni<sup>2+</sup>, Cu<sup>2+</sup>, NH<sub>4</sub><sup>+</sup>.

- 1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- 2. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

# SEMESTER-III

## CEMHGEC03T: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY-II (Credits: Theory-04, Practicals-02) Theory: 60 Lectures Marks: 50

#### Section A: Physical Chemistry-II

(30 Lectures) Marks: 25

#### **Chemical Energetics**

#### (14 Lectures)

(08 Lectures)

(08 Lectures)

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases

Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature

Statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine, refrigerator and efficiency; Entropy change of systems and surroundings for various processes and transformations; Auxiliary state functions (G and A) and Criteria for spontaneity and equilibrium.

#### Chemical Equilibrium:

Thermodynamic conditions for equilibrium, degree of advancement; Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs' free energy change; Definitions of  $K_P$ ,  $K_C$  and  $K_X$  and relation among them; van't Hoff's reaction isotherm, isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle

#### Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts; Buffer solutions; Solubility and solubility product of sparingly soluble salts – applications of solubility product principle

#### **Reference Books:**

- 1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- 2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- 3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- 4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- 5. Ekambaram, S. General Chemistry, Pearson.
- 6. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- 7. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry Kalyani Publishers8.Bahl, B.S., Bahl, A., Tuli, G.D., Essentials of Physical Chemistry S. Chand & Co. ltd.
- 9. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
- 10. Mandal, A. K. Degree Physical and General Chemistry Sarat Book House
- 11. Pahari, S., Physical Chemistry New Central Book Agency
- 12. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency

#### Section-B: Organic Chemistry-II (30 Lectures) Marks: 25

Functional group app roach for the following reactions (preparations & reactions) to be studied in context to their structures.

#### **Aromatic Hydrocarbons**

*Benzene:Preparation*: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: electrophilic substitution (general mechanism); nitration (with mechanism), halogenations (chlorination and bromination), sulphonation and Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene); side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

#### **Organometallic Compounds**

Introduction; *Grignard reagents: Preparations* (from alkyl and aryl halide); concept of *umpolung;* Reformatsky reaction.

#### **Aryl Halides**

*Preparation:* (chloro-, bromo- and iodobenzene): from phenol, Sandmeyer reactions. *Reactions (Chlorobenzene):* nucleophilic aromatic substitution (replacement by –OH group) and effect of nitro substituent (activated nucleophilic substitution).

#### **Alcohols, Phenols and Ethers**

*Alcohols:* (up to 5 Carbons). *Preparation:*  $1^{\circ}$ -,  $2^{\circ}$ - and  $3^{\circ}$ - alcohols: using Grignard reagent, reduction of aldehydes, ketones, carboxylic acid and esters; *Reactions:* With sodium, HX (Lucas test), oxidation (alkaline KMnO<sub>4</sub>, acidic dichromate, concentrated HNO<sub>3</sub>);

#### 06 Lectures)

#### (3 Lectures)

(2 Lectures)

#### (11 Lectures)

Oppenauer oxidation; *Diols: Preparation* (with OsO<sub>4</sub>); pinacol- pinacolone rearrangement (with mechanism) (*with symmetrical diols* only).

*Phenols:Preparation:* cumene hydroperoxide method, from diazonium salts; acidic nature of phenols; *Reactions:* electrophilic substitution: nitration and halogenations; Reimer -Tiemann reaction, Houben–Hoesch condensation, Schotten –Baumann reaction, Fries rearrangement and Claisen rearrangement.

*Ethers:Preparation:* Williamson's ether synthesis; *Reaction:* cleavage of ethers with HI. Carbonyl Compounds (08 Lectures)

*Aldehydes and Ketones (aliphatic and aromatic):*(Formaldehye, acetaldehyde, acetone and benzaldehyde): *Preparation:* from acid chlorides, from nitriles and from Grignard reagents; general properties of aldehydes and ketones; *Reactions:* with HCN, ROH, NaHSO<sub>3</sub>, NH<sub>2</sub>-G derivatives and with Tollens' and Fehling's reagents; iodoform test; aldol condensation (with mechanism); Cannizzaro reaction (with mechanism), Wittig reaction, benzoin condensation; Clemmensen reduction, Wolff- Kishner reduction and Meerwein-Pondorff-Verley (MPV) reduction.

#### **Reference Books:**

- 1. Sethi, A. Conceptual Organic Chemistry; New Age International Publisher.
- 2. Parmar, V. S. A Text Book of Organic Chemistry, S. Chand & Sons.
- 3. Madan, R. L. Organic Chemistry, S. Chand & Sons.
- 4. Wade, L. G., Singh, M. S., Organic Chemistry, Pearson.
- 5. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 6. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

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#### CEMHGEC03P: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY LAB (60 Lectures/Contact Hours) Marks: 25

#### Section A: Physical Chemistry-LAB

#### (15x2=30 Lectures)

(Minimum <u>five</u> experiments to complete)

- (I) Thermochemistry (Any <u>three</u>)
  - 1. Determination of heat capacity of calorimeter for different volumes
  - 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
  - 3. Determination of enthalpy of ionization of acetic acid
  - 4. Determination of enthalpy of hydration of copper sulphate
- (II) Ionic Equilibria (Any <u>two</u>)
  - a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter and compare it with the indicator method
  - b) Preparation of buffer solutions and find the pH of an unknown buffer solution by colour matching method (using following buffers)
    - (i) Sodium acetate-acetic acid
    - (ii) Ammonium chloride-ammonium hydroxide

c)Study of the solubility of benzoic acid in water

#### **Reference Books:**

- 1. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
- 3. Mukherjee, N.G., Selected Experiments in Physical Chemistry J. N. Ghose & Sons
- 4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

#### Section B: Organic Chemistry-LAB

#### Identification of a pure organic compound

*Solid compounds*: oxalic acid, tartaric acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid.

*Liquid Compounds*: methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene

#### **Reference Books:**

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbookof Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.

3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

#### 77

#### SEMESTER-IV

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#### CEMHGEC04T: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & ANALYTICAL AND ENVIORNMETAL CHEMISTRY-I (Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Section A: Physical Chemistry-III (30 Lectures) Marks: 25

#### Solutions

Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions; Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions; Distillation of solutions; Lever rule; Azeotropes

Critical solution temperature; effect of impurity on partial miscibility of liquids; Immiscibility of liquids- Principle of steam distillation; Nernst distribution law and its applications, solvent extraction

#### Phase Equilibria

Phases, components and degrees of freedom of a system, criteria of phase equilibrium; Gibbs' Phase Rule and its thermodynamic derivation; Derivation of Clausius – Clapeyron equation and its importance in phase equilibria; Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (leadsilver, FeCl<sub>3</sub>-H<sub>2</sub>O and Na-K only)

#### Conductance

Conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes; Ostwald's dilution law; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations (acid-base)

Transport Number and principles of Hittorf's and Moving-boundary method

#### **Electromotive force**

Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry; Chemical cells, reversible

#### (08 Lectures)

#### (08 Lectures)

(08 Lectures)

#### (06 Lectures)

and irreversible cells with examples; Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential; Electrochemical series; Thermodynamics of a reversible cell, calculation of thermodynamic properties: *G*, *H* and *S* from EMF data

Concentration cells with and without transference, liquid junction potential; pH determination using hydrogen electrode and quinhydrone; Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)

#### **Reference Books:**

- 1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- 2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- 3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- 4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- 5. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- 6. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., Essentials of Physical Chemistry S. Chand & Co. ltd.
- 8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
- 9. Pahari, S., Physical Chemistry New Central Book Agency
- 10. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency

Section B: Analytical and Environmental Chemistry (30 Lectures) Marks: 25

#### **Chemical Analysis**

#### (15 Lectures)

*Gravimetric analysis*: solubility product and common ion effect; requirements of gravimetry; gravimetric estimation of chloride, sulphate, lead, barium, nickel, copper and zinc.

*Volumetric analysis*: primary and secondary standard substances; principles of acid-base, oxidation –reduction and complexometric titrations; indicators: acid-base, redox and metal ion; principles of estimation of mixtures: NaHCO<sub>3</sub> and Na<sub>2</sub>CO<sub>3</sub> (by acidimetry); iron, copper, manganese and chromium (by redox titration); zinc, aluminum, calcium and magnesium (by complexometric EDTA titration).

*Chromatography*: chromatographic methods of analysis: column chromatography and thin layer chromatography.

#### **Environmental Chemistry**

*The Atmosphere*: composition and structure of the atmosphere; troposphere, stratosphere, mesosphere and thermosphere; ozone layer and its role; major air pollutants: CO,  $SO_2$ ,  $NO_x$  and particulate matters – their origin and harmful effects; problem of ozone layer depletion; green house effect; acid rain and photochemical smog; air pollution episodes: air quality

#### (15 Lectures)

standard; air pollution control measures: cyclone collector, electrostatic precipitator, catalytic converter.

*The Hydrosphere*: environmental role of water, natural water sources, water treatment for industrial, domestic and laboratory uses; water pollutants; action of soaps and detergents, phosphates, industrial effluents, agricultural runoff, domestic wastes; thermal pollution, radioactive pollution and their effects on animal and plant life; water pollution episodes: water pollution control measures : waste water treatment; chemical treatment and microbial treatment; water quality standards: DO, BOD, COD, TDS and hardness parameters; desalination of sea water : reverse osmosis, electrodialysis.

*The Lithosphere*: water and air in soil, waste matters and pollutants in soil, waste classification, treatment and disposal; soil pollution and control measures.

- 1. Banerjee, S. P. A Text Book of Analytical Chemistry, The New Book Stall.
- 2. Gangopadhyay, P. K. Application Oriented Chemistry, Book Syndicate.
- 3. Mondal, A. K & Mondal, S. *Degree Applied Chemistry*, Sreedhar Publications.
- 4. Banerjee, S. P. A Text Book of Analytical Chemistry, The New Book Stall.

#### CEMHGEC04P: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-II LAB

#### (60 Lectures/Contact Hours) Marks: 25

Section A: Physical Chemistry-LAB

(15x2=30 Lectures)

(Minimum six experiments to complete)

(I) Distribution Law (Any **one**)

Study of the equilibrium of <u>one of the following reactions</u> by the distribution method:

$$I_2(aq) + I(aq) = I_3(aq)$$

$$Cu^{2+}(aq) + xNH_2(aq) = [Cu(NH_3)_x]^{2+}$$

- (II) Phase equilibria (Any **one**)
  - a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves
  - b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it
- (III) Conductance
  - a) Determination of dissociation constant of a weak acid (cell constant, equivalent conductance are also determined)
  - b) Perform the following conductometric titrations: (Any one)
    - (i) Strong acid vs. strong base
    - (ii) Weak acid vs. strong base
- (IV) Potentiometry

Perform the following potentiometric titrations:

- (i) Weak acid vs. strong base
- (ii) Potassium dichromate vs. Mohr's salt

- 1. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta, 2003.
- 2. Palit, S.R., Practical Physical Chemistry Science Book Agency
- 3. Mukherjee, N.G., Selected Experiments in Physical Chemistry J. N. Ghose & Sons

4. Dutta, S.K., Physical Chemistry Experiments Bharati Book Stall

#### Section B: Analytic and Environmental Chemistry-LAB (30 Lectures)

- 1. To find the total hardness of water by EDTA titration.
- 2. To find the PH of an unknown solution by comparing color of a series of HCl solutions + 1 drop of methyl orange, and a similar series of NaOH solutions + 1 drop of phenolphthalein.
- 3. To determine the rate constant for the acid catalysed hydrolysis of an ester.
- 4. Determination of the strength of the H2O2 sample.
- 5. To determine the solubility of a sparingly soluble salt, e.g. KHTa (one bottle)

- 1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- 2. Ghosal, Mahapatra & Nad, An Advanced Course in Practical Chemistry, New Central Book Agency.
- 3. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N. University of Calcutta, 2003.
- 4. Das, S. C., Chakraborty, S. B., Practical Chemistry.

## SKILL ENHANCEMENT COURSE (HONOURS) IN CHEMISTRY

#### CEMSSEC001– BASIC ANALYTICAL CHEMISTRY (Credits: 2 Lectures: 30) Marks: 25

#### Introduction

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

#### Analysis of soil

Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators 1. Determination of pH of soil samples.2. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

#### Analysis of water

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

1. Determination of pH, acidity and alkalinity of a water sample.

2. Determination of dissolved oxygen (DO) of a water sample.

#### **Analysis of food products**

Nutritional value of foods, idea about food processing and food preservations and adulteration.

- 1. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
- 2. Analysis of preservatives and colouring matter.

#### Chromatography

Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

1. Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+).

2. To compare paint samples by TLC method.

#### Ion-exchange

Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

#### Analysis of cosmetics

Major and minor constituents and their function

- 1. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
- 2. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration

#### Suggested Applications (Any one)

- 1. To study the use of phenolphthalein in trap cases.
- 2. To analyse arson accelerants.
- 3. To carry out analysis of gasoline.

#### Suggested Instrumental demonstrations

- 1. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
- 2. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
- 3. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks

- 1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- 2. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
- 3. Skoog, D.A.; West, D.M. & Holler, F.J. Analytical Chemistry: An Introduction 6th
- 4. Ed., Saunders College Publishing, Fort Worth, Philadelphia (1994).
- 5. Harris, D. C. Quantitative Chemical Analysis, 9th ed. Macmillan Education, 2016.
- 6. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.
- 7. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India, 1992.
- 8. Freifelder, D.M. Physical Biochemistry 2nd Ed., W.H. Freeman & Co., N.Y. USA (1982).
- 9. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).
- 10. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.
- 11. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
- 12. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).
- 13. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

#### CEMSSEC002-ANALYTICAL CLINICAL BIOCHEMISTRY (Credits: 2 Lectures:30) Marks: 25

#### **Review of Concepts from Core Course**

*Carbohydrates:* Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.

Isolation and characterization of polysachharides.

*Proteins:* Classification, biological importance; Primary and secondary and tertiary structures of proteins:  $\alpha$ -helix and  $\beta$ - pleated sheets, Isolation, characterization, denaturation of proteins. *Enzymes:* Nomenclature, Characteristics (mention of Ribozymes), and Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

*Lipids:* Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.

*Lipoproteins:* Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones.

Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

*Enzymes:* Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

#### Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

*Blood:* Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

*Urine:* Collection and preservation of samples. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

#### Hands On Practical

Identification and estimation of the following:

- 1. Carbohydrates qualitative and quantitative.
- 2. Lipids qualitative.
- 3. Determination of the iodine number of oil.
- 4. Determination of the saponification number of oil.
- 5. Determination of cholesterol using Liebermann- Burchard reaction.
- 6. Proteins qualitative.
- 7. Isolation of protein.
- 8. Determination of protein by the Biuret reaction.
- 9. Determination of nucleic acids
#### **Reference Books**

- 1. Cooper, T.G. Tool of Biochemistry. Wiley-Blackwell (1977).
- 2. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).
- 3. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical Biochemistry, Heinemann, London (1980).
- 4. Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, 2010.
- 5. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
- 6. Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.
- 7. Nelson, D.L. & Cox, M.M. Lehninger Principles of Biochemistry, W.H. Freeman, 2013.
- 8. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods, D. Van Nostrand & Co., 1961.

# CHOICE BASED CREDIT SYSTEM

# B.Sc. HONOURS WITH Computer Science

Semester			credit
Ι	CORE	CMSACOR01T: Programming Fundamental using C/C++	4
		CMSACOR01P: Programming Fundamental using C/C++	2
		CMSACOR02T: Computer System Architecture	4
		CMSACOR02P: Computer System Architecture	2
	GE1	Math /Stat / Phy /Elec	6
	AECC	Environmental Science	2
II	CORE	CMSACOR03T: Programming in Java	4
		CMSACOR03P: Programming in Java	2
		CMSACOR04T: Discrete Structure	6
	GE2	Math /Stat / Phy /Elec	6
	AFCC	Fnglish	2
ш	CODE	CMSACOD05T: Data Structure	
111	CORE	CMSACOR051. Data Structure	4
		CMSACOR057. Data Structure	
		CMSACOR001. Operating System	4
		CMSACOR007. Operating System	
		CMSACOR071. Computer Networks	4
	GE3	Math /Stat /Dhy /Elec	6
	SEC1	CMSSSEC01M:Programming in Python	2
15.7		CMSACODOTE Decise & Anchoriz of Alexider	<u> </u>
1V	CORE	CMSACOR081: Design & Analysis of Algorithm	4
		CMSACOR08P: Design & Analysis of Algorithm	2
		CMSACOR091: Software Engineering	4
		CMSACOR09P: Software Engineering	
		CMSACORIUI: DBMS	4
	CE4	CMISACORTOP: DBMIS	2
	GE4	Main /Stat / Pny /Elec	0
	SEC2	CMSSSEC02M:R Programming	2
V	CORE	CMSACOR11T: Internet Technology	4
		CMSACOR11P: Internet Technology	2
		CMSACOR12T: Theory of Computation	6
	DSE	CMSADSE01T: Microprocessor	4
		CMSADSE01P: Microprocessor	2
	(Any two)	CMSADSE02T: Data Mining	4
		CMSADSE02P: Data Mining	2
		CMSADSE03T: Cloud Computing	4
		CMSADSE03P: Cloud Computing	2
VI	CORE	CMSACOR13T: Artificial Intelligence	4
		CMSACOR13P: Artificial Intelligence	2
		CMSACOR14T: Computer Graphics	4
		CMSACOR14P: Computer Graphics	2
	DSE	CMSADSE04T: Big Data	4
		CMSADSE04P: Big Data	2
	(Any two)	CMSADSE05T: Digital Image Processing	4
		CMSADSE05P: Digital Image Processing	2
		CMSADSE06P: Project	6
Total numbe	r of courses		140
		26	

#### CMSACOR01T: Programming Fundamentals using C/C++ Theory: 60 Lectures

#### **1. Introduction to C and C++**

History of C and C++, Overview of Procedural Programming and Object-Orientation Programming, Using main() function, Compiling and Executing Simple Programs in C++.

#### 2. Data Types, Variables, Constants, Operators and Basic I/O (5 Lectures)

Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc).

#### **3.** Expressions, Conditional Statements and Iterative Statements (5 Lectures)

Simple Expressions in C++ (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

#### 4. Functions and Arrays

Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments. Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays

#### **5. Derived Data Types (Structures and Unions)**

Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members.

#### 6. Pointers and References in C++

Understanding a Pointer Variable, Simple use of Pointers (Declaring and Dereferencing Pointers to simple variables), Pointers to Pointers, Pointers to structures, Problems with Pointers, Passing pointers as function arguments, Returning a pointer from a function, using arrays as pointers, Passing arrays to functions. Pointers vs. References, Declaring and initializing references, Using references as function arguments and function return values

#### volue Void

(10 Lectures)

#### (7 Lectures)

(3 Lectures)

(3 Lectures)

Differentiating between static and dynamic memory allocation, use of malloc, calloc and free functions, use of new and delete operators, storage of variables in static and dynamic memory allocation

#### 8. File I/O, Preprocessor Directives

Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros

#### 9. Using Classes in C++

Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of Template classes and their use.

#### **10.** Overview of Function Overloading and Operator Overloading (5 Lectures)

Need of Overloading functions and operators, Overloading functions by number and type of arguments, Looking at an operator as a function call, Overloading Operators (including assignment operators, unary operators)

#### 11. Inheritance, Polymorphism and Exception Handling(8 Lectures)

Introduction to Inheritance (Multi-Level Inheritance, Multiple Inheritance), Polymorphism (Virtual Functions, Pure Virtual Functions), Basics Exceptional Handling (using catch and throw, multiple catch statements), Catching all exceptions, Restricting exceptions, Rethrowing exceptions.

#### **Reference Books**

1. HerbtzSchildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.2003

2. BjarneStroustrup, "The C++ Programming Language", 4<sup>th</sup> Edition, Addison-Wesley, 2013.

- 3. BjarneStroustroup, "Programming -- Principles and Practice using C++", 2nd Edition, Addison-Wesley 2014.
- 4. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
- 5. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.
- 6. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.
- 7. Andrew Koeni, Barbara, E. Moo, "Accelerated C++", Published by Addison-Wesley, 2000.
- 8. Scott Meyers, "Effective C++", 3rd Edition, Published by Addison-Wesley, 2005.
- 9. Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.2014
- 10. Walter Savitch, "Problem Solving with C++", Pearson Education, 2007.
- 11. Stanley B. Lippman, JoseeLajoie, Barbara E. Moo, "C++ Primer", Published by Addison-Wesley, 5th Edition, 2012

#### (4 Lectures)

(7 Lectures)

#### CMSACOR01P: Programming Fundamentals using C/C++ Lab Practical: 60 Lectures

- 1. WAP to print the sum and product of digits of an integer.
- 2. WAP to reverse a number.
- 3. WAP to compute the sum of the first n terms of the following series S = 1+1/2+1/3+1/4+...
- 4. WAP to compute the sum of the first n terms of the following series S = 1-2+3-4+5.....
- 5. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
- 6. Write a function to find whether a given no. is prime or not. Use the same to generate the prime numbers less than 100.
- 7. WAP to compute the factors of a given number.
- 8. Write a macro that swaps two numbers. WAP to use it.
- 9. WAP to print a triangle of stars as follows (take number of lines from user):

\*\*\* \*\*\*\*\* \*\*\*\*\*\* \*\*\*\*\*\*\*

10. WAP to perform following actions on an array entered by the user:

i.Print the even-valued elements

ii.Print the odd-valued elements

iii.Calculate and print the sum and average of the elements of array

iv.Print the maximum and minimum element of array

v.Remove the duplicates from the array

vi.Print the array in reverse order

The program should present a menu to the user and ask for one of the options.

The menu should also include options to re-enter array and to quit the program.

- 11. WAP that prints a table indicating the number of occurrences of each alphabet in the text entered as command line arguments.
- 12. Write a program that swaps two numbers using pointers.
- 13. Write a program in which a function is passed address of two variables and then alter its contents.
- 14. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main() function.
- 15. Write a program to find sum of n elements entered by the user. To write this program, allocate memory dynamically using malloc() / calloc() functions or new operator.
- 16. Write a menu driven program to perform following operations on strings:
  - a) Show address of each character in string
  - b) Concatenate two strings without using streat function.
  - c) Concatenate two strings using streat function.
  - d) Compare two strings
  - e) Calculate length of the string (use pointers)
  - f) Convert all lowercase characters to uppercase
  - g) Convert all uppercase characters to lowercase
  - h) Calculate number of vowels
  - i) Reverse the string
- 17. Given two ordered arrays of integers, write a program to merge the two-arrays to get an ordered array.
- 18. WAP to display Fibonacci series (i)using recursion, (ii) using iteration
- 19. WAP to calculate Factorial of a number (i)using recursion, (ii) using iteration
- 20. WAP to calculate GCD of two numbers (i) with recursion (ii) without recursion.

- 21. Create Matrix class using templates. Write a menu-driven program to perform following Matrixoperations (2-D array implementation):
  - a) Sum b) Difference c) Product d) Transpose
- 22. Create the Person class. Create some objects of this class (by taking information from the user). Inherit the class Person to create two classes Teacher and Student class. Maintain the respective information in the classes and create, display and delete objects of these two classes (Use Runtime Polymorphism).
- 23. Create a class Triangle. Include overloaded functions for calculating area. Overload assignment operator and equality operator.
- 24. Create a class Box containing length, breath and height. Include following methods in it:
  - Calculate surface Area a)
  - b) Calculate Volume
  - Increment, Overload ++ operator (both prefix & postfix) c)
  - Decrement, Overload -- operator (both prefix & postfix) d)
  - Overload operator == (to check equality of two boxes), as a friend function e)
  - Overload Assignment operator f)
  - Check if it is a Cube or cuboid g)

Roll No.

Write a program which takes input from the user for length, breath and height to test the above class.

- 25. Create a structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 students and store them in a file.
- 26. Write a program to retrieve the student information from file created in previous question and print it in following format:

Name Marks

- 27. Copy the contents of one text file to another file, after removing all whitespaces.
- 28. Write a function that reverses the elements of an array in place. The function must accept only one pointer value and return void.
- 29. Write a program that will read 10 integers from user and store them in an array. Implement array using pointers. The program will print the array elements in ascending and descending order.

# **CMSACOR02T: Computer System Architecture**

#### **1. Introduction**

Logic gates, boolean algebra, combinational circuits, circuit simplification, flip-flops and sequential circuits, decoders, multiplexers, registers, counters and memory units.

#### 2. Data Representation and Basic Computer Arithmetic

Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison, multiplication and division algorithms for integers

### **3.** Basic Computer Organization and Design

Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input -output and interrupt, Interconnection Structures, Bus Interconnection design of basic computer.

### 4. Central Processing Unit

Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming, RISC, CISC architectures, pipelining and parallel architecture.

(6 lectures)

#### 5. Memory Organization

# (8 lectures)

**Theory: 60 Lectures** 

# (13 lectures)

#### (15 lectures)

# (10 lectures)

Cache memory, Associative memory, mapping.

# 6. Input-Output Organization (8 lectures)

Input / Output: External Devices, I/O Modules, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access, I/O Channels.

#### **Recommended Books:**

- 1. M. Mano, Computer System Architecture, Pearson Education, 1992
- 2. A. J. Dos Reis, Assembly Language and Computer Architecture using C++ and JAVA, Course Technology, 2004
- 3. W. Stallings, Computer Organization and Architecture Designing for Performance, 8 Edition, Prentice Hall of India, 2009
- 4. M.M. Mano, Digital Design, Pearson Education Asia, 2013
- 5. Carl Hamacher, Computer Organization, Fifth edition, McGrawHill, 2012.

#### CMSACOR02P: Computer System Architecture

Lab Practical: 60 Lectures

1. Create a machine based on the following architecture:



Basic Computer Instructions

Me	mory Re	eference	Register	Reference	Inp	ut-Output	
Symbol		Hex	Symbol	Hex	Symbol	Hex	
AND	0xxx		CLA	E800	INP	F80 0	
ADD	2xxx		CLE	E400	OUT	F40 0	
LDA	4xxx	Direct	CMA	E200	SKI	F20 0	
STA	6xxx	Addressing	CME	E100	SKO	0	Ontional
BUN	8xxx		CIR	E080	ION	0	Optional
BSA	Axxx	4	CIL	E040	IOF	F04 0	
ISZ	Cxxx		INC	E020	<u> .    .    .                          </u>	· · -	
AND I	1xxx	4	SPA	E010	<u> </u>	· · -	
ADD I	3xxx		SNA	E008	<u>↓.                                    </u>	· · •	
LDA I	5xxx	Indirect	SZA	E004	- <del> </del>		
STA_I	7xxx	Addressing	SZE	E002		· · -	
BUN_I	9xxx		HLT	E001			
BSA_I	Bxxx						
ISZ_I	Dxxx		L		<u></u>		

Refer to Chapter-5 of Morris Mano for description of instructions.

- 2. Create the micro operations and associate with instructions as given in the chapter (except interrupts). Design the register set, memory and the instruction set. Use this machine for the assignments of this section.
- 3. Create a Fetch routine of the instruction cycle.
- 4. Simulate the machine to determine the contents of AC, E, PC, AR and IR registers in hexadecimal after the execution of each of following register reference instructions:

e. CIR	i. SNA
f. CIL	j. SZA
g. INC	k. SZE
h. SPA	1. HLT
	e. CIR f. CIL g. INC h. SPA

Initialize the contents of AC to  $(A937)_{16}$ , that of PC to  $(022)_{16}$  and E to 1.

5. Simulate the machine for the following memory-reference instructions with I= 0 and address part = 082. The instruction to be stored at address 022 in RAM. Initialize the memory word at address 082 with the operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

f. BSA

g. ISZ

- a. ADD
- b. AND
- c. LDA
- d. STA
- e. BUN
- 6. Simulate the machine for the memory-reference instructions referred in above question with I= 1 and address part = 082. The instruction to be stored at address 026 in RAM. Initialize the memory word at address 082 with the value 298. Initialize the memory word at address 298 with operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.
- 7. Modify the machine created in Practical 1 according to the following instruction format:

Instruction format					
0	2	3	4		15
Opcode		Ι		Address	

- a. The instruction format contains a 3-bit opcode, a 1-bit addressing mode and a 12bit address. There are only two addressing modes, I = 0 (direct addressing) and I = 1 (indirect addressing).
- b. Create a new register I of 1 bit.
- c. Create two new microinstructions as follows :
  - i. Check the opcode of instruction to determine type of instruction (Memory Reference/Register Reference/Input-Output) and then jump accordingly.
  - ii. Check the I bit to determine the addressing mode and then jump accordingly.

### **CMSACOR03T: Programming in Java**

#### **1. Introduction to Java**

Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods),

#### 2. Arrays, Strings and I/O

Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects,

Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.

# Theory: 60 Lectures

# (4 Lectures)

(8 Lectures)

#### Irocaina

#### 3. Object-Oriented Programming Overview

Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

**4. Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata (14 lectures)** Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

#### 5. Exception Handling, Threading, Networking and Database Connectivity (15 Lectures)

Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

#### 6. Applets and Event Handling

using different fonts. Overview of servlets.

#### (15 Lectures)

Java Applets:Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms,Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, textfields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals,

### **Reference Books**

- 1. Ken Arnold, James Gosling, David Homes, "The Java Programming Language", 4th Edition, 2005.
- James Gosling, Bill Joy, Guy L Steele Jr, GiladBracha, Alex Buckley"The Java Language Specification, Java SE 8 Edition (Java Series)", Published by Addison Wesley, 2014.
- 3. Joshua Bloch, "Effective Java" 2nd Edition, Publisher: Addison-Wesley, 2008.
- 4. Cay S. Horstmann, GaryCornell, "Core Java 2 Volume 1,9th Edition,Printice Hall.2012
- 5. Cay S. Horstmann, Gary Cornell, "Core Java 2 Volume 2 Advanced Features)", 9th Edition, Printice Hall.2013
- 6. Bruce Eckel, "Thinking in Java", 3rd Edition, PHI, 2002.
- 7. E. Balaguruswamy, "Programming with Java", 4th Edition, McGraw Hill.2009.
- 8. Paul Deitel, Harvey Deitel, "Java: How to Program", 10th Edition, Prentice Hall, 2011.
- 9. "Head First Java", Orielly Media Inc. 2nd Edition, 2005.
- 10. David J. Eck, "Introduction to Programming Using Java", Published by CreateSpace Independent Publishing Platform, 2009.
- 11. John R. Hubbard, "Programming with JAVA", Schaum's Series, 2nd Edition, 2004.

### CMSACOR03P: Programming in Java Lab

- 1. To find the sum of any number of integers entered as command line arguments
- 2. To find the factorial of a given number
- 3. To learn use of single dimensional array by defining the array dynamically.
- 4. To learn use of .lenth in case of a two dimensional array
- 5. To convert a decimal to binary number
- 6. To check if a number is prime or not, by taking the number as input from the keyboard
- 7. To find the sum of any number of integers interactively, i.e., entering every number from the keyboard, whereas the total number of integers is given as a command line argument

**Practical: 60 Lectures** 

#### (4 Lectures)

- 8. Write a program that show working of different functions of String and StringBufferclasss like setCharAt(, setLength(), append(), insert(), concat()and equals().
- 9. Write a program to create a —distance class with methods where distance is computed in terms of feet and inches, how to create objects of a class and to see the use of this pointer
- 10. Modify the —distance class by creating constructor for assigning values (feet and inches) to the distance object. Create another object and assign second object as reference variable to another object reference variable. Further create a third object which is a clone of the first object.
- 11. Write a program to show that during function overloading, if no matching argument is found, then java will apply automatic type conversions(from lower to higher data type)
- 12. Write a program to show the difference between public and private access specifiers. The program should also show that primitive data types are passed by value and objects are passed by reference and to learn use of final keyword
- 13. Write a program to show the use of static functions and to pass variable length arguments in a function.
- 14. Write a program to demonstrate the concept of boxing and unboxing.
- 15. Create a multi-file program where in one file a string message is taken as input from the user and the function to display the message on the screen is given in another file (make use of Scanner package in this program).
- 16. Write a program to create a multilevel package and also creates a reusable class to generate Fibonacci series, where the function to generate fibonacii series is given in a different file belonging to the same package.
- 17. Write a program that creates illustrates different levels of protection in classes/subclasses belonging to same package or different packages
- 18. Write a program —DivideByZerol that takes two numbers a and b as input, computes a/b, and invokes Arithmetic Exception to generate a message when the denominator is zero.
- 19. Write a program to show the use of nested try statements that emphasizes the sequence of checking for catch handler statements.
- 20. Write a program to create your own exception types to handle situation specific to your application (Hint: Define a subclass of Exception which itself is a subclass of Throwable).
- 21. Write a program to demonstrate priorities among multiple threads.
- 22. Write a program to demonstrate multithread communication by implementing synchronization among threads (Hint: you can implement a simple producer and consumer problem).
- 23. Write a program to create URL object, create a URLConnection using the openConnection() method and then use it examine the different components of the URLand content.
- 24. Write a program to implement a simple datagram client and server in which a message that is typed into the server window is sent to the client side where it is displayed.
- 25. Write a program that creates a Banner and then creates a thread to scrolls the message in the banner from left to right across the applet's window.
- 26. Write a program to get the URL/location of code (i.e. java code) and document(i.e. html file).
- 27. Write a program to demonstrate different mouse handling events like mouseClicked(), mouseEntered(), mouseExited(), mousePressed, mouseReleased() and mouseDragged().
- 28. Write a program to demonstrate different keyboard handling events.
- 29. Write a program to generate a window without an applet window using main() function.
- 30. Write a program to demonstrate the use of push buttons.

# **Theory: 75 Lectures**

# **CMSACOR04T: Discrete Structures** AdditionalTutorial: 15 Lectures

# **1. Introduction:**

## Sets - finite and Infinite sets, uncountably Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation andCombination; Mathematical Induction, Principle of Inclusion and Exclusion.

# **2.** Growth of Functions:

Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals

# 3. Recurrences:

(12 Lectures) Recurrence Relations, generating functions, Linear RecurrenceRelations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem

# 4. Graph Theory

Basic Terminology, Models and Types, multigraphs andweighted graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees, Introduction to Spanning Trees

# **5.** Prepositional Logic

Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

# **Recommended Books:**

- 1. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2<sup>nd</sup> Edition , Tata McGraw Hill, 1985,
- 2. Kenneth Rosen, Discrete Mathematics and Its Applications, Sixth Edition, McGraw Hill 2006
- 3. T.H. Coremen, C.E. Leiserson, R. L. Rivest, Introduction to algorithms, 3rd edition Prentice Hall on India, 2009
- 4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms, John wiley Publication, 1988
- 5. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
- 6. D.J. Hunter, Essentials of Discrete Mathematics, Jones and Bartlett Publishers, 2008

#### **CMSACOR05T: Data Structures** 1. Arrays

# **Theory: 60 Lectures**

#### (5 Lectures) Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation)

(5 Lectures)

Stacks Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

#### 3. **Linked Lists**

(10 Lectures) Singly, Doubly and Circular Lists (Array and Linked representation); Normal and Circular representation of Stack in Lists; Self Organizing Lists; Skip Lists (5 Lectures)

#### 4. Oueues

2.

Array and Linked representation of Queue, De-queue, Priority Queues

#### 5. Recursion

(5 lectures) Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

# (20 Lectures)

(10 Lectures)

(18 Lectures)

(15 Lectures)

#### 6. Trees

#### Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion, Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

7. **Searching and Sorting** (5 Lectures) Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort,

#### Insertion Sort, Insertion Sort, Shell Sort, Comparison of Sorting Techniques

Hashing

8.

#### (5 Lectures)

Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collusion by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function

#### **Reference Books:**

- 1. Adam Drozdek, "Data Structures and algorithm in C++", Third Edition, Cengage Learning, 2012.
- 2. SartajSahni, Data Structures, "Algorithms and applications in C++", Second Edition. Universities Press. 2011.
- 3. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using C and C++:, Second edition, PHI, 2009.
- 4. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson, 1999.
- 5. D.S Malik, Data Structure using C++, Second edition, Cengage Learning, 2010.
- 6. Mark Allen Weiss, "Data Structures and Algorithms Analysis in Java", Pearson Education, 3rd edition, 2011
- 7. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using Java, 2003.
- 8. Robert Lafore, "Data Structures and Algorithms in Java, 2/E", Pearson/ Macmillan Computer Pub.2003
- 9. John Hubbard, "Data Structures with JAVA", McGraw Hill Education (India) Private Limited: 2 edition, 2009
- 10. Goodrich, M. and Tamassia, R. "Data Structures and Algorithms Analysis in Java", 4th Edition, Wiley, 2013
- 11. Herbert Schildt, "Java The Complete Reference (English) 9th Edition Paperback", Tata McGraw Hill, 2014.
- 12. 12. D. S. Malik, P.S. Nair, "Data Structures Using Java", Course Technology, 2003.

#### (20 Lectures)

#### CMSACOR05P: Data Structures Lab

- 1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
- 2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
- 3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list and concatenate two linked lists (include a function and also overload operator +).
- 4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
- 5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
- 6. Perform Stack operations using Linked List implementation.
- 7. Perform Stack operations using Array implementation. Use Templates.
- 8. Perform Queues operations using Circular Array implementation. Use Templates.
- 9. Create and perform different operations on Double-ended Queues using Linked List implementation.
- 10. WAP to scan a polynomial using linked list and add two polynomial.
- 11. WAP to calculate factorial and to compute the factors of a given no. (i)using recursion, (ii) using iteration
- 12. (ii) WAP to display Fibonacci series (i)using recursion, (ii) using iteration
- 13. WAP to calculate GCD of 2 number (i) with recursion (ii) without recursion
- 14. WAP to create a Binary Search Tree and include following operations in tree:
  - i. Insertion (Recursive and Iterative Implementation)
  - ii. Deletion by copying
  - iii. Deletion by Merging
  - iv. Search a no. in BST
  - v. Display its preorder, postorder and inorder traversals Recursively
  - vi. Display its preorder, postorder and inorder traversals Iteratively
  - vii. Display its level-by-level traversals
  - viii. Count the non-leaf nodes and leaf nodes
  - ix. Display height of tree
  - x. Create a mirror image of tree
  - xi. Check whether two BSTs are equal or not
- 15. WAP to convert the Sparse Matrix into non-zero form and vice-versa.
- 16. WAP to reverse the order of the elements in the stack using additional stack.
- 17. WAP to reverse the order of the elements in the stack using additional Queue.
- 18. WAP to implement Diagonal Matrix using one-dimensional array.
- 19. WAP to implement Lower Triangular Matrix using one-dimensional array.
- 20. WAP to implement Upper Triangular Matrix using one-dimensional array.
- 21. WAP to implement Symmetric Matrix using one-dimensional array.
- 22. WAP to create a Threaded Binary Tree as per inorder traversal, and implement operations like finding the successor / predecessor of an element, insert an element, inorder traversal.
- 23. WAP to implement various operations on AVL Tree.

CMSACOR06T: Operating Systems Lectures

Theory: 60

**1. Introduction** 

(10 Lectures)

# **CMSACOR07T:** Computer Networks

Basic OS functions, resource abstraction, types of operating systems–multiprogramming systems, batch systems , time sharing systems; operating systems for personal computers & workstations, process control & real time systems.

#### 2. Operating System Organization

Processor and user modes, kernels, system calls and systemprograms.

#### 3. Process Management

System view of the process and resources, process abstraction, processhierarchy, threads, threading issues, thread libraries; Process Scheduling, non-pre-emptive and pre-emptive scheduling algorithms; concurrent and processes, critical section, semaphores, methods for interprocess communication; deadlocks.

#### 4.Memory Management

Physical and virtual address space; memory allocation strategies -fixed and variable partitions, paging, segmentation, virtual memory

#### 5.File and I/O Management

Directory structure, file operations, file allocation methods, devicemanagement.

#### **6.**Protection and Security

Policy mechanism, Authentication, Internal access Authorization.

#### **Recommended Books**

- 1. Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.
- 2. A.S. Tanenbaum, Modern Operating Systems, 3<sup>rd</sup> Edition, Pearson Education 2007.
- 3. G. Nutt, Operating Systems: A Modern Perspective, 2<sup>nd</sup> Edition Pearson Education 1997.
- 4. W. Stallings, Operating Systems, Internals & Design Principles, 5<sup>th</sup> Edition, Prentice Hall of India. 2008.
- 5. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

### CMSACOR06P: Operating Systems Lab

#### **Practical: 60 Lectures**

#### C/ C++ programs

- 1. WRITE A PROGRAM (using *fork()* and/or *exec()* commands) where parent and child execute:
  - a. same program, same code.
  - b. same program, different code.
  - c. before terminating, the parent waits for the child to finish its task.
- 2. WRITE A PROGRAM to report behaviour of Linux kernel including kernel version, CPU type and model. (CPU information)
- 3. WRITE A PROGRAM to report behaviour of Linux kernel including information on configured memory, amount of free and used memory. (memory information)
- 4. WRITE A PROGRAM to print file details including owner access permissions, file access time, where file name is given as argument.
- 5. WRITE A PROGRAM to copy files using system calls.
- 6. Write program to implement FCFS scheduling algorithm.
- 7. Write program to implement Round Robin scheduling algorithm.
- 8. Write program to implement SJF scheduling algorithm.
- 9. Write program to implement non-preemptive priority based scheduling algorithm.
- 10. Write program to implement preemptive priority based scheduling algorithm.
- 11. Write program to implement SRJF scheduling algorithm.
- 12. Write program to calculate sum of n numbers using *thread* library.
- 13. Write a program to implement first-fit, best-fit and worst-fit allocation strategies.

# (6 Lectures)

(20Lectures)

(10 Lectures)

(4 Lectures)

(10 Lectures)

	(0 200000)
Network definition; network topologies; network classifications; network p	rotocol; layered
network architecture; overview of OSI reference model; overview of TCP/IP pro	tocol suite.
2. Data Communication Fundamentals and Techniques	(10 Lectures)
Analog and digital signal; data-ratelimits; digital to digital line encoding sche	mes; pulse code
modulation; parallel and serial transmission; digital to analog modulation	n-; multiplexing
techniques- FDM, TDM; transmission media.	
3 Networks Switching Techniques and Access mechanisms	(10 Lectures)
Circuit switching: nacket switching, connectionless datagram switching con	nection_oriented
virtual circuit switching: dial-up modems: digital subscriber line: cable TV for d	ata transfer
4 Data Link Lover Functions and Protocol	(10 Loctures)
4. Data Link Layer Functions and Flotocol	(10 Lectures)
Error detection and error correction techniques; data-link control- framing and flo	ow control; error
recovery protocols- stop and wait ARQ, go-back-n ARQ; Point to Point Protocol	on Internet.
5. Multiple Access Protocol and Networks	(5 Lectures)
CSMA/CD protocols; Ethernet LANS; connecting LAN and back-bone netw	vorks- repeaters,
hubs, switches, bridges, router and gateways;	
6. Networks Layer Functions and Protocols	(6 Lectures)
Routing; routing algorithms; network layer protocolof Internet- IP protocol,	Internet control
protocols.	
7. Transport Layer Functions and Protocols	(6 Lectures)
Transport services- error and flow control, Connection establishment and rel	ease- three way
handshake;	
8. Overview of Application layer protocol	(5 Lectures)
Overview of DNS protocol; overview of WWW &HTTP protocol.	

#### **Reference Books**

- 1. B. A. Forouzan: Data Communications and Networking, Fourth edition, THM, 2007.
- 2. A.S. Tanenbaum: Computer Networks, Fourth edition, PHI, 2002

#### CMSACOR07P: Computer Networks Lab Lectures

**1. Introduction to Computer Networks** 

60

**Practical:** 

(8 Lectures)

- 1. Simulate Cyclic Redundancy Check (CRC) error detection algorithm for noisy channel.
- 2. Simulate and implement stop and wait protocol for noisy channel.
- 3. Simulate and implement go back n sliding window protocol.
- 4. Simulate and implement selective repeat sliding window protocol.
- 5. Simulate and implement distance vector routing algorithm
- 6. Simulate and implement Dijkstra algorithm for shortest path routing.

# **CMSACOR08T: Design and Analysis of Algorithms Lab Theory: 60 Lectures**

(5 Lectures)

#### **1. Introduction**

Basic Design and Analysis techniques of Algorithms, Correctness of Algorithm. 2. Algorithm Design Techniques (8 Lectures)

Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms.

#### **3. Sorting and Searching Techniques**

(20 Lectures) Elementary sorting techniques-Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques - Heap Sort, Quick Sort, Sorting in Linear Time - Bucket Sort, Radix Sort and Count Sort, Searching Techniques, Medians & Order Statistics, complexity analysis;

4. Lower Bounding Techniques (5 Lectures) **Decision Trees 5. Balanced Trees** (7 Lectures) **Red-Black Trees** 6. Advanced Analysis Technique (5 Lectures) Amortized analysis 7. Graphs (5 Lectures)

Graph Algorithms-Breadth First Search, Depth First Search and its Applications, Minimum Spanning Trees.

8. String Processing (5Lectures)

String Matching, KMP Technique

#### **Recommended Books:**

- 1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein Introduction to Algorithms, PHI, 3rd Edition 2009
- 2. Sarabasse& A.V. Gelder Computer Algorithm Introduction to Design and Analysis, Publisher – Pearson 3rd Edition 1999

#### CMSACOR08P: Design and Analysis of Algorithms Lab **Practical:** 60 Lectures

- 1. i. Implement Insertion Sort (The program should report the number of comparisons) ii.Implement Merge Sort(The program should report the number of comparisons)
- 2. Implement Heap Sort(The program should report the number of comparisons)
- 3. Implement Randomized Quick sort (The program should report the number of comparisons)
- 4. Implement Radix Sort
- 5. Create a Red-Black Tree and perform following operations on it:
  - Insert a node i.
  - Delete a node ii.
  - iii. Search for a number & also report the color of the node containing this number.
- 6. Write a program to determine the LCS of two given sequences
- 7. Implement Breadth-First Search in a graph
- 8. Implement Depth-First Search in a graph
- 9. Write a program to determine the minimum spanning tree of a graph

For the algorithms at S.No 1 to 3 test run the algorithm on 100 different inputs of sizes varying from 30 to 1000. Count the number of comparisons and draw the graph. Compare it with a graph of nlogn.

# CMSACOR09T: Software EngineeringTheory:60Lectures

#### 1.Introduction

(8 Lectures)

(10 Lectures)

The Evolving Role of Software, Software Characteristics, Changing Nature of Software, Software Engineering as a Layered Technology, Software Process Framework, Framework and Umbrella Activities, Process Models, Capability Maturity Model Integration (CMMI).

#### **2.Requirement Analysis**

Software Requirement Analysis, Initiating Requirement Engineering Process, Requirement Analysis and Modeling Techniques, Flow Oriented Modeling, Need for SRS, Characteristics and Components of SRS. **3.Software Project Management** (8Lectures) Estimation in Project Planning Process, Project Scheduling. **4.Risk Management** (8 Lectures) Software Risks, Risk Identification, Risk Projection and Risk Refinement, RMMM Plan. **5.**Ouality Management (8 Lectures) Ouality Concepts, Software Quality Assurance, Software Reviews, Metrics for Process and Projects. **6.Design Engineering** (10 Lectures)

Design Concepts, Architectural Design Elements, Software

Architectural Level and Component Level, Mapping of Data Flow into Software Architecture, Modeling Component Level Design.

**7.Testing Strategies & Tactics** (8 Lectures) Software Testing Fundamentals, Strategic Approachto Software Testing, Test Strategies for Conventional Software, Validation Testing, System testing, Black-Box Testing, White-Box Testing and their type, Basis Path Testing.

#### **Recommended Books:**

- 1. R.S. Pressman, Software Engineering: A Practitioner's Approach (7th Edition), McGraw-Hill, 2009.
- 2. P. Jalote, An Integrated Approach to Software Engineering (2<sup>nd</sup> Edition), Narosa Publishing House, 2003.
- 3. K.K. Aggarwal and Y. Singh, Software Engineering (2nd Edition), New Age International Publishers, 2008.
- 4. I. Sommerville, Software Engineering (8 edition), Addison Wesley, 2006.
- 5. D. Bell, Software Engineering for Students (4th Edition), Addison-Wesley, 2005.
- **6.** R. Mall, Fundamentals of Software Engineering (2<sup>nd</sup> Edition), Prentice-Hall of India, 2004.

## CMSACOR09P: Software Engineering Lab Practical: Lectures

S. No	Practical Title
1.	Problem Statement,
2.	Process Model  Requirement Analysis:
	Creating a Data Flow
3	Data Dictionary, Use Cases  Project Management:
	Computing FP     Effort
4	Schedule, Kisk Table, Timeline chart     Design Engineering:
	<ul> <li>Architectural Design</li> <li>Data Design, Component Level Design</li> </ul>
5.	Testing: • Basis Path Testing

#### **Sample Projects:**

- 1. **Criminal Record Management**: Implement a criminal record management system forjailers, police officers and CBI officers
- 2. **DTC Route Information**: Online information about the bus routes and their frequency andfares
- 3. **Car Pooling**: To maintain a web based intranet application that enables the corporate employees within an organization to avail the facility of carpooling effectively.
- 4. Patient Appointment and Prescription Management System
- 5. Organized Retail Shopping Management Software
- 6. Online Hotel Reservation Service System
- 7. Examination and Result computation system
- 8. Automatic Internal Assessment System
- 9. Parking Allocation System
- 10. Wholesale Management System

# CMSACOR10T: Database Management Systems Theory: Lectures

(6 Lectures)

60

1. Introduction

Characteristics of database approach, data models, database system architecture and data

60

independence.	
2. Entity Relationship(ER) Modeling	(8 Lectures)
Entity types, relationships, constraints.	
3. Relation data model	(20 Lectures)
Relational model concepts, relational constraints, relational algebra, SQLqueries	
4. Database design	(15 Lectures)
Mapping ER/EER model to relational database, functional dependent	lencies,Lossless
decomposition, Normal forms (upto BCNF).	
5. Transaction Processing	(3 Lectures)
ACID properties, concurrency control	
6. File Structure and Indexing	(8 Lectures)
Operations on files File of Unordered and ordered records overview of File organiz	vations Indexing

Operations on files, File of Unordered and ordered records, overview of File organizations, Indexing structures for files( Primary index, secondary index, clustering index), Multilevel indexing using B and B+ trees.

#### **Books Recommended:**

- 1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.
- 2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
- 3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.
- 4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education, 2013.

# CMSACOR10P: Database Management SystemsLabPractical:60Lectures

Create and use the following database schema to answer the given queries. **EMPLOYEE Schema** 

<b>F</b> ald	True			DEFAUL
riela	1 ype	NULL KI	EI	I
Eno	Char(3)	NO	PRI	NIL
Ename	Varchar(50)	NO		NIL
Job_type	Varchar(50)	NO		NIL
Manager	Char(3)	Yes	FK	NIL
Hire_date	Date	NO		NIL
Dno	Integer	YES	FK	NIL
Commission	Decimal(10,2)	YES		NIL
Salary	Decimal(7,2)	NO		NIL

#### **DEPARTMENT Schema**

Field	Туре	NULL KEY	DEFAULT
Dno	Integer	No PRI	NULL
Dname	Varchar(50)	Yes	NULL
Location	Varchar(50)	Yes	New Delhi
A T' 4			

#### **Query List**

1. Query to display Employee Name, Job, Hire Date, Employee Number; for each employee with the Employee Number appearing first.

2. Query to display unique Jobs from the Employee Table.

3. Query to display the Employee Name concatenated by a Job separated by a comma.

4. Query to display all the data from the Employee Table. Separate each Column by a comma and name the said column as THE\_OUTPUT.

5. Query to display the Employee Name and Salary of all the employees earning more than \$2850.

6. Query to display Employee Name and Department Number for the Employee No= 7900.

7. Query to display Employee Name and Salary for all employees whose salary is not in the range of \$1500 and \$2850.

8. Query to display Employee Name and Department No. of all the employees in Dept 10 and Dept 30 in the alphabetical order by name.

9. Query to display Name and Hire Date of every Employee who was hired in 1981.

10. Query to display Name and Job of all employees who don't have a current Manager.

11. Query to display the Name, Salary and Commission for all the employees who earn commission.

12. Sort the data in descending order of Salary and Commission.

13. Query to display Name of all the employees where the third letter of their name is \_A'.

14. Query to display Name of all employees either have two R's or have two A's in their name and are either in Dept No = 30 or their Manger's Employee No = 7788.

15. Query to display Name, Salary and Commission for all employees whose Commission Amount is 14 greater than their Salary increased by 5%.

16. Query to display the Current Date.

17. Query to display Name, Hire Date and Salary Review Date which is the 1st Monday after six months of employment.

18. Query to display Name and calculate the number of months between today and the date each employee was hired.

19. Query to display the following for each employee <E-Name> earns < Salary> monthly but wants < 3 \* Current Salary >. Label the Column as Dream Salary.

20. Query to display Name with the 1st letter capitalized and all other letter lower case and length of their name of all the employees whose name starts with \_J', 'A' and \_M'.

21. Query to display Name, Hire Date and Day of the week on which the employee started.

22. Query to display Name, Department Name and Department No for all the employees.

23. Query to display Unique Listing of all Jobs that are in Department # 30.

24. Query to display Name, Dept Name of all employees who have an \_A' in their name.

25. Query to display Name, Job, Department No. And Department Name for all the employees working at the Dallas location.

26. Query to display Name and Employee no. Along with their Manger's Name and the Manager's employee no; along with the Employees' Name who do not have a Manager.

27. Query to display Name, Dept No. And Salary of any employee whose department No. and salary matches both the department no. And the salary of any employee who earns a commission.

28. Query to display Name and Salaries represented by asterisks, where each asterisk (\*) signifies \$100.

29. Query to display the Highest, Lowest, Sum and Average Salaries of all the employees

30. Query to display the number of employees performing the same Job type functions.

31. Query to display the no. of managers without listing their names.

32. Query to display the Department Name, Location Name, No. of Employees and the average salary for all employees in that department.

33. Query to display Name and Hire Date for all employees in the same dept. as Blake.

34. Query to display the Employee No. And Name for all employees who earn more than the average salary.

35. Query to display Employee Number and Name for all employees who work in a department with any employee whose name contains a  $T^{\circ}$ .

36. Query to display the names and salaries of all employees who report to King.

37. Query to display the department no, name and job for all employees in the Sales department.

# **CMSACOR11T: Internet Technologies**

#### Java

Use of Objects, Array and ArrayList class

#### JavaScript

Data types, operators, functions, control structures, events and event handling.

#### **JDBC**

JDBC Fundamentals, Establishing Connectivity and working with connection interface, Working with statements, Creating and Executing SOL Statements, Working with Result Set Objects. **JSP** (20 lectures)

Introduction to JavaServer Pages, HTTP and Servlet Basics, The Problem with Servlets, The Anatomy of a JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, Implicit JSP Objects, Conditional Processing, Displaying Values, Using an expression to Set an Attribute, Declaring Variables and Methods, Error Handling and Debugging, Sharing Data Between JSP Pages, Requests, and Users, Database Access.

#### **Java Beans**

Java Beans Fundamentals, JAR files, Introspection, Developing a simple Bean, Connecting to DB

#### **Recommended Books:**

- Ivan Bayross, Web Enabled Commercial Application Development Using Html, 1. Dhtml, javascript, Perl Cgi, BPB Publications, 2009.
- Cay Horstmann, BIG Java, Wiley Publication, 3rd Edition., 2009 2.
- 3. Herbert Schildt, Java 7, The Complete Reference, , 8th Edition, 2009.
- 4. Jim Keogh, The Complete Reference J2EE, TMH, , 2002.
- 5. O'Reilly, Java Server Pages, Hans Bergsten, Third Edition, 2003.

# **CMSACOR11P: Internet Technologies Lab**

#### Lectures

1. Languages

Create event driven program for following:

- 1. Print a table of numbers from 5 to 15 and their squares and cubes using alert.
- 2. Print the largest of three numbers.
- 3. Find the factorial of a number n.
- 4. Enter a list of positive numbers terminated by Zero. Find the sum and average of these numbers.
- 5. A person deposits Rs 1000 in a fixed account yielding 5% interest. Compute the amount in the account at the end of each year for n years.
- 6. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the list.

#### **CMSACOR12T:** Theory of Computation AdditionalTutorial: 15 Lectures

(10 Lectures)

**Theory: 75 Lectures** 

(5 lectures)

**Theory: 60 Lectures** 

(15 lectures)

(10 lectures)

(10 lectures)

**Practical:** 

60

#### Alphabets, string, language, Basic Operations on language, Concatenation, Kleene Star 2. Finite Automata and Regular Languages

(25 Lectures) Regular Expressions, Transition Graphs, Deterministics and non-deterministic finite automata, NFA to DFA Conversion, Regular languages and their relationship with finite automata, Pumping lemma and closure properties of regular languages.

#### **3.** Context free languages

Context free grammars, parse trees, ambiguities in grammars and languages, Pushdown automata (Deterministic and Non-deterministic), Pumping Lemma, Properties of context free languages, normal forms.

### 4. Turing Machines and Models of Computations

RAM, Turing Machine as a model of computation, Universal Turing Machine, Language acceptability, decidability, halting problem, Recursively enumerable and recursive languages, unsolvability problems.

#### **Recommended Books:**

- 1. Daniel I.A.Cohen, Introduction to computer theory, John Wiley, 1996
- 2. Lewis & Papadimitriou, Elements of the theory of computation, PHI 1997.
- 3. Hoperoft, Aho, Ullman, Introduction to Automata theory, Language & Computation -3<sup>rd</sup> Edition, Pearson Education. 2006
- 4. P. Linz, An Introduction to Formal Language and Automata  $\overset{th}{4}$  edition Publication Jones Bartlett, 2006

# **CMSACOR13T:** Artificial Intelligence

#### **1. Introduction** Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Intelligent Agents, their structure, behavior and environment.

#### 2. Problem Solving and Searching Techniques

Problem Characteristics, Production Systems, Control Strategies, Breadth First Search, Depth First Search, Hill climbing and its Variations, Heuristics Search Techniques: Best First Search, A\* algorithm, Constraint Satisfaction Problem, Means-End Analysis, Introduction to Game Playing, Min-Max and Alpha-Beta pruning algorithms.

#### 3. Knowledge Representation

(20 Lectures) Introduction to First Order Predicate Logic, Resolution Principle, Unification, Semantic Nets, Conceptual Dependencies, Frames, and Scripts, Production Rules, Conceptual Graphs. Programming in Logic (PROLOG)

#### 4. Dealing with Uncertainty and Inconsistencies (08 Lectures) Truth Maintenance System, Default Reasoning, Probabilistic Reasoning, Bayesian Probabilistic Inference, Possible World Representations.

### **5. Understanding Natural Languages**

(06 Lectures) Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.

### **BOOKS RECOMMENDED:**

#### **Theory: 60 Lectures**

(06 Lectures)

(20 Lectures)

(20 Lectures)

(20 Lectures)

- 2. Russell &Norvig, Artificial Intelligence-A Modern Approach, LPE, Pearson Prentice nd Hall, 2 edition, 2005.
- 3. Rich & Knight, Artificial Intelligence Tata McGraw Hill, 2<sup>nd</sup> edition, 1991.
- 4. W.F. Clocksin and Mellish, Programming in PROLOG, Narosa Publishing House, 3<sup>rd</sup> edition, 2001.
- 5. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley, Pearson Education, 3<sup>rd</sup> edition, 2000.

#### CMSACOR13P: Artificial Intelligence Lab Lectures

- 1. Write a prolog program to calculate the sum of two numbers.
- 2. Write a prolog program to find the maximum of two numbers.
- 3. Write a prolog program to calculate the factorial of a given number.
- 4. Write a prolog program to calculate the nth Fibonacci number.
- 5. Write a prolog program, insert\_nth(item, n, into\_list, result) that asserts that result is the list into list with item inserted as the n'th element into every list at all levels.
- 6. Write a Prolog program to remove the Nth item from a list.
- 7. Write a Prolog program, remove-nth(Before, After) that asserts the After list is the Before list with the removal of every n'th item from every list at all levels.
- 8. Write a Prolog program to implement append for two lists.
- 9. Write a Prolog program to implement palindrome (List).
- 10. Write a Prolog program to implement max(X,Y,Max) so that Max is the greater of two numbers X and Y.
- 11. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List.
- 12. Write a Prolog program to implement sumlist(List,Sum) so that Sum is the sum of a given list of numbers List.
- 13. Write a Prolog program to implement two predicates evenlength(List) and oddlength(List) so that they are true if their argument is a list of even or odd length respectively.
- 14. Write a Prolog program to implement reverse(List,ReversedList) that reverses lists.
- 15. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List using cut predicate.
- 16. Write a Prolog program to implement GCD of two numbers.
- 17. Write a prolog program that implements Semantic Networks/Frame Structures.

### **CMSACOR14T: Computer Graphics**

#### **1. Introduction**

Basic elements of Computer graphics, Applications of Computer Graphics.

#### 2. Graphics Hardware

Architecture of Raster and Random scan display devices, input/output devices.

#### **3.** Fundamental Techniques in Graphics

Raster scan line, circle and ellipse drawing, thick primitives, Polygon filling, line and polygon clipping algorithms, 2D and 3D Geometric Transformations, 2D and 3D Viewing Transformations (Projections- Parallel and Perspective), Vanishing points.

#### 4. Geometric Modeling

(10 Lectures)

#### **Theory: 75 Lectures**

**Practical:** 

60

(5 Lectures)

(8 Lectures)

(22 Lectures)

Representing curves & Surfaces.

#### 5.Visible Surface determination

(8 Lectures) Hidden surface elimination.

#### **6.Surface rendering**

(7 Lectures) Illumination and shading models. Basic color models and Computer Animation.

#### **Books Recommended:**

- J.D.Foley, A.Van Dan, Feiner, Hughes Computer Graphics Principles & Practice nd 2 edition Publication Addison Wesley 1990.
  - 2 edition Publication Addison wesley 1990.
- 2. D.Hearn, Baker: Computer Graphics, Prentice Hall of India 2008.
- 3. D.F.Rogers Procedural Elements for Computer Graphics, McGraw Hill 1997.
- 4. D.F.Rogers, Adams Mathematical Elements for Computer Graphics, McGraw Hill nd 2 edition 1989.

#### **CMSACOR14P:** Computer Graphics Lab

#### Lectures

- 1. Write a program to implement Bresenham's line drawing algorithm.
- 2. Write a program to implement mid-point circle drawing algorithm.
- 3. Write a program to clip a line using Cohen and Sutherland line clipping algorithm.
- 4. Write a program to clip a polygon using Sutherland Hodgeman algorithm.
- 5. Write a program to apply various 2D transformations on a 2D object (use homogenous coordinates).
- 6. Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.
- 7. Write a program to draw Hermite/Bezier curve.

#### **Discipline Specific Elective Papers COMPUTER SCIENCE:**

#### CSMADSE01T:Microprocessor

**Microprocessor architecture:** Internal architecture, system bus architecture, memory and I/Ointerfaces.

**Microprocessor programming:** Register Organization, instruction formats, assembly languageprogramming.

**Interfacing:** Memory address decoding, cache memory and cache controllers, I/O interface,keyboard, display, timer, interrupt controller, DMA controller, video controllers, communication interfaces.

#### **Recommended Books:**

- 1. Barry B. Brey : The Intel Microprocessors : Architecture, Programming and Interfacing. Pearson Education, Sixth Edition, 2009.
- 2. Walter A Triebel, Avtar Singh; The 8088 and 8086 Microprocessors Programming, Interfacing, Software, Hardware, and Applications. PHI, Fourth Edition 2005.

#### CSMADSE01P: Microprocessor Lab

#### Practical: 60 Lectures

#### ASSEMBLY LANGUAGE PROGRAMMING

- 1. Write a program for 32-bit binary division and multiplication
- 2. Write a program for 32-bit BCD addition and subtraction
- 3. Write a program for Linear search and binary search.
- 4. Write a program to add and subtract two arrays
- 5. Write a program for binary to ascii conversion
- 6. Write a program for ascii to binary conversion

#### **CSMADSE02T: Data Mining**

#### **Theory: 60 lectures**

#### Theory: 60 Lectures

# Practical: 60

**Overview:** Predictive and descriptive data mining techniques, supervised and unsupervisedlearning techniques, process of knowledge discovery in databases, pre-processing methods

**Data Mining Techniques:** Association Rule Mining, classification and regressiontechniques, clustering, Scalability and data management issues in data mining algorithms, measures of interestingness

# **Books Recommended:**

- 1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education.2005.
- 2. Richard Roiger, Michael Geatz, Data Mining: A Tutorial Based Primer, Pearson Education 2003.
- 3. G.K. Gupta, Introduction to Data Mining with Case Studies, PHI, 2006.
- 4. Soman K P, Diwakar Shyam, Ajay V Insight Into Data Mining: Theory And Practice, , PHI, 2006

# CSMADSE02P: Data Mining Lab

Practical exercises based on concepts listed in theory.

# **CSMADSE03T: Cloud Computing**

# **Overview of Computing Paradigm**

Recent trends in Computing : Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing,

# **Introduction to Cloud Computing**

Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Benefits and limitations of Cloud Computing,

# **Cloud Computing Architecture**

Comparison with traditional computing architecture (client/server), Services provided at various levels, Service Models- Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), How Cloud Computing Works, Deployment

Models- Public cloud, Private cloud, Hybrid cloud, Community cloud, Case study of NIST architecture.

# (7 lectures)

(8 lectures)

# (20 lectures)

# **Practical: 60 lectures**

#### NOSQL DATA MANAGEMENT

#### **Case Studies**

Case study of Service model using Google App Engine, Microsoft Azure, Amazon EC2, Eucalyptus.

#### Service Management in Cloud Computing

Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling.

#### **Cloud Security**

Infrastructure Security- Network level security, Host level security, Application level security, Data security and Storage- Data privacy and security Issues, Jurisdictional issues raised by Data location, Authentication in cloud computing.

#### **Reference Books**

- 1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
- 2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
- 3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
- 4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India, 2010.
- 5. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications , Adobe Reader ebooks available from eBooks.com,2010.
- 6. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach ,McGraw Hills, 2010.
- 7. Dimitris N. Chorafas, Cloud Computing Strategies ,CRC Press, 2010.

#### CSMADSE03P: Cloud Computing Lab

- 1. Create virtual machines that access different programs on same platform.
- 2. Create virtual machines that access different programs on different platforms .
- 3. Working on tools used in cloud computing online
  - a. Storage
  - b. Sharing of data
  - c. manage your calendar, to-do lists,
  - d. a document editing tool
- 4. Exploring Google cloud
- 5. Exploring microsoft cloud
- 6. Exploring amazon cloud

#### CSMADSE04T: Big Data

#### UNDERSTANDING BIG DATA

What is big data – why big data –.Data!, Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System , Grid Computing, Volunteer Computing, convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

#### (5 lectures)

**Theory: 60 lectures** 

(7 lectures)

#### (13 lectures)

Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models - relationships - graph databases - schema less databases - materialized views distribution models - shading - version - map reduce - partitioning and combining composing map-reduce calculations.

#### **BASICS OF HADOOP**

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow - Hadoop I/O - data integrity - compression - serialization - Avro - file-based data structures.

#### **MAPREDUCE APPLICATIONS**

MapReduce workflows - unit tests with MRUnit - test data and local tests - anatomy of MapReduce job run - classic Map-reduce - YARN - failures in classic Map-reduce and YARN - job scheduling - shuffle and sort - task execution - MapReduce types - input formats - output formats

#### HADOOP RELATED TOOLS

Hbase - data model and implementations - Hbase clients - Hbase examples - praxis. Cassandra -Cassandra data model - Cassandra examples - Cassandra clients - Hadoop integration. Pig -Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

#### **Reference Books:**

- 1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
- 2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
- 3. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.
- 4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
- 5. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
- 6. Alan Gates, "Programming Pig", O'Reilley, 2011

#### **CSMADSE04P: Big Data Lab**

Practical exercises based on concepts listed in theory.

#### **CMSADSE05T: Digital Image Processing Lab**

# **1. Introduction**

#### (6 Lectures)

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.

#### 2. Spatial Domain Filtering

Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.

#### **3.** Filtering in the Frequency domain

Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering.

#### 4. Image Restoration

Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters,

## (8 Lectures)

#### **Theory: 60 Lectures**

(7 Lectures)

(8 Lectures)

## 5. Image Compression

Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

## 6. Wavelet based Image Compression

Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

# 7. Morphological Image Processing

Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

# 8. Image Segmentation

Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

# **Reference Books**

- 1. R C Gonzalez, R E Woods, Digital Image Processing, 3rd Edition, Pearson Education.2008.
- 2. A K Jain, Fundamentals of Digital image Processing, Prentice Hall of India.1989.
- 3. K R Castleman, Digital Image Processing, Pearson Education.1996
- 4. Schalkoff, Digital Image Processing and Computer Vision, John Wiley and Sons.1989.
- 5. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.

# CMSADSE05P: Digital Image Processing Lab

# 1. Write program to read and display digital image using MATLAB or SCILAB

- a. Become familiar with SCILAB/MATLAB Basic commands
- b. Read and display image in SCILAB/MATLAB
- c. Resize given image
- d. Convert given color image into gray-scale image
- e. Convert given color/gray-scale image into black & white image
- f. Draw image profile
- g. Separate color image in three R G & B planes
- h. Create color image using R, G and B three separate planes
- i. Flow control and LOOP in SCILAB
- j. Write given 2-D data in image file
- 2. To write and execute image processing programs using point processing method
  - a. Obtain Negative image

## (10 Lectures)

### (7 Lectures)

(5 Lectures)

### (9 Lectures)

### **Practical: 60 Lectures**

- b. Obtain Flip image
- c. Thresholding
- d. Contrast stretching
- 3. To write and execute programs for image arithmetic operations
  - a. Addition of two images
  - b. Subtract one image from other image
  - c. Calculate mean value of image
  - d. Different Brightness by changing mean value
- 4. To write and execute programs for image logical operations
  - a. AND operation between two images
  - b. OR operation between two images
  - c. Calculate intersection of two images
  - d. Water Marking using EX-OR operation

- e. NOT operation (Negative image)
- 5. To write a program for histogram calculation and equalization using
  - a. Standard MATLAB function
  - b. Program without using standard MATLAB functions
  - c. C Program
  - 6. To write and execute program for geometric transformation of image
    - a. Translation
    - b. Scaling
    - c. Rotation
    - d. Shrinking
    - e. Zooming
- 7. To understand various image noise models and to write programs for
  - a. image restoration
  - b. Remove Salt and Pepper Noise
  - c. Minimize Gaussian noise
  - d. Median filter and Weiner filter

8. Write and execute programs to remove noise using spatial filters

- a. Understand 1-D and 2-D convolution process
- b. Use 3x3 Mask for low pass filter and high pass filter

9. Write and execute programs for image frequency domain filtering

- a. Apply FFT on given image
- b. Perform low pass and high pass filtering in frequency domain
- c. Apply IFFT to reconstruct image

10. Write a program in C and MATLAB/SCILAB for edge detection using different edge detection mask

11. Write and execute program for image morphological operations erosion and dilation.

12. To write and execute program for wavelet transform on given image and perform inverse wavelet transform to reconstruct image.

### **CMSADSE06P:** Discipline Specific Elective: Dissertation / Project work

This option to be offered only in  $6^{\text{th}}$  Semester.

The students will be allowed to work on any project based on the concepts studied in core / elective or skill based elective courses.

The group size should be maximum of three (03) students.

Each group will be assigned a teacher as a supervisor who will handle both their theory as well lab classes.

A maximum of Four (04) projects would be assigned to one teacher.

# Skill Enhancement Courses (any two) (Credit: 02 each) – SEC1 to SEC2 Theory: 01, Labs: 02

# **CMSSSEC01M:** Programming in Python

**Planning the Computer Program:** Concept of problem solving, Problem definition, Programdesign, Debugging, Types of errors in programming, Documentation. (2L)

**Techniques ofProblem Solving:** Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

(2L)

**Overview of Programming :** Structure of a Python Program, Elements of Python (3L)

**Introduction to Python:** Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators(Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator,

Increment or Decrement operator).

**Creating Python Programs :** Input and Output Statements, Control statements(Branching,Looping, Conditional Statement, Exit function, Difference between break, continue and pass.),

Defining Functions, default arguments.

### **Reference Books**

- 1. T. Budd, Exploring Python, TMH, 1st Ed, 2011
- 2. Python Tutorial/Documentation www.python.or 2015
- 3. Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist : learning with Python, Freely available online.2012
- 4. http://docs.python.org/3/tutorial/index.html
- 5. http://interactivepython.org/courselib/static/pythonds
- 6. http://www.ibiblio.org/g2swap/byteofpython/read/

#### **Software Lab Based on Python:**

#### Section: A (Simple programs)

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon users choice.

2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :

Grade A: Percentage >=80

Grade B: Percentage>=70 and

<80 Grade C: Percentage>=60

and <70 Grade D:

Percentage>=40 and <60 Grade

E: Percentage<40

3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input paramters from user.

- 4. WAP to display the first n terms of Fibonacci series.
- 5. WAP to find factorial of the given number.
- 6. WAP to find sum of the following series for n terms: 1 2/2! + 3/3! - n/n!
- 7. WAP to calculate the sum and product of two compatible matrices.

#### Section: B (Visual Python):

All the programs should be written using user defined functions, wherever possible.

- 1. Write a menu-driven program to create mathematical
- 3D objects I. curve

(4L)

(4L)

#### II. sphere

III. cone

IV. arrow

V. ring

VI. cylinder.

2. WAP to read n integers and display them as a histogram.

3. WAP to display sine, cosine, polynomial and exponential curves.

4. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.

5. WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.

6. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:

P(t) = (15000(1+t))/(15+e)

where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

7. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:

I. velocity wrt time (v=u+at)

II. distance wrt time ( s=u\*t+0.5\*a\*t\*t)

- III. distance wrt velocity ( s=(v\*v-u\*u)/2\*a )
- WAP to show a ball bouncing between 2 walls. (Optional)

# CMSSSEC02M: R-Programming (1+2 Labs)

Introduction: Overview and History of R, Getting Help, Data Types, Subsetting, Vectorized Operations, Reading and Writing Data. (5L

Control Structures, Functions, lapply, tapply, split, mapply, apply, Coding Standards. (5L

(5L

Scoping Rules, Debugging Tools, Simulation, R Profiler.

# **Reference Books**

8.

- 1. William N. Venables and David M. Smith, An Introduction to R. 2<sup>nd</sup> Edition. Network Theory Limited.2009
- 2. Norman Matloff, The Art of R Programming A Tour of Statistical Software Design, No Starch Press.2011

# Software Lab Based on R Programming

- 1. Write a program that prints \_Hello World' to the screen.
- 2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n
- 3. Write a program that prints a multiplication table for numbers up to 12.
- 4. Write a function that returns the largest element in a list.
- 5. Write a function that computes the running total of a list.
- 6. Write a function that tests whether a string is a palindrome.
- 7. Implement the following sorting algorithms: Selection sort, Insertion sort, Bubble Sort
- 8. Implement linear search.
- 9. Implement binary search.
- 10. Implement matrices addition, subtraction and Multiplication
# CHOICE BASED CREDIT SYSTEM

# **B.Sc. Program with**

# **Computer Science**

Semester			Total
			credit
I	CORE	CMSGCOR01T: Problem Solving with Computer	4
		CMSGCOR01P: Problem Solving with Computer	2
	AECC1	ENVS	2
II	CORE	CMSGCOR02T: DBMS	4
		CMSGCOR02P: DBMS	2
	AECC2	English	2
	CORE	CMSGCOR03T: OS	4
		CMSGCOR03P: LINUX	2
	SEC1	CMSSSEC01M:Programming in Python	2
IV	CORE	CMSGCOR04T: Computer System Architecture	4
		CMSGCOR04P: Computer System Architecture	2
	SEC2	CMSSSEC02M:R Programming	2
V	DSE1	CMSGDSE01T: Programming in JAVA	6
	(Any one)	CMSGDSE02T: Discrete Structures	
VI	DSE2	CMSGDSE03T: Software Engg	6
	(Any one)	CMSGDSE04T: Computer Networks	
Total numbe	er of courses	10	

# **CORE PAPERS:**

# **CMSGCOR01T : Problem Solving with Computer**

Computer Fundamentals: Introduction to Computers: Characteristics of Computers, Uses of

computers, Types and generations of Computers.

Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices.

Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. (3L)

Techniques of Problem Solving: Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming. (4L)

**Overview of Programming:** Structure of a Python Program, Elements of Python (4L)

Introduction to Python: Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator).

(8L)

Creating Python Programs: Input and Output Statements, Control statements (LoopingwhileLoop, for Loop , Loop Control, Conditional Statement- if...else, Difference between break. continue and pass).

(10L)

(3L)

Structures: Numbers, Strings, Lists, Tuples, Dictionary, Date & Time, Modules, Defining Functions, Exit function, default arguments.

(10L)

Introduction to Advanced Python: Objects and Classes, Inheritance, Regular Expressions, Event Driven Programming, GUI Programming.

(14L)

# **Reference Books:**

- 1. P. K. Sinha & Priti Sinha, "Computer Fundamentals", BPB Publications, 2007.
- 2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.
- 3. T. Budd, Exploring Python, TMH, 1st Ed, 2011
- 4. Python Tutorial/Documentation www.python.or 2010
- 5. Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist : learning with Python, Freely available online.2012

- 6. http://docs.python.org/3/tutorial/index.html
- 7. http://interactivepython.org/courselib/static/pythonds
- 8. http://www.ibiblio.org/g2swap/byteofpython/read/

#### **CMSGCOR01P: Problem Solving with Computer**

### Section: A (Simple programs)

- 1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
- 2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :
  - a. Grade A: Percentage >=80
  - b. Grade B: Percentage>=70 and <80
  - c. Grade C: Percentage>=60 and <70
  - d. Grade D: Percentage>=40 and <60
  - e. Grade E: Percentage<40
- 3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
- 4. WAP to display the first n terms of Fibonacci series.
- 5. WAP to find factorial of the given number.
- 6. WAP to find sum of the following series for n terms:  $1 2/2! + 3/3! \cdots n/n!$
- 7. WAP to calculate the sum and product of two compatible matrices.

### Section: B (Visual Python):

All the programs should be written using user defined functions, wherever possible.

- 1. Write a menu-driven program to create mathematical 3D objects
  - I. curve
  - II. sphere
  - III. cone
  - IV. arrow
  - V. ring

VI. Cylinder.

- 2. WAP to read n integers and display them as a histogram.
- 3. WAP to display sine, cosine, polynomial and exponential curves.
- 4. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.
- 5. WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.
- 6. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:

P(t) = (15000(1+t))/(15+e)

where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

- 7. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:
  - I. velocity wrt time (v=u+at)
  - II. distance wrt time (s=u\*t+0.5\*a\*t\*t)
  - III. distance wrt velocity (s=(v\*v-u\*u)/2\*a)

# **CMSGCOR02T: Database Management Systems**

Introduction to Database Management Systems: Characteristics of database approach,

datamodels, DBMS architecture and data independence.

(10L)

Entity Relationship and Enhanced ER Modeling: Entity types, relationships, SQL-

99: Schema Definition, constraints, and object modeling. (15L)

Relational Data Model : Basic concepts, relational constraints, relational algebra, SQLqueries.

Database design: ER and EER to relational mapping, functional dependencies, normal forms up

(15L)

(20 L)

to third normal form.

# **Books Recommended:**

- 1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6<sup>th</sup> Edition, Pearson Education, 2010.
- 2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3<sup>rd</sup> Edition, McGraw-Hill, 2002.
- 3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6<sup>th</sup> Edition, McGraw Hill, 2010.
- 4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6<sup>th</sup> Edition, Pearson Education, 2013.

# **CMSGCOR02P: Database Management Systems**

### Note: MyAccess/MySQL may be used.

The following concepts must be introduced to the students: **DDL Commands** 

•Create table, alter table, drop table

# **DML Commands**

- Select , update, delete, insert statements
- Condition specification using Boolean and comparison operators

(and, or, not,=,<>,>,<,>=,<=)

- Arithmetic operators and aggregate functions(Count, sum, avg, Min, Max)
- Multiple table queries (join on different and same tables)
- Nested select statements
- Set manipulation using (any, in, contains, all, not in, not contains,

exists, not exists, union, intersect, minus, etc.)

- Categorization using group by......having
  - Arranging using order by



#### Questions to be performed on above schema

- 1. Create tables with relevant foreign key constraints
- 2. Populate the tables with data
- 3. Perform the following queries on the database :
  - 1. Display all the details of all employees working in the company.
  - 2. Display ssn, lname, fname, address of employees who work in department no 7.
  - 3. Retrieve the birthdate and address of the employee whose name is 'Franklin
  - T. Wong'
  - 4. Retrieve the name and salary of every employee
  - 5. Retrieve all distinct salary values.
  - 6. Retrieve all employee names whose address is in 'Bellaire'
  - 7. Retrieve all employees who were born during the 1950s
  - 8. Retrieve all employees in department 5 whose salary is between 50,000

and 60,000(inclusive)

- 9. Retrieve the names of all employees who do not have supervisors
- 10. Retrieve SSN and department name for all employees

11. Retrieve the name and address of all employees who work for the 'Research' department

12. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate.

13. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.

14. Retrieve all combinations of Employee Name and Department Name

15. Make a list of all project numbers for projects that involve an employee whose last name is 'Narayan' either as a worker or as a manager of the department that controls the project.

16. Increase the salary of all employees working on the 'ProductX' project by 15%. Retrieve employee name and increased salary of these employees.

17. Retrieve a list of employees and the project name each works in, ordered by the employee's department, and within each department ordered alphabetically by employee first name.

18. Select the names of employees whose salary does not match with salary of any employee in department 10.

19. Retrieve the name of each employee who has a dependent with the same first

name and same sex as the employee.

20. Retrieve the employee numbers of all employees who work on project located in Bellaire, Houston, or Stafford.

21. Find the sum of the salaries of all employees, the maximum salary, the minimum salary, and the average salary. Display with proper headings.

22. Find the sum of the salaries and number of employees of all employees of the 'Marketing' department, as well as the maximum salary, the minimum salary, and the average salary in this department.

23. Select the names of employees whose salary is greater than the average salary of all employees in department 10.

24. For each department, retrieve the department number, the number of employees in the department, and their average salary.

25. For each project, retrieve the project number, the project name, and the number of employees who work on that project.

26. Change the location and controlling department number for all projects having more than 5 employees to 'Bellaire' and 6 respectively.

27. For each department having more than 10 employees, retrieve the department no, no of employees drawing more than 40,000 as salary.

28. Insert a record in Project table which violates referential integrity constraint with respect to Department number. Now remove the violation by making necessary insertion in the Department table.

29. Delete all dependents of employee whose ssn is '123456789'.

30. Delete an employee from Employee table with ssn = '12345'( make sure that this employee has some dependents, is working on some project, is a manager of some department and is supervising some employees). Check and display the cascading effect on Dependent and Works on table. In Department table MGRSSN should be set to default value and in Employee table SUPERSSN should be set to NULL

31. Perform a query using alter command to drop/add field and a constraint in Employee table.

# **CMSGCOR03T: Operating Systems**

Introduction: System Software, Resource Abstraction, OS strategies.(2L)Types of operating systems - Multiprogramming, Batch, Time Sharing, Single user(2L)andMultiuser, Process Control & Real Time Systems.(2L)

**Operating System Organization**: Factors in operating system design, basic OS functions, implementation consideration; process modes, methods of requesting system services – system

calls and system programs.

**Process Management :** System view of the process and resources, initiating the OS, processaddress space, process abstraction, resource abstraction, process hierarchy, Thread model (15L) Scheduling: Scheduling Mechanisms, Strategy selection, non-pre-emptive and pre-emptive

strategies.	(12L)
Memory Management: Mapping address space to memory space, memory	
allocation	
strategies, fixed partition, variable partition, paging, virtual memory	(12L)

## Shell introduction and Shell Scripting

(7L)

- What is shell and various type of shell, Various editors present in linux •
- Different modes of operation in vi editor
- What is shell script, Writing and executing the shell script
- Shell variable (user defined and system variables) •
- System calls, Using system calls
- Pipes and Filters
- Decision making in Shell Scripts (If else, switch), Loops in shell
- Functions •
- Utility programs (cut, paste, join, tr, uniq utilities)
- Pattern matching utility (grep)

# **Books Recommended:**

- 1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8<sup>th</sup> Edition, John Wiley Publications 2008.
- 2. A.S. Tanenbaum, Modern Operating Systems, <sup>3</sup><sup>rd</sup> Edition, Pearson Education 2007.
- 3. G. Nutt, Operating Systems: A Modern Perspective, 2<sup>nd</sup> Edition Pearson Education 1997.
- 4. W. Stallings, Operating Systems, Internals & Design Principles, 5<sup>th</sup> Edition, Prentice Hall of India. 2008.
- 5. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

# **CMSGCOR03P:** Software Lab based on Operating Systems

# Note: Following exercises can be performed using Linux or Unix

- 1. Usage of following commands:
  - ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd.
- 2. Usage of following commands:
  - cal, cat(append), cat(concatenate), mv, cp, man, date.
- 3. Usage of following commands:

chmod, grep, tput (clear, highlight), bc.

- 4. Write a shell script to check if the number entered at the command line is prime or not.
- 5. Write a shell script to modify "cal" command to display calendars of the specified months.
- 6. Write a shell script to modify "cal" command to display calendars of the specified range of months.
- 7. Write a shell script to accept a login name. If not a valid login name display message "Entered login name is invalid".
- 8. Write a shell script to display date in the mm/dd/yy format.
- 9. Write a shell script to display on the screen sorted output of "who" command along with the total number of users.
- 10. Write a shell script to display the multiplication table any number,
- 11. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.
- 12. Write a shell script to find the sum of digits of a given number.
- 13. Write a shell script to merge the contents of three files, sort the contents and then display them page by page.
- 14. Write a shell script to find the LCD(least common divisor) of two numbers.
- 15. Write a shell script to perform the tasks of basic calculator.
- 16. Write a shell script to find the power of a given number.
- 17. Write a shell script to find the factorial of a given number.
- 18. Write a shell script to check whether the number is Armstrong or not.
- 19. Write a shell script to check whether the file have all the permissions or not.
- 20. Program to show the pyramid of special character "\*".

# **CMSGCOR04T: Computer System Architecture**

**Introduction:** Logic gates, boolean algebra, combinational circuits, circuit simplification, flip-flops and sequential circuits, decoders, multiplexors, registers, counters and memory units. (12L)

**Data Representation and basic Computer Arithmetic:** Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison. (8L)

**Basic Computer Organization and Design:** Computer registers, bus system, instructionset, timing and control, instruction cycle, memory reference, input-output and interrupt.(18L)

**Central Processing Unit:** Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. (10L)

**Programming the Basic Computer:** Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming. (8L)

**Input-output Organization:** Peripheral devices, I/O interface, Modes of data transfer, direct memory access. (4L)

# **Books Recommended:**

- 1. M. Mano, Computer System Architecture, Pearson Education 1992.
- 2. A. J. Dos Reis, Assembly Language and Computer Architecture using C++ and JAVA, Course Technology, 2004
- 3. W. Stallings, Computer Organization and Architecture Designing for Performance, 8th Edition, Prentice Hall of India ,2009
- 4. Digital Design, M.M. Mano, Pearson Education Asia, 1979

# CMSGCOR04P: Computer System Architecture Lab Practical: 60 Lab Periods

Memory 4096 words	0	Iı	nstruction format	15	
16 bits per word	Opcode		Address		

**Basic Computer Instructions** 

		Input-
Memory Reference	<b>Register Reference</b>	Output

1. Create a machine based on the following architecture: Register Set

IR	<u> </u>	DR	AC	AR	PC		FGI	FGO	)	S	 Ι	E	
0 15	0	15	0 1	5 011	011	1 B	it	1 Bit		1 Bit	1 bit	1 Bit	
Symbol		Hex		Symbol	Hex		Symbol			Hex			
									F80				
AND	0xxx			CLA	E800		INP	(	)				
									F40				
 ADD	2xxx			CLE	E400		OUT	(	)				
ISZ	Cxxx			INC	E020								
AND_I	1xxx			SPA	E010								

ADD_I	3xxx		SNA	E008	
LDA_I	5xxx	Indirect	SZA	E004	
STA_I	7xxx	Addressing	SZE	E002	
BUN_I	9xxx		HLT	E001	
BSA_I	Bxxx				
ISZ_I	Dxxx				

Refer to Chapter-5 of Morris Mano for description of instructions.

- ii) Create the micro operations and associate with instructions as given in the chapter (except interrupts). Design the register set, memory and the instruction set. Use this machine for the assignments of this section.
- iii)Create a Fetch routine of the instruction cycle.
- iv) Simulate the machine to determine the contents of AC, E, PC, AR and IR registers in hexadecimal after the execution of each of following register reference instructions:

e. CIR	i. SNA
f. CIL	j. SZA
g. INC	k. SZE
h. SPA	1. HLT
	e. CIR f. CIL g. INC h. SPA

Initialize the contents of AC to (A937)16, that of PC to (022)16 and E to 1.

5. Simulate the machine for the following memory-reference instructions with I= 0 and address part = 082. The instruction to be stored at address 022 in RAM. Initialize the memory word at address 082 with the operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

a. ADD	f. BSA
b. AND	g. ISZ
c. LDA	
d. STA	
e. BUN	

- 6. Simulate the machine for the memory-reference instructions referred in above question with I= 1 and address part = 082. The instruction to be stored at address 026 in RAM. Initialize the memory word at address 082 with the value 298. Initialize the memory word at address 298 with operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.
- 7. Modify the machine created in Practical 1 according to the following instruction format:

#### **Instruction format**

0	2 3	4	15

Opeode I Rudiciss
-------------------

a. The instruction format contains a 3-bit opcode, a 1-bit addressing mode and a 12-bit address. There are only two addressing modes, I = 0 (direct addressing) and I = 1 (indirect addressing).

b. Create a new register I of 1 bit.

c. Create two new microinstructions as follows :

i. Check the opcode of instruction to determine type of instruction (Memory Reference/Register Reference/Input-Output) and then jump accordingly.

ii. Check the I bit to determine the addressing mode and then jump accordingly.

# **Discipline Specific Elective Papers:**

# CMSGDSE01T: Programming in Java 75 Lectures

AdditionalTutorial: 15 Lectures

Introduction to Java: Features of Java, JDK Environment

**Object Oriented Programming Concept** Overview of Programming, Paradigm, Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, Difference between C++ and JAVA

(12L) Java Programming Fundamental :Structure of java program, Data types, Variables, Operators,Keywords, Naming Convention, Decision Making (if, switch),Looping(for, while) ,Type Casting

Classes and Objects: Creating Classes and objects, Memory allocation for objects, Constructor,

Implementation of Inheritance, Implementation of Polymorphism, Method Overloading, Method Overriding, Nested and Inner classes (12L)

**Arrays and Strings:** Arrays, Creating an array, Types of Arrays, String class Methods, StringBuffer methods.

(8L) **Abstract Class, Interface and Packages:** Modifiers and Access Control, Abstract classes and methods, Interfaces, Packages Concept, Creating user defined packages (10L) **Exception Handling:** Exception types, Using try catch and multiple catch, Nested try, throw, throws and finally, Creating User defined Exceptions. (6L)

**File Handling:** Byte Stream, Character Stream, File IO Basics, File Operations, Creating file, Reading file, Writing File (6L)

**Applet Programming:** Introduction, Types Applet, Applet Life cycle, Creating Applet, Applet tag (7L)

# **Books Recommended:**

1. Ivan Bayross, Web Enabled Commercial Application Development Using Html, Dhtml, javascript, Perl Cgi , BPB Publications, 2009.

(12L)

(2L)

- 2. Cay Horstmann, BIG Java, Wiley Publication, 3rd Edition., 2009
- 3. Herbert Schildt, Java 7, The Complete Reference, , 8th Edition, 2009.

4. E Balagurusamy, Programming with JAVA, TMH, 2007

# **CMSGDSE02T: Discrete Structures** AdditionalTutorial: 15 Lectures

**Introduction:** Introduction to Sets, Finite and Infinite Sets, Unaccountably Infinite Sets. Introduction to Functions and relations, Properties of Binary relations, Closure, Partial Ordering Relations. (15L)

**Unit-II:** Pigeonhole Principle, Permutation and Combinations, Mathematical Induction, Principle of Inclusion and Exclusion. (15L)

Unit-III : Asymptotic Notations

**Recurrence Relations**: Introduction, Generating Functions, Linear Recurrence Relations with constant coefficients and their solution. (15L)

**Graphs Theory**: Basic Terminology of Graphs, Models and Types, Multigraphs, Weighted Graphs, Graph Representation. Graph Isomorphism Graph Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Basic Terminology of Trees, Properties of Trees, Spanning Trees. (15L)

**Inference Theory**: Introduction, Logical Connectives, Well Formed Formulas, Tautologies, Equivalence (10L)

### **Books Recommended:**

- 1. C. L. Liu and D.P. Mohapatra, Elements of Discrete Mathematics, Third Edition, Tata McGraw Hill, 2008.
- 2. K. Rosen, Discrete Mathematics and Its Applications, Sixth Edition, Tata McGraw Hill,2007.
- 3. T.H. Cormen, C.E. Leiserson, R.L. Rivest, Introduction to Algorithms, Third Edition,Prentice Hall of India,2010.
- 4. J.P. Trembley, R. Manohar, Discrete Mathematical Structures with Application to Computer Science, First Edition, Tata McGraw Hill, 2001.
- 5. David Gries, Fred B. Schneider, A Logical Approach to

Discrete Math, Springer, 2010

# **Online Reading/Supporting Material:**

1. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer- science-fall-2005/

**75** Lectures

(5)

## **CMSGDSE03T:** Software Engineering AdditionalTutorial: 15 Lectures

**Software Process:** Introduction, S/W Engineering Paradigm , life cycle models (water fall,incremental, spiral, evolutionary, prototyping, object oriented) , System engineering, computer based system, verification, validation, life cycle process, development process, system engineering hierarchy. (10L)

**Software requirements:** Functional and non-functional , user, system, requirement engineeringprocess, feasibility studies, requirements, elicitation, validation and management, software prototyping, prototyping in the software process, rapid prototyping techniques, user interface prototyping, S/W document. Analysis and modeling, data, functional and behavioral models,

structured analysis and data dictionary.

**Design Concepts and Principles:** Design process and concepts, modular design, designheuristic, design model and document, Architectural design, software architecture, data design, architectural design, transform and transaction mapping, user interface design, user interface design principles. Real time systems, Real time software design, system design, real time executives, data acquisition system, monitoring and control system. (15L)

Software Configuration Management: The SCM process, Version control, Change control,

Configuration audit, SCM standards.

**Software Project Management:** Measures and measurements, S/W complexity and sciencemeasure, size measure, data and logic structure measure, information flow measure. Estimations

for Software Projects, Empirical Estimation Models, Project Scheduling. (12L)

**Testing:** Taxonomy of software testing, levels, test activities, types of s/w test, black box testingtesting boundary conditions, structural testing, test coverage criteria based on data flow, mechanisms, regression testing, testing in the large. S/W testing strategies, strategic approach and issues, unit testing, integration testing, validation testing, system testing and debugging.

(10L)

**Trends in Software Engineering:** Reverse Engineering and Re-engineering – wrappers – Case Study of CASE tools. (6L)

### **Books Recommended:**

- 1. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill
- 2. Ian Sommerville, Software engineering, Pearson education Asia, 6th edition, 2000.
- 3. Pankaj Jalote- An Integrated Approach to Software Engineering, Springer Verlag, 1997.

#### **75** Lectures

(10L)

(12L)

- 4. James F Peters and Witold Pedryez, "Software Engineering An Engineering Approach", John Wiley and Sons, New Delhi, 2000.
- 5. Ali Behforooz and Frederick J Hudson, "Software Engineering Fundamentals", Oxfor University Press, New Delhi, 1996.
- 6. Pfleeger, "Software Engineering", Pearson Education India, New Delhi, 1999.
- 7. Carlo Ghezzi, Mehdi Jazayari and Dino Mandrioli, "Fundamentals of Software Engineering", Prentice Hall of India, New Delhi, 1991.

#### **CMSGDSE04:Computer Networks** AdditionalTutorial: 15 Lectures

#### **75** Lectures

**Basic concepts** : Components of data communication, standards and organizations, NetworkClassification, Network Topologies ; network protocol; layered network architecture; overview

of OSI reference model; overview of TCP/IP protocol suite. (20L)

Physical Layer : Cabling, Network Interface Card, Transmission Media Devices- Repeater, Hub, Bridge, Switch, Router, Gateway. (8L)

Data Link Layer : Framing techniques; Error Control; Flow Control Protocols; Shared media

protocols - CSMA/CD and CSMA/CA.	(10L)
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Network Layer : Virtual Circuits and Datagram approach, IP addressing methods - Subnetting;

Routing Algorithms (adaptive and non-adaptive	(10L)
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**Transport Layer:** Transport services, Transport Layer protocol of TCP and UDP (8L)

Application Layer : Application layer protocols and services - Domain name system, HTTP,

WWW, telnet, FTP, SMTP	(12L)
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**Network Security**: Common Terms, Firewalls, Virtual Private Networks (7L)

#### **Books Recommended:**

- 1.B.A. Forouzan: Data Communication and Networking, 4th Edition, Tata McGraw Hill, 2007.
- 2.D.E. Comer, Internetworking with TCP/IP, Vol. I, Prentice Hall of India, 1998.
- 3. W. Stalling, Data & Computer Communication, 8th edition, Prentice Hall of India, 2006.

4.D. Bertsekas, R. Gallager, Data Networks, 2nd edition, Prentice Hall of India, 1992.

# Skill Enhancement Courses (Credit: 02 each)

## **CMSSSEC01M:** Programming in Python

**Planning the Computer Program:** Concept of problem solving, Problem definition, Programdesign, Debugging, Types of errors in programming, Documentation. (2L)

**Techniques ofProblem Solving:** Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

**Overview of Programming :** Structure of a Python Program, Elements of (2L) Python (3L)

**Introduction to Python:** Python Interpreter, Using Python as calculator, Python shell, Indentation.Atoms, Identifiers and keywords, Literals, Strings, Operators(Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator,

Increment or Decrement operator).

**Creating Python Programs :** Input and Output Statements, Control statements(Branching,Looping, Conditional Statement, Exit function, Difference between break, continue and pass.),

Defining Functions, default arguments.

### **Reference Books**

- 1. T. Budd, Exploring Python, TMH, 1st Ed, 2011
- 2. Python Tutorial/Documentation www.python.or 2015
- 3. Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist : learning with Python, Freely available online.2012
- 4. http://docs.python.org/3/tutorial/index.html
- 5. http://interactivepython.org/courselib/static/pythonds

6. http://www.ibiblio.org/g2swap/byteofpython/read/

# Software Lab Based on Python:

#### **Section:** A (Simple programs)

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon users choice.

2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :

Grade A: Percentage >=80

Grade B: Percentage>=70 and <80 Grade C: Percentage>=60 and <70 Grade D: (4L)

(4L)

Percentage>=40 and <60 Grade

1. Percentage<40

1 Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input paramters from user.

2 WAP to display the first n terms of Fibonacci series.

3 WAP to find factorial of the given number.

4 WAP to find sum of the following series for n terms:  $1 - 2/2! + 3/3! - \cdots - n/n!$ 

5 WAP to calculate the sum and product of two compatible matrices.

# Section: B (Visual Python):

All the programs should be written using user defined functions, wherever possible.

4. Write a menu-driven program to create mathematical

3D objects I. curve

4. sphere

III. cone

IV. arrow

1. ring

VI. cylinder.

1. WAP to read n integers and display them as a histogram.

2. WAP to display sine, cosine, polynomial and exponential curves.

3. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.

4. WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.

5. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:

P(t) = (15000(1+t))/(15+e)

where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

1. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:

I. velocity wrt time (v=u+at)

II. distance wrt time (  $s=u^{t+0.5*a^{t*t}}$ )

a. distance wrt velocity ( s=(v\*v-u\*u)/2\*a )

1. WAP to show a ball bouncing between 2 walls. (Optional)

# CMSSSEC02M:R-Programming

Introduction: Overview and History of R, Getting Help, Data Types, Subsetting, Vectorized (5L) Operations, Reading and Writing Data. (5L)

Control Structures, Functions, lapply, tapply, split, mapply, apply, Coding Standards. (5L)

(5L)

Scoping Rules, Debugging Tools, Simulation, R Profiler.

#### ReferenceBook

1. W. N. Venables, D. M. Smith, An Introduction to R, R-core team, 2015

# Software Lab Based on R Programming:

- 1. Write a program that prints 'Hello World' to the screen.
- 2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n
- 3. Write a program that prints a multiplication table for numbers up to 12.
- 4. Write a function that returns the largest element in a list.
- 5. Write a function that computes the running total of a list.
- 6. Write a function that tests whether a string is a palindrome.
- 7. Implement the following sorting algorithms: Selection sort, Insertion sort, Bubble Sort
- 8. Implement linear search.
- 9. Implement binary search.
- 10. Implement matrices addition, subtraction and Multiplication

# SYLLABUS FOR B.SC. (General) IN MATHEMATICS

# **Under Choice Based Credit System (CBCS)**

# Effective from 2018-2019



West Bengal State University Barasat Kolkata-700 126 West Bengal

lester	Core Course (12)	Discipline Specific Elective	Ability 1	Enhancement Course
Sem		(DSE)(6)	AECC (2)	<b>SEC</b> (4)
	MTMGCOR01T			
	(Mathematics)			
т			AECC1	
1	Other TWO CORE		AECCI	
	Courses to be offered			
	by Other discipline			
	MTMGCOR02T			
	(Mathematics)			
п				
11	Other TWO CORE		AECC2	
	Courses to be offered			
	by Other discipline			
	MTMGCOR03T			
	(Mathematics)			
TTT				SEC-1
111	Other TWO CORE			
	Courses to be offered			
	by Other discipline			
	MTMGCOR04T			
	(Mathematics)			
				SEC 2
IV	Other TWO CORE			SEC-2
	Courses to be offered			
	by Other discipline			

# **B.Sc. Mathematics General Course Structure**

	MTMGDSE01T	
	Or	
	MTMGDSE02T	
V	(Mathematics)	SEC-3
	Other TWO DSE	
	Courses to be offered	
	by Other discipline	
	MTMGDSE03T	
	Or	
	MTMGDSE04T	SEC 4
VI	(Mathematics)	SEC-4
	Other TWO DSE	
	Courses to be offered	
	by Other discipline	

# **Core Courses of Mathematics :**

Seme ster	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
Ι	CORE	MTMGCOR01T	Differential Calculus	5:1:0	6	75	6
II	CORE	MTMGCOR02T	Differential Equations	5:1:0	6	75	6
III	CORE	MTMGCOR03T	Real Analysis	5:1:0	6	75	6
IV	CORE	MTMGCOR04T	Algebra	5:1:0	6	75	6

# **Discipline Specific Electives (DSE)**

# Choices for DSE in Semester V (Choose any one)

Seme ster	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
V	DSE	MTMGDSE01T	Matrices	5:1:0	6	75	6
	DSE	MTMGDSE02T	Mechanics	5:1:0	6	75	6

## Choices for DSE in Semester VI (Choose any one)

Seme ster	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
VI	DSE	MTMGDSE03T	Numerical Methods	5:1:0	6	75	6
	DSE	MTMGDSE04T	Linear Programming	5:1:0	6	75	6

# Following Two Skill Enhancement Courses (SEC) offered by the Dept. of Mathematics

Seme ster	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
III & V	SEC	MTMSSEC01M	C-Programming Language	2:0:0	2	25	2
IV & VI	SEC	MTMSSEC02M	Logic and Sets	2:0:0	2	25	2

# **Course : MTMGCOR01T**

# **Differential Calculus (Marks : 75)**

Limit and Continuity ( $\epsilon$  and  $\delta$  definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x,  $\cos x$ ,  $e^x$ ,  $\log(l+x)$ ,  $(l+x)^n$ , Maxima and Minima, Indeterminate forms.

#### **Books Recommended:**

- 1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
- 2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

# **Course : MTMGCOR02T**

# **Differential Equations (Marks : 75)**

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

#### **Books Recommended:**

1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.

2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

# **Course : MTMGCOR03T**

# Real Analysis (Marks: 75)

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

#### **Books Recommended :**

- 1. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
- 2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P.Ltd., 2000.
- 3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
- 4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series-* Undergraduate Texts in Mathematics, Springer Verlag, 2003.

### **Course : MTMGCOR04T**

### Algebra (Marks: 75)

Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Definition and examples of groups, examples of abelian and non-abelian groups, the group  $Z_n$  of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group  $GL_n(n,R)$ , groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle,(iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems,  $Z_n$  the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields:  $Z_p$ , Q, R, and C. Field of rational functions.

#### **Books Recommended:**

- 1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- 3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
- 4. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.

# Course : MTMGDSE01T Matrices (Marks : 75)

R, R<sub>2</sub>, R<sub>3</sub> as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of R<sub>2</sub>, R<sub>3</sub>.

Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.

Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

#### **Books Recommended :**

- 1. A.I. Kostrikin, Introduction to Algebra, Springer Verlag, 1984.
- 2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
- 3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.

# Course : MTMGDSE02T Mechanics (Marks : 75)

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity, Work and potential energy. Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve), tangential and normal components (space curve), Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.

#### **Books Recommended :**

- 1. A.S. Ramsay, Statics, CBS Publishers and Distributors (Indian Reprint), 1998.
- 2. A.P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University Press, 2003.

# **Course : MTMGDSE03T Numerical Methods (Marks : 75)**

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Lagrange and Newton interpolation: linear and higher order, finite difference operators. Numerical differentiation: forward difference, backward difference and central Difference. Integration: trapezoidal rule, Simpson's rule, Euler's method for solving ordinary differential equations..

#### **Books Recommended :**

- 1. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
- 2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.

# Course : MTMGDSE04T Linear Programming (Marks : 75)

Linear Programming Problems, Graphical Approach for solving some Linear Programs. Convex Sets, Supporting and Separating Hyperplanes. Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis.

#### **Books Recommended :**

- 1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
- 2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 8th Ed., Tata McGrawHill, Singapore, 2004.
- 3. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006.

# Skill Enhancement Courses (SEC)

#### **Course : MTMSSEC01M**

## **C-Programming Language (Marks : 25)**

#### **Unit 1 : Basics of Computer Programming:**

Definition, Requirement of programming language, Machine language, high-level programming languages, machine code of a program: compilation process, Problem solving approaches: algorithm and flowchart

#### **Unit 2 : Fundamentals of Programming:**

Built in Data Types: int, float, double, char; Constants and Variables; first program: printf(), scanf(), compilation etc., keywords, Arithmetic operators: precedence and associativity, Assignment Statements: post & pre increment/decrement, logical operators: and, or, not

#### Unit 3 : Statements:

Relational operators, if-else statement,

Iterative Statements: for loop, while loop and do-while loop; controlling loop execution: break and continue, nested loop

#### Unit 4 : Arrays:

Definition & requirement, declaration & initialization, indexing, one dimensional array: finding maximum, minimum, simple sorting and searching.

#### **Unit 5 : Multi-dimensional arrays:**

Matrix Manipulations (Addition, Multiplication, Transpose)

Arrays and Pointers, Memory allocation and deallocation: malloc() and free() functions

#### **Unit 6 : Functions:**

Why?, How to declare, define and invoke a function, Variables' scope, local& global variables and function parameters, Pointers, arrays as function parameters, *return* statement, Header files and their role. Illustrate different examples like swapping values, compute n!, nCr, find max/min from a list of elements, sort a set of numbers, matrix addition/multiplication etc.

#### **Books Recommended :**

- B. W. Kernighan and D. M. Ritchi : The C-Programming Language, 2nd Edi.(ANSI Refresher), Prentice Hall, 1977.
- Y. Kanetkar : Let Us C ; BPB Publication, 1999.
- C. Xavier : C-Language and Numerical Methods, New Age International.

#### **Course : MTMSSEC02M**

### Logic and Sets (Marks : 25)

**Unit 1 :** Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

**Unit 2 :** Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

**Unit 3 :** Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set. Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations.

#### **Books Recommended :**

- R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
- ▶ P.R. Halmos, Naive Set Theory, Springer, 1974.

E. Kamke, Theory of Sets, Dover Publishers, 1950.

# SYLLABUS FOR B.SC. (HONOURS) IN MATHEMATICS

# **Under Choice Based Credit System (CBCS)**

# Effective from 2018-2019



West Bengal State University Barasat Kolkata-700 126 West Bengal

# **Outlines of Course Structures**

The main components of this syllabus are as follows :

- **1.** Core Course
- 2. Elective Course
- **3. Ability Enhancement Course**

# 1. Core Course :

A course, that should compulsorily be studied by a candidate as a core requirement, is termed as a core course.

# 2. Elective Course

- **2.1 Discipline Specific Elective (DSE) Course :** A course, which may be offered by the main discipline/subject of study, is referred to as Discipline Specific Elective.
- **2.2 Generic Elective (GE) Course :** An elective course, chosen generally from an unrelated discipline/subject of study with intention to seek an exposure, is called a Generic Elective Course.

# **3.** Ability Enhancement Course (AEC)

The Ability Enhancement Course may be of two kinds :

- **3.1** Ability Enhancement Compulsory Course (AECC)
- **3.2** Skill Enhancement Course (SEC)

# **Course Structure: Honours**

Category	No of Courses	Credit of each course	Total credit in this category
Core	14	6	84
Discipline Specific Elective, DSE	4	6	24
Generic Elective, GE	4	6	24
Ability Enhancement Compulsory Courses (EVS/English), AECC	2	2	4
Skill Enhancement Courses, SEC (Department specific)	2	2	4
		Total	140

# Semester wise Course Structures

Sem ester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs. /week	Marks	Credit	
	CORE	MTMACOR01T	Calculus, Geometry and Ordinary Differential Equation	5:1:0	6	75	6	
Ι		MTMACOR02T	Algebra	5:1:0	6	75	6	
	AECC		Environmental Science	2:0:0	2	25	2	
	GE		To be offered by other discipline.			75	6	
	CORE	MTMACOR03T	Real Analysis	5:1:0	6	75	6	
II	CORE	MTMACOR04T	Ordinary Differential Equations and Vector Calculus	5:1:0	6	75	6	
	AECC		English/MIL Communication	2:0:0	2	25	2	
	GE		To be offered by other discipline.			75	6	
	CORE	MTMACOR05T	Theory of Real Functions	5:1:0	6	75	6	
		MTMACOR06T	Group Theory I	5:1:0	6	75	6	
		MTMACOR07T	Numerical Methods	4:0:0	4	50	4	
III		MTMACOR07P	Numerical Methods Lab	0:0:2	4	25	2	
		Choose the following SEC or from any other discipline.						
	SEC	MTMSSEC01M	C-Programming Language	2:0:0	2	25	2	
	GE		To be offered by other discipline.			75	6	
		MTMACOR08T	Riemann Integration and Series of Functions	5:1:0	6	75	6	
	CORE	MTMACOR09T	Multivariate Calculus	5:1:0	6	75	6	
IV		MTMACOR10T	Ring Theory and Linear Algebra I	5:1:0	6	75	6	
			Choose the following SEC or from a	ny other d	iscipline.	<u>.</u>		
	SEC	MTMSSEC02M	Logic and Sets	2:0:0	2	25	2	
	GE		To be offered by other discipline.			75	6	

Sem ester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs. /week	Marks	Credit
	CORE	MTMACOR11T	Partial Differential Equations, Applications of Ordinary Differential Equations	5:1:0	6	75	6
		MTMACOR12T	Group Theory II	5:1:0	6	75	6
v		Choose any two	o from the following courses for Disc	cipline Sp	ecific Electi	ives.	
·	DSE	MTMADSE01T	Linear Programming	5:1:0	6	75	6
		MTMADSE02T	Number Theory	5:1:0	6	75	6
		MTMADSE03T	Probability & Statistics	5:1:0	6	75	6
VI	CORE	MTMACOR13T	Metric Spaces and Complex Analysis	5:1:0	6	75	6
		MTMACOR14T	Ring Theory and Linear Algebra II	5:1:0	6	75	6
		Choose any two	o from the following courses for Dise	cipline Sp	ecific Electi	ives.	
		MTMADSE04T	Theory of Equations	5:1:0	6	75	6
	DSE	MTMADSE05T	Boolean Algebra and Automata Theory	5:1:0	6	75	6
		MTMADSE06T	Mechanics	5:1:0	6	75	6

# **Detailed Syllabus**

### **Course : MTMACOR01T**

#### **Calculus, Geometry & Ordinary Differential Equations (Marks : 75)**

**Unit -1:** Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type  $e^{ax+b} \sin x$ ,  $e^{ax+b} \cos x$ ,  $(ax+b)^n \sin x$ ,  $(ax+b)^n \cos x$ , concavity and inflection points, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

**Unit-2**: Reduction formulae, derivations and illustrations of reduction formulae for the integration of  $\sin^n x$ ,  $\cos^n x$ ,  $\tan^n x$ ,  $\sec^n x$ ,  $(\log x)^n$ ,  $\sin^n x \sin^m x$ , parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Techniques of sketching conics.

**Unit -3:** Reflection properties of conics, translation and rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics.

Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Unit – 4: Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

#### **Graphical Demonstration (Teaching Aid)**

- 1. Plotting of graphs of function  $e^{ax+b}$ , log(ax+b), 1/(ax+b), sin(ax+b), cos(ax+b), |ax+b| and to illustrate the effect of a and b on the graph
- 2. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
- 3. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).
- 4. Obtaining surface of revolution of curves.
- 5. Tracing of conics in Cartesian coordinates/polar coordinates.
- 6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using Cartesian coordinates.

#### **Books Recommended :**

- ▶ G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
- M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
- H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
- R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Murray, D., Introductory Course in Differential Equations, Longmans Green and Co.
- ▶ G.F.Simmons, Differential Equations, Tata Mcgraw Hill.
- T. Apostol, Calculus, Volumes I and II.
- S. Goldberg, Calculus and Mathematical analysis.

## **Course : MTMACOR02T**

### Algebra (Marks: 75)

**Unit -1 :** Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications.

Theory of equations: Relation between roots and coefficients, Transformation of equation, Descartes rule of signs, Cubic (Cardan's method) and biquadratic equations (Ferrari's method).

Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality.

**Unit -2 :** Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

**Unit -3:** Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

**Unit 4:** Matrix, inverse of a matrix, characterizations of invertible matrices. Rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

#### **Books Recommended :**

- > Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
- Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
- > David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
- ➢ K.B. Dutta, Matrix and linear algebra.
- ▶ K. Hoffman, R. Kunze, Linear algebra.
- ▶ W.S. Burnstine and A.W. Panton, Theory of equations.

# **Course : MTMACOR03T**

## Real Analysis (Marks: 75)

**Unit-1:** Review of Algebraic and Order Properties of  $\mathbb{R}$ ,  $\varepsilon$ -neighbourhood of a point in  $\mathbb{R}$ . Idea of countable sets, uncountable sets and uncountability of  $\mathbb{R}$ . Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets. Suprema and Infima.Completeness Property of  $\mathbb{R}$  and its equivalent properties. The Archimedean Property, Density of Rational (and Irrational) numbers in  $\mathbb{R}$ , Intervals. Limit points of a set, Isolated points, Open set, closed set, derived set, Illustrations of Bolzano-Weierstrass theorem for sets, compact sets in  $\mathbb{R}$ , Heine-Borel Theorem.

**Unit-2**: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence, liminf, lim sup. Limit Theorems. Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria. Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

**Unit-3**: Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test. Alternating series, Leibniz test. Absolute and Conditional convergence.

#### **Graphical Demonstration (Teaching Aid)**

- 1. Plotting of recursive sequences.
- 2. Study the convergence of sequences through plotting.
- 3. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
- 4. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
- 5. Cauchy's root test by plotting nth roots.
- 6. Ratio test by plotting the ratio of nth and (n+1)th term.
#### **Books Recommended :**

- R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
- Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
- Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
- S.K. Berberian, a First Course in Real Analysis, Springer Verlag, New York, 1994.
- > Tom M. Apostol, Mathematical Analysis, Narosa Publishing House
- > Courant and John, Introduction to Calculus and Analysis, Vol I, Springer
- ▶ W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill
- Terence Tao, Analysis I, Hindustan Book Agency, 2006
- S. Goldberg, Calculus and mathematical analysis.

# **Course : MTMACOR04T**

#### **Differential Equation and Vector Calculus (Marks : 75)**

**Unit-1**: Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

**Unit -2 :** System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients,

Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

**Unit-3**: Equilibrium points, Interpretation of the phase plane, Power series solution of a differential equation about an ordinary point, solution about a regular singular point.

**Unit- 4 :** Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions.

#### **Graphical Demonstration (Teaching Aid) :**

- 1. Plotting of family of curves which are solutions of second order differential equation.
- 2. Plotting of family of curves which are solutions of third order differential equation.

#### **Books Recommended :**

- Belinda Barnes and Glenn R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and New York, 2009.
- C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India, 2005.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
- Murray, D., Introductory Course in Differential Equations, Longmans Green and Co.
- > Boyce and Diprima, Elementary Differential Equations and Boundary Value Problems, Wiley.
- ▶ G.F.Simmons, Differential Equations, Tata McGraw Hill
- Marsden, J., and Tromba, Vector Calculus, McGraw Hill.
- Maity, K.C. and Ghosh, R.K., Vector Analysis, New Central Book Agency (P) Ltd. Kolkata (India).
- M.R. Speigel, Schaum's outline of Vector Analysis

### **Course : MTMACOR05T**

#### **Theory of Real Functions (Marks : 75)**

**Unit -1**: Limits of functions ( $\varepsilon$  -  $\delta$  approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

**Unit -2** : Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum, theorem. Rolle's theorem. Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials.

**Unit-3**: Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions,  $\ln(1 + x)$ , 1/ax+b and  $(1 + x)^n$ . Application of Taylor's theorem to inequalities.

#### **Books Recommended :**

- 1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
- 2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
- 3. A, Mattuck, Introduction to Analysis, Prentice Hall, 1999.
- 4. S.R. Ghorpade and B.V. Limaye, a Course in Calculus and Real Analysis, Springer, 2006.
- 5. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, 2002.
- 6. R. Courant and F. John, Introduction to Calculus and Analysis, Vol II, Springer, 1999.
- 7. W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill, 2017.
- 8. Terence Tao, Analysis II, Hindustan Book Agency, 2006
- 9. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006
- 10. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
- 11. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.

## **Course : MTMACOR06T**

#### Group Theory–I (Marks: 75)

**Unit-1**: Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (through matrices), elementary properties of groups.

Unit-2: Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

**Unit-3**: Properties of cyclic groups, classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

**Unit-4:** External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

**Unit-5:** Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

#### .Books Recommended :

- > John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- ▶ Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., 1999.
- ▶ Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., 1995.
- > I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.
- > D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of Abstract Algebra, 1997.

#### **Course : MTMACOR07T**

#### Numerical Methods (Marks : 50)

Unit-1: Algorithms, Convergence, Errors: Relative, Absolute. Round off, Truncation.

**Unit-2** : Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method, Regulafalsi method, fixed point iteration, Newton-Raphson method. Rate of convergence of these methods.

**Unit -3** : System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis, LU Decomposition

**Unit-4**: Interpolation: Lagrange and Newton's methods, Error bounds, Finite difference operators. Gregory forward and backward difference interpolations.

Numerical differentiation: Methods based on interpolations, methods based on finite differences.

**Unit** – **5** : Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpsons 3/8th rule, Weddle's rule, Boole's rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's 1/3rd rule, Gauss quadrature formula.

The algebraic eigenvalue problem: Power method.

**Unit** – **6:** Ordinary Differential Equations: The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

### **Course : MTMACOR07P**

### Numerical Methods Lab (Marks : 25)

#### List of practical (using C programming)

- 1. Calculate the sum  $1/1 + 1/2 + 1/3 + 1/4 + \dots + 1/N$ .
- 2. Enter 100 integers into an array and sort them in an ascending order.
- 3. Solution of transcendental and algebraic equations by
  - a. Bisection method
  - b. Newton Raphson method.
  - c. Secant method.
  - d. Regula Falsi method.
- 4. Solution of system of linear equations
  - a. LU decomposition method
  - b. Gaussian elimination method
  - c. Gauss-Jacobi method
  - d. Gauss-Seidel method
- 5. Interpolation
  - a. Lagrange Interpolation
  - b. Newton Interpolation
- 6. Numerical Integration
  - a. Trapezoidal Rule
  - b. Simpson's one third rule
  - c. Weddle's Rule
  - d. Gauss Quadrature
- 7. Method of finding Eigenvalue by Power method
- 8. Fitting a Polynomial Function
- 9. Solution of ordinary differential equations
  - a. Euler method

- b. Modified Euler method
- c. Runge Kutta method

#### **Books Recommended :**

- > Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
- M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering, 2012.
- > Computation, 6th Ed., New age International Publisher, India, 2007.
- C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
- Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
- John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
- Scarborough, James B., Numerical Mathematical Analysis, Oxford and IBH publishing co, 1966.
- > Atkinson, K. E., An Introduction to Numerical Analysis, John Wiley and Sons, 1978.
- > Yashavant Kanetkar, Let Us C , BPB Publications, 2016.

#### **Course : MTMACOR08T**

#### **Riemann Integration and Series of Functions (Marks : 75)**

**Unit -1 :** Riemann integration: inequalities of upper and lower sums, Darbaux integration, Darbaux theorem, Riemann conditions of integrability, Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two Definitions.

Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.

Intermediate Value theorem for Integrals, Fundamental theorem of Integral Calculus.

Unit-2: Improper integrals, Convergence of Beta and Gamma functions.

**Unit-3**: Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions, Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

**Unit 4:** Fourier series: Definition of Fourier coefficients and series, Reimann Lebesgue lemma, Bessel's inequality, Parseval's identity, Dirichlet's condition.

Examples of Fourier expansions and summation results for series.

Unit – 5: Power series, radius of convergence, Cauchy Hadamard Theorem.

Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

#### **Books Recommended :**

- K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
- R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
- > Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.
- S. Goldberg, Calculus and Mathematical analysis.
- Santi Narayan, Integral calculus, S Chand, 2005.
- ➤ T. Apostol, Calculus I, II, Wiley, 2007.

#### **Course : MTMACOR09T**

#### Multivariate Calculus (Marks : 75)

**Unit-1** : Functions of several variables, limit and continuity of functions of two or more variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems

**Unit-2** : Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical coordinates. Change of variables in double integrals and triple integrals.

**Unit-3** : Definition of vector field, divergence and curl. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

**Unit-4** : Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

#### **Books Recommended :**

- ▶ G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
- M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
- E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
- James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001
- > Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, 2<sup>nd</sup> Ed., 2002
- Courant and John, Introduction to Calculus and Analysis, Vol II, Springer New York, 2012
- ▶ W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill, 3rd Ed., 2013
- Marsden, J., and Tromba, Vector Calculus, McGraw Hill, 6th revised international Ed, 2012
- Maity, K.C. and Ghosh, R.K. Vector Analysis, New Central Book Agency (P) Ltd. Kolkata (India).
- ▶ Terence Tao, Analysis II, Hindustan Book Agency, 3<sup>rd</sup> Ed., 2015
- M.R. Speigel, Schaum's outline of Vector Analysis. Tata McGraw-Hill, 2009.

#### **Course : MTMACOR10T**

#### **Ring Theory and Linear Algebra I (Marks : 75)**

**Unit 1:** Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

**Unit 2 :** Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients.

**Unit 3 :** Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

**Unit 4 :** Introduction to linear transformations, Subspaces, dimension of subspaces, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

#### **Books Recommended**

> John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
- Solution Solution Section 2017 Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
- S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
- Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
- S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999
- Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
- D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.
- D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of Abstract Algebra, 1997.

#### **Course : MTMACOR11T**

# Partial Differential Equations, Applications of Ordinary Differential Equations (Marks : 75)

**Unit 1:** Partial Differential Equations – Basic concepts and Definitions. Mathematical Problems. First- Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

**Unit 2:** Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

**Unit 3:** The Cauchy problem, Cauchy-Kowalewskaya theorem, Cauchy problem of an infinite string, Initial Boundary Value Problems. Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end. Equations with non-homogeneous boundary conditions. Non-Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem. Solving the Heat Conduction problem

**Unit 4:** Central force. Constrained motion, varying mass, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law.

#### **Graphical Demonstration (Teaching Aid)**

- 1. Solution of Cauchy problem for first order PDE.
- 2. Finding the characteristics for the first order PDE.
- 3. Plot the integral surfaces of a given first order PDE with initial data.

4. Solution of wave equation  $\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial x^2} = 0$  for the following associated conditions:

(a) u(x,0) =φ(x), u<sub>x</sub> (x,0) =ψ(x), x∈R, t >0.
(b) u(x,0) =φ(x), u<sub>x</sub> (x,0) =ψ(x), u(0, t) =0 x∈ (0,∞), t >0.

5. Solution of wave equation  $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$  for the following associated conditions: (a)  $u(x,0) = \phi(x), u(0, t) = a, u(l, t) = b, 0 < x < l, t > 0.$ (b)  $u(x,0) = \phi(x), x \in R, 0 < t < T.$ 

#### **Books Recommended :**

- Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th Edition, Springer, Indian reprint, 2006.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Martha L Abell, James P Braselton, Differential equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
- Sneddon, I. N., Elements of Partial Differential Equations, McGraw Hill, 2013.
- Miller, F. H., Partial Differential Equations, John Wiley and Sons, 2013.
- Loney, S. L., An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, Loney Press, 2007.

#### **Course : MTMACOR12T**

#### Group Theory II (Marks : 75)

**Unit 1:** Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

**Unit 2 :** Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

**Unit 3 :** Group actions, stabilizers and kernels, permutation representation associated with a given group action. Applications of group actions. Generalized Cayley's theorem. Index theorem.

**Unit 4** : Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, pgroups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of  $A_n$  for  $n \ge 5$ , non-simplicity tests.

#### **Books Recommended:**

- > John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- > Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., 1999.
- David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
- ▶ J.R. Durbin, Modern Algebra, John Wiley & Sons, New York Inc., 2000.
- > D. A. R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998
- D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of Abstract Algebra, Tata McGraw Hill,1997.
- > I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

#### **Course : MTMACOR13T**

#### Metric Spaces and Complex Analysis (Marks : 75)

**Unit-1** : Metric spaces: Definition and examples. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, subspaces, dense sets, separable spaces. Sequences in Metric Spaces, Cauchy sequences. Complete Metric Spaces, Cantor's theorem.

**Unit 2 :** Continuous mappings, sequential criterion and other characterizations of continuity, Uniform continuity, Connectedness, connected subsets of R.

Compactness: Sequential compactness, Heine-Borel property, Totally bounded spaces, finite intersection property, and continuous functions on compact sets.

Homeomorphism, Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equation.

**Unit 3 :** Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

**Unit 4 :** Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, and definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Unit 5 : Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series,

Taylor series and its examples.

Unit 6: Laurent series and its examples, absolute and uniform convergence of power series.

#### **Books Recommended :**

- Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
- S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
- ▶ G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.
- James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw Hill International Edition, 2009.
- Joseph Bak and Donald J. Newman, Complex Analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.
- S. Ponnusamy, Foundations of omplex Analysis, Alpha Science International, 2005.
- E.M.Stein and R. Shakrachi, Complex Analysis, Princeton University Press, 2010.

#### **Course : MTMACOR14T**

#### **Ring Theory and Linear Algebra II** (Marks : 75)

**Unit 1 :** Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, and unique factorization in Z [x]. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

**Unit 2 :** Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms.

**Unit 3 :** Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

#### **Books Recommended :**

- > John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- ▶ Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.
- Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
- S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.

- ▶ Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
- S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
- Kenneth Hoffman and Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
- S.H. Friedberg, A.L. Insel and L.E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., 2004.

# **Skill Enhancement Courses (SEC)**

# **Course : MTMSSEC01M**

### **C-Programming Language (Marks : 25)**

#### **Unit 1 : Basics of Computer Programming:**

Definition, Requirement of programming language, Machine language, high-level programming languages, machine code of a program: compilation process, Problem solving approaches: algorithm and flowchart

#### **Unit 2 : Fundamentals of Programming:**

Built in Data Types: int, float, double, char; Constants and Variables; first program: printf(), scanf(), compilation etc., keywords, Arithmetic operators: precedence and associativity, Assignment Statements: post & pre increment/decrement, logical operators: and, or, not

#### Unit 3 : Statements:

Relational operators, if-else statement,

Iterative Statements: for loop, while loop and do-while loop; controlling loop execution: break and continue, nested loop

#### Unit 4 : Arrays:

Definition & requirement, declaration & initialization, indexing, one dimensional array: finding maximum, minimum, simple sorting and searching.

#### Unit 5 : Multi-dimensional arrays:

Matrix Manipulations (Addition, Multiplication, Transpose)

Arrays and Pointers, Memory allocation and deallocation: malloc() and free() functions

#### Unit 6 : Functions:

Why?, How to declare, define and invoke a function, Variables' scope, local& global variables and function parameters, Pointers, arrays as function parameters, *return* statement, Header files and their role. Illustrate different examples like swapping values, compute n!, nCr, find max/min from a list of elements, sort a set of numbers, matrix addition/multiplication etc.

#### **Books Recommended :**

- B. W. Kernighan and D. M. Ritchi : The C-Programming Language, 2nd Edi.(ANSI Refresher), Prentice Hall, 1977.
- Y. Kanetkar : Let Us C ; BPB Publication, 1999.
- C. Xavier : C-Language and Numerical Methods, New Age International.

#### **Course : MTMSSEC02M**

#### Logic and Sets (Marks : 25)

**Unit 1 :** Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

**Unit 2 :** Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

**Unit 3 :** Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set. Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations.

#### **Books Recommended :**

- R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
- ▶ P.R. Halmos, Naive Set Theory, Springer, 1974.
- E. Kamke, Theory of Sets, Dover Publishers, 1950.

# **Discipline Specific Elective (DSE)**

#### **Course : MTMADSE01T**

#### Linear Programming (Marks: 75)

**Unit 1 :** Introduction to linear programming problem. Theory of simplex method, graphical solution, convex sets, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method. Big-M method and their comparison.

**Unit 2 :** Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual. Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

**Unit 3 :** Game theory: Formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

#### **Books Recommended :**

- Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
- F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009.
- Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006.
- ➤ G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.

#### **Course : MTMADSE02T**

#### Number Theory (Marks: 75)

**Unit 1 :** Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.

**Unit 2 :** Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues. Some properties of Euler's phi-function.

Unit 3 : Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli, Public key encryption, RSA encryption and decryption, the equation  $x^2 + y^2 = z^2$ , Fermat's Last theorem.

#### **Books Recommended :**

- > David M. Burton, Elementary Number Theory, 6th Ed., Tata McGraw-Hill, Indian reprint, 2007.
- > Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007

#### **Course : MTMADSE03T**

#### **Probability and Statistics (Marks : 75)**

**Unit 1 :** Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

**Unit 2 :** Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

**Unit 3 :** Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers. Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Unit 4: Random Samples, Sampling Distributions, Estimation of parameters, Testing of hypothesis.

#### **Books Recommended :**

- Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.
- Irwin Miller and Marylees Miller and John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.
- Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.
- Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007
- A. Gupta, Ground work of Mathematical Probability and Statistics, Academic publishers, 1983.

#### **Course : MTMADSE04T**

## **Theory of Equations** (Marks : 75)

**Unit 1 :** General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

**Unit 2 :** Symmetric functions. Applications of symmetric function of the roots. Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic (Cardan's method) and biquadratic (Ferrari's method). Properties of the derived functions.

**Unit 3 :** Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

**Unit 4 :** Separation of the roots of equations, Strums theorem. Applications of Strum's theorem, Conditions for reality of the roots of an equation. Solution of numerical equations.

#### **Books Recommended :**

- ▶ W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.
- C. C. MacDuffee, Theory of Equations, John Wiley & Sons Inc., 1954.

#### **Course : MTMADSE05T**

#### **Boolean Algebra and Automata Theory (Marks : 75)**

**Unit 1 :** Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.

**Unit 2 :** Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal and maximal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, Logic Gates, switching circuits and applications of switching circuits.

**Unit 3 :** Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

**Unit 4 :** Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

**Unit 5 :** Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

**Unit 6 :** Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem. Post Correspondence Problem, and undecidability problems about CFGs.

#### **Books Recommended :**

- B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
- Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003.
- Rudolf Lidl and Günter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
- J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages, and Computation, 2nd Ed., Addison-Wesley, 2001.
- H.R. Lewis, C.H. Papadimitriou and C. Papadimitriou, Elements of the Theory of Computation, 2nd Ed., Prentice-Hall, NJ, 1997.
- > J.A. Anderson, Automata Theory with Modern Applications, Cambridge University Press, 2006.

#### **Course : MTMADSE06T**

#### Mechanics (Marks : 75)

**Unit 1 :** Co-planar forces. Astatic equilibrium. Friction. Equilibrium of a particle on a rough curve. Virtual work. Forces in three dimensions. General conditions of equilibrium. Centre of gravity for different bodies. Stable and unstable equilibrium.

**Unit 2 :** Equations of motion referred to a set of rotating axes. Motion of a projectile in a resisting medium. Stability of nearly circular orbits. Motion under the inverse square law. Slightly disturbed orbits. Motion of artificial satellites. Motion of a particle in three dimensions. Motion on a smooth sphere, cone, and on any surface of revolution.

**Unit 3 :** Degrees of freedom. Moments and products of inertia. Momental Ellipsoid. Principal axes. D'Alembert's Principle. Motion about a fixed axis. Compound pendulum. Motion of a rigid body in two dimensions under finite and impulsive forces. Conservation of momentum and energy.

#### **Books Recommended :**

- I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, 2006. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
- R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2010.
- Chorlton, F., Textbook of Dynamics CBS Publishers & Distributors, 2005.
- Loney, S. L., An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, 2017
- ▶ Loney, S. L., Elements of Statics and Dynamics I and II, 2004.
- ➢ Ghosh, M. C, Analytical Statics.
- Verma, R. S., A Textbook on Statics, Pothishala, 1962.
- Matiur Rahman, Md., Statics, New Central Book Agancy (P) Ltd, 2004.
- Ramsey, A. S., Dynamics (Part I), Cambridge University Press, 1952.

# SYLLABUS FOR

# GENERIC ELECTIVES OF MATHEMATICS (For Other Honours Discipline)

Seme ster	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
Ι	GE	MTMHGEC01T	Differential Calculus	5:1:0	6	75	6
II	GE	MTMHGEC02T	Differential Equations	5:1:0	6	75	6
III	GE	MTMHGEC03T	Real Analysis	5:1:0	6	75	6
IV	GE	MTMHGEC04T	Algebra	5:1:0	6	75	6

# **Course : MTMHGEC01T**

#### **Differential Calculus (Marks : 75)**

Limit and Continuity ( $\epsilon$  and  $\delta$  definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x,  $e^x$ , log(l+x),  $(l+x)^n$ , Maxima and Minima, Indeterminate forms.

#### **Books Recommended:**

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.

2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

#### Course : MTMHGEC02T

#### **Differential Equations (Marks : 75)**

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties.

Solving a differential equation by reducing its order.

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

#### **Books Recommended:**

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.

2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

# Course : MTMHGEC03T

# Real Analysis (Marks : 75)

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Pointwise and uniform convergence .Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

#### Books Recommended :

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.

2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P.Ltd., 2000.

- 3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
- 4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series-* Undergraduate Texts in Mathematics, Springer Verlag, 2003.

# Course : MTMHGEC04T

# Algebra (Marks: 75)

Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Definition and examples of groups, examples of abelian and non-abelian groups, the group  $Z_n$  of integers under addition modulo n and the group U(n) of units under multiplication modulo n.Cyclic groups from number systems, complex roots of unity, circle group, the general linear group  $GL_n(n,R)$ , groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z<sub>n</sub> the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Z<sub>p</sub>, Q, R, and C. Field of rational functions.

#### **Books Recommended:**

- 1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- 3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
- 4. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.

# Syllabus of Choices Offered by Physiology Discipline for B.Sc. Program under Choice Based Credit System (CBCS)



# **West Bengal State University**

# **Course Curriculum for Physiology General under Choice Based Credit System**

- All general courses will have3subjects/disciplines of interest. Student will select4corecourseseachfrom discipline of choice including Physiology as one of the disciplines.
- Student will select 2 elective courses each from discipline of choice including Physiology as one of the disciplines.
- Student may also choose skill enhancement courses in Physiology.

# Summary of the Syllabus

# Semester I

Courses	Theoretical (T)	Credits	Practical (P)	Credit	Total
				S	Credits
Core Courses (+2 from allied disciplines)	<b>PHYGCOR01T</b> Nutrition, Metabolism & Gastrointestinal Functions	4	<b>PHYGCOR01P</b> Nutrition, Metabolism & Gastrointestinal Functions	2	6 X 3 =18(Inclu ding allied disciplines)
Ability Enhancement Courses	ENVSAEC01T Environmental Science	2			2
					20

# Semester II

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	<b>PHYGCOR02T</b> Circulation, Respiration & Excretion	4	PHYGCOR02P Circulation, Respiration & Excretion	2	6 X 3 =18
Ability Enhancement Courses	ENGSAEC02M English/MIL Communication	2			2
					20

**Semester III** 

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	PHYGCOR03T Nervous System & Special Senses	4	PHYGCOR03P Nervous System & Special Senses	2	6 X 3 =18
Skill Enhancement Courses	PHYSSEC01M Haematological techniques (OR FROM OTHER DISCIPLINES)	2	PHYSSEC01M Haematological techniques (OR FROM OTHER DISCIPLINES)		2
					20

# **Semester IV**

Courses	Theoretical (T)	Credit s	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	PHYGCOR04T Endocrinology &Reproduction	4	<b>PHYGCOR04P</b> Endocrinology & Reproduction	2	6 X 3 =18
Skill Enhancement Courses	<b>PHYSSEC02M</b> Diet Survey(OR FROM OTHER DISCIPLINES)	2	<b>PHYSSEC02M</b> Diet Survey(OR FROM OTHER DISCIPLINES)		2
					20

# Semester V

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Skill Enhancement Courses	PHYSSEC01M Hematological Techniques(OR FROM OTHER DISCIPLINES)		PHYSSEC01M Hematological Techniques(OR FROM OTHER DISCIPLINES)		2
Discipline Specific Elective Course (ANY ONE)	<b>PHYGDSE01T</b> Biological Statistics	4	<b>PHYGDSE01P</b> Biological Statistics	2	6 X 3
(+2 from allied disciplines)	PHYGDSE02T SportsandExercisePhysi ology	4	PHYGDSE02P SportsandExercisePhysio logy	2	=18
					20

# <u>Semester VI</u>

Skill Enhancement Courses	<b>PHYSSEC02M</b> Diet Survey(OR FROM OTHER DISCIPLINES)		<b>PHYSSEC02M</b> Diet Survey(OR FROM OTHER DISCIPLINES)		2
Discipline Specific Elective Course (ANY ONE)	PHYGDSE03T Community Nutrition andPublicHealth	4	PHYGDSE01PCommunit y Nutrition andPublicHealth	2	6
(+2 from allied disciplines)	PHYGDSE04TEnvironme ntal Pollution and HumanHealth	4	PHYGDSE04PEnvironme ntal Pollution and HumanHealth	2	U
					20

# CoursesofB.Sc.GeneralPhysiologyunderCBCS

#### Core Courses

- 1. Nutrition, Metabolism & Gastrointestinal Functions
- 2. Circulation, Respiration & Excretion
- 3. Nervous System & Special Senses
- 4. Endocrinology & Reproduction

#### Ability EnhancementCourse(AEC) (Compulsory)

1. Environmental Science

2.English/MILCommunication/Bengali	i
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ElectiveCourse (EC)(anytwo)	
	1. Biological Statistics
	2. Community Nutrition & Public Health
Discipline Specific Electives (GDSE)	<ol> <li>SportsandExercisePhysiology</li> <li>Environmental Pollution and HumanHealth</li> </ol>
SkillEnhancementCourse(SEC)	
1. Hematological Techniques	
2.DietSurvey andformulation ofDietChart	

# Summary of the Syllabus

1. Eachsemesterwillconsistof15-18weeksofacademicworkequivalentto90actualteaching days.

2. OneCreditisequivalenttoone(1)hourofteaching(lecture)ortwohoursofPracticalwork perweek.

Total creditsin SemesterI:6 (forPhysiology)+2(Compulsory)=(6+2)=8=(8-2)=6 forPhysiology only <u>3.Numbersinparentheses indicatevalueofcredit.</u>

# Details of Courses: Components of Core Courses

PHYGCOR01T:	
Nutrition, Metabolism & Gastrointestinal Functions	4 Credits

### Enzymes :(6 hours)

Classification, coenzymes, cofactor, Prosthetic Groups. Mechanism of enzyme action: activation energy, enzyme-substrate complex, transition state. Michaelis constant, Michaelis-Menten equation, Hyperbolic kinetics, Significance of Km and Vmax. Enzyme Inhibition: Competitive, noncompetitive, uncompetitive. Factors regulating enzyme activities: substrate concentration, enzyme concentration, pH and temperature. Isoenzymes, Allosteric enzymes, Ribozymes, Abzymes, Concept of Rate limiting enzymes.

### **<u>Chemistry of Biomolecules</u>: (14 hours)**

Classification, structure, Properties and Functions of Carbohydrates, Proteins and lipids. Structure, types and Function of DNAs and RNAs.

# Nutrition& Metabolism: (20 hours)

Carbohydrate metabolism. Protein metabolism. Fat metabolism. Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins. Vitamins: A, C, D, E, K, B12. Minerals: Sodium, Potassium, Calcium, Iron, Iodine, Fluorine.

# **Gastrointestinal Functions**: (20 hours)

- **1. Digestion & aborption** Introduction, carbohydrates, Proteins & Nucleic Acids, Lipids.
- 2. Regulation of Gastrointestinal Function

General Considerations, Gastrointestinal hormones, Mouth & Esophagus, Stomach, Digestive Function of the Stomach. Exocrine Portion of the Pancreas, Liver & Biliary System, Small Intestine, Colon.

PHYGCOR01P:	
Nutrition, Metabolism & Gastrointestinal Functions Lab	2 Credits

#### **Biological Chemistry:**

Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic Acid, Uric Acid, Glucose, Galactose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin, Urea, Glycerol, Bile salts.

#### **Biochemical Estimation:**

Quantitative estimation of glucose and sucrose by Benedict's method. Quantitative estimation of amino nitrogen [Sorensen's formol titration method (percentage as well as total quantity to be done)]. Estimation of percentage quantity of lactose in milk by Benedict's method.

**Demonstration:Dale's Experiments** : Kymographic recording of normal movements of rat's intestine in Dale's apparatus. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

# AbilityEnhancementCourse(AEC) (Compulsory)

- **1.** Environmental science
- **2.** English/MILcommunication

# SEMESTER-II

PHYGCOR02T	
Circulation, Respiration & Excretion	4 Credits

## **<u>Circulation</u>** (25 hours)

- **1. Origin of the Heartbeat & the Electrical Activity of the heart** Introduction, Origin & Spread of Cardiac Excitation, The Electrocardiogram, Cardiac Arrhythmias, Hypertrophy and cardiac myopathy.
- **2.** The Heart as a Pump Introduction, Mechanical Events of the Cardiac Cycle, Cardiac Output.
- **3.** Dynamics of Blood & Lymph Flow Introduction, Introduction, Blood, Bone Marrow, White Blood Cells, Platelets, Red Blood Cells, Hemostasis: factors, mechanism. Hemoglobin. Anatomic Considerations: artery, vein, capillaries. Lymphatic Circulation & Interstitial Fluid Volume.
- **4. Cardiovascular regulatory Mechanisms** Introduction, Local Regulatory Mechanisms, Regulation by Hormones, Systemic Regulation by the Nervous System.
- **5. Circulation Through Special Regions** Introduction, Coronary Circulation, Circulation of the skin, Placental & Fetal Circulation.

# Respiration (20 Hours)

1. Pulmonary Function

Anatomy of the Lungs, Mechanics of breathing, Gas Exchange in the lungs, Pulmonary Circulation, Other Functions of the Respiratory System.

- 2. Gas Transport Between the Lungs & the Tissues Introduction, Oxygen Transport, Carbon Dioxide Transport, Respiratory acidosis and alkalosis.
- 3. Regulation of Respiration

Neural control of Breathing, Chemical Control of Breathing.

#### 4. Respiratory Adjustments in Health & Disease

Forms of Hypoxia, Hypercapnia & Hypocapnia, Artificial Respiration.

#### Excretion (15 hours)

Renal Function & Micturition Introduction,

Juxta Glomerular Apparatus, Function of Malpighian corpuscles and renal tubule, counter-current mechanism, Water Excretion, Acidification of the Urine & Bicarbonate Excretion, Regulation of Na+ & Cl- Excretion, Renal Circulation, Disorders of Renal Functions, Filling of the Bladder, Emptying of the Bladder, Non-excretory function of kidney.

PHYGCOR02P	
Circulation, Respiration & Excretion Lab	2 Credits

**Circulation:** Sphygmomanometric measurement of arterial blood pressure at rest and after exercise. Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard exercise and graphical plotting.

**Respiration:**Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation and breath - holding.

**Demonstration:**Measurement of oxygen saturation by pulse oxymeter before and after exercise.Measurement of peak expiratory flow rate. Measurement of forced expiratory volume (FEV) in first second. **Cardiovascular Experiments:** Preparation of Amphibian Ringer solution. Kymographic recording of the movements of perfused heart of toad. Study of the effects of changes in perfusion fluid pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine, adrenaline on the movement of heart. **Renal biochemistry:** Identification of normal and abnormal constituents of urine.**Hematological Experiments:**Differential count of WBC.Total count of RBC and WBC.Preparation and staining of bone marrow.Measurement of diameter of megakaryocyte.Reticulocyte staining.

#### AbilityEnhancementCourse(AEC) (Compulsory)

- 1. Environmental science
- 2. English/MILcommunication

# **SEMESTER-III**

PHYGCOR03T:	Nervous system & Special senses	4 Credits

### <u>Nerve & Muscle</u> (20 hours)

1. Excitable Tissue: Nerve Introduction,

Nerve Cells, Excitation & Conduction, Measurement of Electrical Events, Ionic Basis of Excitation & Conduction, Properties of Mixed Nerves, Nerve Fiber Types

 Excitable Tissue: Muscle Introduction, Skeletal Muscle: Morphology, Electrical Phenomena & Ionic Fluxes, Contractile Responses, Properties. Cardiac Muscle: Morphology, Electrical Properties, Mechanical Properties Pacemaker

Cardiac Muscle: Morphology, Electrical Properties, Mechanical Properties Pacemaker Tissue,

Smooth Muscle: Morphology.

- **3.** Synaptic & Junctional Transmission Introduction, Synaptic Transmission: Functional Anatomy, Electrical Events at Synapses, Inhibition & Facilitation at Synapses, Chemical Transmission of Synaptic Activity.
- **4. Initiation of Impulses in Sense Organs** Introduction, Sense Organs & Receptors, The Senses, Electrical & Ionic Events in Receptors, "Coding" of Sensory Information.

### Nervous system (25 hours)

- 1. **Reflexes** Introduction, Monosynaptic Reflexes: The Stretch Reflex, Polysynaptic Reflexes: The Withdrawal Reflex, General Properties of Reflexes.
- **2.** Cutaneous, Deep & Visceral Sensation Introduction, Pathways Touch, Proprioception, Temperature, Pain.
- **3.** Arousal Mechanisms, Sleep, & the Electrical Activity of the Brain The Reticular Formation & the Reticular Activating System, The Thalamus & the Cerebral Cortex: structure & functions. The Electroencephalogram, Physiological Basis of the EEG & Sleep, Interpretation of abnormal EEG pattern.
- 4. **Control of Posture & Movement** Introduction, General Principles, Basal Ganglia & Cerebellum: Structure & functions. Movement disorders.
- **5. The Autonomic Nervous System** Introduction, Anatomic Organization of Autonomic Outflow, Chemical Transmission at autonomic Junctions.
- 6. Central Regulation of Visceral Function Introduction, Hypothalamus: Anatomic Considerations, Hypothalamic Function, Relation to Autonomic Function, Relation to Sleep, Hunger, Thirst, Control of Posterior Pituitary Secretion, Control of Anterior pituitary Secretion, Temperature Regulation, fever.
- **7. Neural Basis of Instinctual Behavior & Emotions** Introduction, Limbic system: Anatomic Considerations, Functions - Sexual Behavior, Fear & Rage, Motivation,

# Special sense (15 hours)

**Vision:** Anatomic Considerations, The Image-Forming Mechanism (accommodation and visual acuity), The Photoreceptor Mechanism: Genesis of Electrical Responses, Visual Pathways and effects of lesions of these pathways, Color Vision, Errors in visual process.

**Hearing & Equilibrium:** Introduction, Anatomic considerations, Hair cells, Mechanism of hearing, Vestibular function.

**Smell & Taste:** Introduction, Smell: Receptors & Pathways. Taste: Receptor Organs & Pathways.

PHYGCOR03P	
Nervous system & Special Senses Lab	2 Credits

#### Histological Study, Experiment of Nerve and Muscle:

Isolation and Staining of nerve fibres with node(s) of Ranvier (AgNO3) and muscle fibres (H and E).

Measurement of grip strength. Determination of visual acuity by Snellen's chart / Landolt's C chart. Determination of colour blindness by Ishihara chart.

**Demonstration:** Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle. Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli. Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch. Calculation of work done by the muscle. Determination of nerve conduction velocity. **Neurological experiments:** Experiments on superficial (plantar) and deep (knee jerk) reflex. Reaction time by stick drop test. Short term memory test (shape, picture word). Two point discrimination test. Principles of fixation and staining, Staining and identification of fixed endocrine glands and nervous tissue.

# Skill Enhancement Course (SEC)

PHYSSEC01M Hematological Techniques	2 Credits
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Preparation of blood smear and identification of blood cells. Preparation of haemin crystal. Bleeding time, clotting time. Measurement of haemoglobin in blood. Preparation of serum, Blood group determination.

# **SEMESTER-IV**

PHYGCOR04T:	
Endocrinology & Reproduction	4 Credits

#### Endocrinology:(30 hours)

- The Thyroid Gland Introduction, Anatomic Considerations, Formation & Secretion of Thyroid Hormones, Transport of Thyroid Hormones, Effects of Thyroid Hormones, Clinical Correlates.
- 2. Endocrine Functions of the Pancreas & the Regulation of Carbohydrate Metabolism Introduction, Islet Cell Structure, Structure, Biosynthesis, & Secretion of Insulin, Effects of Insulin, Insulin Excess, Glucagon, Hypoglycemia & Diabetes Mellitus in Humans.
- **3. The Adrenal Medulla & Adrenal Cortex** Introduction, Adrenal Morphology, Adrenal Medulla, Structure & Function of Medullary Hormones, Adrenal Cortex, Structure & Biosynthesis of Adrenocortical Hormones, Effects of

Adrenal Androgens & Estrogens, Physiologic Effects of Glucocorticoids, Effects of Mineralocorticoids, Summary of the effects of Adrenocortical Hyper & Hypofunction in Humans.

- **4. Hormonal Control of Calcium Metabolism & the Physiology of Bone** Introduction, The Parathyroid Glands: Structure, hormone, functions. Calcitonin. Role on Calcium & Phosphate Metabolism,
- **5. The Pituitary Gland** Introduction, Morphology, Posterior pituitary hormones, Growth Hormone, Pituitary Hyper- and hypo-function.
- **6. Endocrine Functions of the Kidneys, Heart, & Pineal Gland** Introduction, The Renin-Angiotensin System, Erythropoietin, The Endocrine Function of the Heart: Atrial Natriuretic Peptide.

#### Reproduction: (30 hours)

The male reproductive System: Structure, Gametogenesis, Endocrine Function of the Testes, Control of Testicular Function, Abnormalities of Testicular Function, The Female Reproductive system: The Menstrual Cycle, Ovarian Hormones, Control of Ovarian Function, Abnormalities of Ovarian Function, Pregnancy: Physiological changes during pregnancy. Placenta: Structure & functions. Puberty, Precocious & Delayed Puberty, Menopause, Pituitary Gonadotropins & Prolactin,

PHYGCOR04P:	
Endocrinology & Reproduction Lab	2 Credits

#### Histology

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:

Trachea, Lungs, Spleen, Lymph gland, Esophagus, Stomach, Duodenum, Ileum, Jejunum, large Intestine, Liver, Kidney, Salivary glands, Pancreas, Adrenal gland, Thyroid gland, Testes, Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Tongue.

**Demonstration:** Study of the effects of oxytocin on uterine contraction. Study of the effects of adrenaline on intestinal / uterine movements. Study of estrous cycle. Staining and identification of kidney and ureters. Estimation of estrogen by spectrophotometric method. Pregnancy test from human urine by kit method.

#### Skill Enhancement Course (SEC)

PHYSSEC02M: Diet s	survey and	Formulation of die	et chart		2 Credits
Survey of dietary st	tatus of pe	ple in the nearb	y area by the st	udents, ana	alysis of survey

results, and, formulation of diet chart.

# **SEMESTER-V**

**Skill Enhancement Course (SEC)** 

PHYSSEC01M Hematological Techniques 2 Credits	PHYSSEC01M	Hematological Techniques	2 Credits	
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Preparation of blood smear and identification of blood cells. Preparation of haemin crystal. Bleeding time, clotting time. Measurement of haemoglobin in blood. Preparation of serum, Blood group determination.

FRIADSEUTT	
: Biological Statistics	4 Credits

Scope of statistics – Principles of statistical analysis of biological data. Basic concepts – variable, parameter, statistics. Sampling. Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram. Parameters. Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of mean. Standard score.Degrees of freedom. Probability. Normal distribution. Student's t-distribution. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, Students' 't' test and z score for significance of difference. Distribution-free test - Chi-square test.

PHYADSE01T									
: Bio	logical S	statistics	s Lab					2 Credits	
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Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in frequency polygon and histogram. Student's 't' test for significance of difference between means. Demonstration: Statistical analysis and graphical representation of biological data with computer using One way ANOVA etc.

#### PHYADSE02T

Sports and Exercise Physiology

Importance of regular exercise in health and wellbeing. Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system). Cardio-respiratory responses during different grades of exercise. Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery. Aerobic work Capacity: Measurement, physiological factors and applications. Training: Principles of physical training, Training to improve aerobic and anaerobic power. Effect of overtraining and detraining. Nutritional supplements and ergogenic aids.Sports injury and its' management. Basic idea sports rehabilitation and sports medicine.

PHYADSE02P	
Sports and Exercise Physiology Lab	2 Credits
Magging mont of blood processing before and after different grades of	avanaiga Dagandi

Measurement of blood pressure before and after different grades of exercise. Recording of recovery heart-rate after standard exercise. Determination of VO2max by queen college step test. Measurement of body fat percentage.Six minute walk test. Determination of endurance time by hand grip dynamometer.

**SEMESTER-VI** 

4 Credits

PHYSSEC02M: Diet survey and Formulation of diet chart	2 Credits
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Survey of dietary status of people in the nearby area by the students, analysis of survey results, and, formulation of diet chart.

# Discipline Specific Electives (DSE) (Any one)

PHYADSE03T	
Community Nutrition and Public Health	4 Credits

Principles of human nutrition – relationship between nutrition, health & disease.

Balanced diet, Diet survey, Concept of ACU, Nutritional classification, Digestive absorption, metabolism of carbohydrates, proteins and lipids.

Composition and nutritional value of common Indian foodstuff, rice, wheat, pulses, egg, meat, fish and milk. Dietary fibers. Calorie requirement.

Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman.

Diet management of obese, diabetic, hypertensive person and athlete. Basic idea on PCM, marasmus, kwashiorkor and their prevention.

Recommended dietary allowances, malnutrition and chronic energy, LBW, PEM, Xerophthalmia, IDD, Iron and iodine deficiency, micronutrient disorders.

Food toxicity,

Effect of processing on nutritive values of foods

Socioecology of nutrition, Habitual diets in India and their adequacy

Basic idea about community health and public health issues.

Sound pollution as a community health issue; definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards).

PHYADSE03T	
Community Nutrition and Public Health Lab	2 Credits

Qualitative assessment of noise, survey on the status of dietary intake in the surrounding area through visits, etc.

#### PHYADSE06T: Environmental Physiology

4 Credits

**Environmental Pollutions and Health Hazards** 

Definition: hygiene, health and public health.

Air, Water, Food Borne Diseases: causes, symptoms and control.

Food Additives and Adulterants: definition, examples and human health hazards.

Vector Borne Epidemic Diseases: Malaria and Plague-etiology and control.

**Air Pollution:** definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

**Water Pollution:** definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

**Soil Pollution:**causes, health hazards, solid waste management, bioremediation, phytoremediation.

**Sound Pollution:** definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).

**Radionuclide Pollution:** ionizing radiations, effects of ionizing radiation on human health, permissible doses.
**Arsenic Pollution:** sources, sources of arsenic in ground water, drinking water standard forarsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

#### **Environmental management**

Environmental ethics.

Conservation of topsoil, ground water and wild lives; rain water harvesting; sanctuary, national park, biosphere reserve, wildlife (conservation) Act, 1992.

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Determination of sound levels by sound level meter and noise index.

Determination of dissolve oxygen in the supplied water samples-supplied water, ground water extracted by shallow and deep tube wells, stream waters, pond water etc. Detection of food additives in different food samples.

Demonstration of kymographic recording of the effects of food additives on the movement of perfused heart of toad and intestinal movements of rat in Dale's bath.

Biochemical estimation of serum glucose, total proteins, SGPT and SGOT

### **Syllabus for Physiology Honours**

### **Choice Based Credit System**

### (CBCS)



### West Bengal State University

	Core	Ability Enhancement	Skill	Elective:	Elective for Hons:
	course	Compulsory Course	Enhancement Course (SEC)	Discipline	(GEC)
	(14)	(AECC) (2)	(2)	Specific (DSE) (4)	(4)
Ι	PHYACOR01	Environmental			PHYHGEC01
	PHYACOR02	Sciences			
II	PHYACOR03	(English /MIL)			PHYHGEC02
	PHYACOR04				
III	PHYACOR05		PHYSSEC01M		PHYHGEC03
	PHYACOR06				
	PHYACOR07				
IV	PHYACOR08		PHYSSEC02M		PHYHGEC04
	PHYACOR09				
	PHYACOR10				
V	PHYACOR11			PHYADSE01	
				PHYADSE02	
				PHYADSE03	
				(any two)	
171					
VI	PHYACOR13			PHYADSE04	
				PHYADSE06	
				(any two)	
	PHYACOR14				

#### Framework of CBCS in Physiology Honours (B.Sc., Hons. in Physiology)

#### **Courses of B.Sc. Honours Physiology under CBCS**

	1. Cellular Basis of Physiology
	2. Biological Physics and Enzymes
	3. Physiology of Nerve and Muscle Cells
	4. Chemistry of Biomolecules
	5. Circulating Body Fluids
	6. Circulation
Como Coursos	7. Functions of Nervous system
Core Courses	8. Energy Balance, Metabolism and Nutrition
	9. Gastrointestinal Function
	10. Respiration
	11. Special Senses
	12. Endocrinology
	13. Reproductive Function
	14. Formation and Excretion of Urine
Ability Enhancement Course	1. Environmental Science
(AEC) (Compulsory)	2. English/MIL Communication
	1. Nutrition, Metabolism & Gastrointestinal Functions
Generic Elective Course	
(HGEC)	Circulation, Respiration, Excretion
	2.
	Nervous system & Special senses
	3.
	Endocrinology & Reproduction
	<del>4.</del>

Skill Enhancement Course (SEC) (two)

**Discipline Specific Elective Course (ADSEC)** (Any Four)

- 1. Hematological Techniques
- 2. Diet Survey and formulation of Diet Chart
- 1. Biological Statistics
- 2. Microbiology and Immunology
- 3. Sports and Exercise Physiology
- 4. Human Nutrition and Dietetics
- 5. Genetics and Molecular Biology
- 6. Environmental Physiology

#### **Summary of the Syllabus**

#### Semester 1

Semester 1					
(A) Core Courses (COR)					
Theoretical (T)	Practical (P)				
PHYACOR01T. Cellular Basis of Physiology (4)	PHYACOR01P Cellular Basis of Physiology (2)				
	PHYACOR02P. Biological Physics and Enzymes				
PHYACOR02T. Biological Physics and Enzymes (4)	(2)				
(B) Ability Enhancement Courses (AEC)					
ENVSAEC01T Environmental Science (2)					
(C) Generic Elective Course for Hons (HGEC)					
From Related	Discipline				

- 1. Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days.
- 2. One Credit is equivalent to one (1) hour of teaching (lecture) or two hours of Practical work per week.
- Total credits in Semester I: [(4X2)]+(2X2)]+(2X1)+(4+2)=[8+4]+2+6=20 3. Numbers in parentheses indicate value of credit.

#### Semester II

(A) Core Courses (COR)	
Theoretical (T)	Practical (P)
PHYACOR03T. Physiology of Nerve and Muscle Cells (4) PHYACOR04T. Chemistry of Biomolecules (4)	PHYACOR03P. Physiology of Nerve and Muscle Cells(2) PHYACOR04P. Chemistry of Biomolecules (2)

#### (B) Ability Enhancement Courses (AEC)

**ENGSAEC02M** English/MIL Communication (1)

(C) Generic Elective Course for Hons (HGEC)

#### **From related discipline** Total credits: [(4X2)]+(2X2)]+(2X1)+(4+2)=[8+4]+2+6=20

#### **Semester III**

(A) Core Courses (COR)	
Theoretical (T)	Practical (P)
PHYACOR05T Circulating Body Fluids (4)	PHYACOR05P. Circulating Body Fluids (2)
PHYACOR06T. Circulation (4)	PHYACOR06P. Circulation (2)
	PHYACOR07P. Functions of Nervous System
PHYACOR07T. Functions of Nervous System (4)	(2)
(B) Skill Enhancement Courses (SEC)	
PHYSSEC01M Haematological techniques (1)	

#### (C) Generic Elective Course for Hons (HGEC)

From related	discipline
Total credits:[12+6]+2+(4+2) =26	
Semester IV	
(A) Core Courses (COR)	
Theoretical (T)	Practical (P)
PHYACOR08T. Energy Balance, Metabolism and	PHYACOR08P. Energy Balance, Metabolism
Nutrition	and
(4)	Nutrition (2)
PHYACOR09T. Gastrointestinal Function (4)	<b>PHYACOR09P</b> . Gastrointestinal Function (2)
PHYACOR10T. Respiration (4)	PHYACOR10P Respiration (2)
(B) Skill Enhancement Courses (SEC)	
PHYSSEC002Diet Survey (1)	
(C) Generic Elective Course for Hons (HGEC)	
From related	discipline
Total credits:[12+6]+2+(4+2) =26	
Somostor V	
(A) Core Courses (COP)	
(A) COLE COULSES (COK)	Dractical (D)
DHVACOD11T Special Senses (4)	Plactical (r)
<b>PHYACOD12T</b> Endogrinology (4)	<b>PHYACOP12P</b> Endocrinology (2)
FHIACORIZI. Endocrinology (4)	FHIACORIZE. Endocrinology (2)
(B) Discipline Specific Elective for Honours	
(ADSE) (any two)	
	Practical (P)
PHYADSEUTI. Biological Statistics (4)	PHYADSEUIP Biological Statistics (2)
PHYADSE021 Microbiology and immunology (4)	PHYADSE02P Microbiology and Immunology (2)
Total credits: $[8+4]+(6Y2) = 24$	PHTADSE0SP Sports and Exercise Physiology
10tar treuts.[0+4]+(0x2)-24	
Semester VI	
(A) Core Courses (COR)	
Theoretical (T)	Practical (P)
PHYACOR13T. Reproductive Function (4)	<b>PHYACOR13P</b> Reproductive Function (2)
	PHYACOR14P Formation and Excretion of
<b>PHYACOR14T</b> . Formation and Excretion of Urine (4)	Urine
	(2)
(B) Discipline Specific Elective for Honours (ADSE) (Any two)	
Theoretical (T)	Practical (P)
	PHYADSE04P Human Nutrition and Dietetics
PHYADSE04T Human Nutrition and Dietetics (4)	(2)
	PHYADSE05P Genetics and Molecular Biology
<b>PHYADSE05T</b> Genetics and Molecular Biology (4)	(2)
PHYADSE06TEnvironmental Physiology	PHYADSE06PEnvironmental Physiology (2)
Total credits:[8+4]+(6X2) =24	

Summary of the Syllabus

#### <u>Semester I</u>

Courses/	Theoretical (T)	Credits	Practical (P)	Credits	Total
Papers					Credits
Core	<b>PHYACOR01T</b> Cellular Basis of Physiology	4	<b>PHYACOR01P</b> Cellular Basis of Physiology	2	6
PHYACOR01T Cellular Basis of PhysiologyPHYACOR01T Cellular PhysiologyPHYACOR01T Cellular PhyCoursesPHYACOR02T PHYACOR02T Biological Physics and Enzymes4PHYA Biologi and 1AbilityENVSAEC01T Environmental Science2CourseEnvironmental Science 	<b>PHYACOR02P</b> . Biological Physics and Enzymes	2	6		
Ability Enhancemen t Course	ENVSAEC01T Environmental Science	2			2
Generic Elective	F	rom related o	liscipline		6
					20

#### Semester II

Courses/	Theoretical (T)	Credit	Practical (P)	Credit	Total
Papers		S		S	Credits
Core Courses	<b>PHYACOR03T</b> Physiology of Nerve and Muscle Cells	4	<b>PHYACOR03P</b> Physiology of Nerve and Muscle Cells	2	6
	<b>PHYACOR04T</b> Chemistry of Biomolecules	4	<b>PHYACOR04P</b> Chemistry of Biomolecules	2	6
Ability					
Enhancement Courses	ENGSAEC02M English/MIL Communication	2			2
<b>Generic Elective</b>	Fro	om related (	discipline		6
					20

#### Semester III

<b>Courses/Papers</b>	Theoretical (T)	Credits	Practical (P)	Credits	Total
					Credits
Core Courses	<b>PHYACOR05T</b> Circulating Body Fluids	4	<b>PHYACOR05P</b> Circulating Body Fluids	2	6
	<b>PHYACOR06T</b> Circulation	4	PHYACOR06PCircula tion	2	6

	<b>PHYACOR07T</b> Functions of Nervous System	4	PHYACOR07P Functions of Nervous System	2	6
Skill Enhancement Courses	<b>PHYSSEC01M</b> Haematological techniques		<b>PHYSSEC01M</b> Haematological techniques		2
Generic Elective		From related d	liscipline		6
					26

#### **Semester IV**

<b>Courses/Paper</b>	Theoretical (T)	Credi	Practical (P)	Credits	Total
S		ts			Credits
	<b>PHYACOR08T</b> Energy Balance, Metabolism and Nutrition	4	<b>PHYACOR08P</b> Energy Balance, Metabolism and Nutrition	2	6
Core Courses	<b>PHYACOR09T</b> Gastrointestinal Function	4	<b>PHYACOR09P</b> Gastrointestinal Function	2	6
	Theoretical (T)Credi tsPractical (P)CreditsPHYACOR08T Energy Balance, Metabolism and Nutrition4PHYACOR08P Energy Balance, Metabolism and Nutrition2PHYACOR09T Gastrointestinal Function4PHYACOR09P Gastrointestinal Function2PHYACOR10T Respiration4PHYACOR10P Respiration2PHYSSEC002M Diet SurveyPHYSSEC002M Diet SurveyPHYSSEC002M Diet SurveyPHYSSEC002M Diet Survey	6			
Skill Enhancement Courses	<b>PHYSSEC002M</b> Diet Survey		<b>PHYSSEC002M</b> Diet Survey		2
Generic Elective		From rela	ited discipline		6
					26

Semester V

<b>Courses/Papers</b>	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Coro Coursos	<b>PHYACOR11T</b> Special Senses	4	PHYACOR11P Special Senses	2	6
Core Courses	<b>PHYACOR12T</b> Endocrinology	4	<b>PHYACOR12P</b> Endocrinology	2	6
Discipline	<b>PHYADSE01T</b> Biological Statistics	4	<b>PHYADSE01P</b> Biological Statistics	2	6
Specific Electives (Any two)	<b>PHYADSE02T</b> Microbiol ogy and Immunology	4	<b>PHYADSE02P</b> Microbiol ogy and Immunology	2	6

<b>PHYADSE03T</b> Sports and Exercise Physiology	4	<b>PHYADSE03P</b> Sports and Exercise Physiology	2	6
				24

#### Semester VI

<b>Courses/Papers</b>	Theoretical (T)	Credit	Practical (P)	Credits	Total
		S			Credits
	<b>PHYACOR13T</b> Reproductive Function	4	<b>PHYACOR13P</b> Reproductive Function	2	6
Core Courses	<b>PHYACOR14T</b> Formation and Excretion of Urine	4	<b>PHYACOR14P</b> Formation and Excretion of Urine	2	6
Discipline	<b>PHYADSE04T</b> Human Nutrition and Dietetics	4	<b>PHYADSE04P</b> Human Nutrition and Dietetics	2	6
Specific Electives (Any two)	<b>PHYADSE05T</b> Genetics and Molecular Biology	4	<b>PHYADSE05P</b> Genetics and Molecular Biology	2	6
	<b>PHYADSE06T</b> Environmental Physiology	4	<b>PHYADSE06P</b> Environmental Physiology	2	6
					24

#### **Details of Courses :** Components of Core Courses

PHYACOR01T:	Cellular Basis of Physiology	4 Credits
Introduction,		
Body Fluid Compon	ents,	
Organ Systems, Tiss	sues, and Cells,	
Functional Morphol	ogy of Cell,	
Transport Across ce	ell Membranes,	
Cell Signaling		
Capillary Wall,		
Intercellular Comm	unication,	
Cell Cycle,		
Cell Division- Mitos	is,	
Meiosis		
Homeostasis,		
Aging.		

PHYACOR01P:	Cellular Basis of Physiology Lab	2 Credits

#### Histology:

Ribozymes, Abzymes,

Concept of Rate limiting enzymes.

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:

Bone, Cartilage, Trachea, Lungs, Spleen, Lymph gland, Esophagus, Stomach, Duodenum, Ileum, Jejunum, large Intestine, Liver, Kidney, Ureter, Salivary glands, Pancreas, Adrenal gland, Thyroid gland, Testes, Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Tongue, Uterus.

Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal mus Artery, Vein, Tongue, Uterus.	scle, Smooth muscle,
PHYACOR02T: Biological Physics and Enzymes	4 Credits
A study of units for Measuring Concentration of solutes: Moles, Equivalents, Ost dilution, pH, Buffers, Bonds and Forces in Biomolecules, Colloids: Properties, I tension, Specific Gravity, Viscosity and Resistance, Acids Bases Buffers and pH	moles; Principles of mportance, Surface
Flow and Pressure,	
Dialysis and Ultracentrifugation, Chromatography, Electrophoresis, Autoradiography	
Cell Fractionation and Tracer Techniques.	
Nanoparticles and its application in Physiology, Laminar and Streamline flow, Poiseuille-Hagen	
Formula,	
Laws of Laplace,	
Thermodynamics :	
Application in Physiology.	
Osmosis and Diffusion,	
Enzymes :	
Structure, coenzymes, Prosthetic Groups, Mechanism of enzyme action,	
Kinetics, Michaelis constant, Enzyme	
Inhibition,	
Modulation of Enzymes Activities,	
Isoenzymes, Allosteric enzymes,	
Pro- enzymes,	

#### PHYACOR02P: Biological Physics and Enzymes Lab

**Biological Physics and Enzymes :** 

Determination of oncotic pressure of colloidal solutions; Determination of Systolic, Diastolic, Pulse and Mean Blood Pressure by non-invasive methods (Auscultatory Methods). Determination of enzyme activities (e.g., SOD, CAT, Amylase, Transaminases etc.).

РНУАС	OR03T: Physiology of Nerve & Muscle Cells	4 Credits
1.	Excitable Tissue: Nerve	
	Introduction,	
	Nerve Cells,	
	Excitation & Conduction, Measurement	
	of Electrical Events, Ionic Basis of	
	Excitation & Conduction, Properties of	
	Mixed Nerves,	
	Nerve Fiber Types & Function,	
	Neurotrophins, Glia.	
2.	Excitable Tissue: Muscle	
	Introduction,	
	Skeletal Muscle	
	Morphology,	
	Electrical Phenomena & Ionic Fluxes,	
	Contractile Responses,	
	Energy Sources & Metabolism,	
	Properties of Muscle in the Intact Organism,	
	Morphology, Electrical	
	Properties, Mechanical	
	Properties, Metabolishi, Dacamakar Ticsua	
	Smooth Musclo	
	Mornhology	
	Visceral Smooth Muscle.	
	Multi-Unit Smooth Muscle.	
3.	Synaptic & Junctional Transmission	
	Introduction,	
	Synaptic Transmission: Functional	
	Anatomy, Electrical Events at	
	Synapses,	
	Inhibition & Facilitation at Synapses,	
	Chemical Transmission of Synaptic Activity,	
	Principal Neurotransmitter Systems,	
	Synaptic Plasticity & Learning,	
	Neuromuscular Transmission,	
	Neuromuscular Junction, Denervation Hypersensitivity.	
4.	Initiation of Impulses in Sense Organs	
	Introduction,	
	Sense Organs & Receptors,	
	I ne Senses,	
	Electrical & Ionic Events in Receptors, "Coding" of Sonsory Information	

#### 5. Clinical Aspect of Nerve and Muscle Physiology

PHYACOR03P:	Physiology of Nerves and Muscle Cells Lab	2 Credits		
Histological Study, Experiment of Nerve and Muscle:				
Isolation and Staining of nerve fibres with node(s) of Ranvier (AgNO <sub>3</sub> ) and muscle fibres				

Isolation and Staining of nerve fibres with node(s) of Ranvier (AgNO<sub>3</sub>) (H and E).

Preparation of sciatic nerve innervated gastrocnemius muscle of toad.

Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle.

Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli.

Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch.

Calculation of work done by the muscle.

Determination of nerve conduction velocity.

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Classification, structure, Properties and Functions of Carbohydrates, Proteins and lipids. Structure, types and Function of DNAs and RNAs.

PHYACOR04 P: Chemist	ry of Biomolecules Lab	2 Credits
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#### **Biological Chemistry:**

Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic Acid, Uric Acid, Glucose, Galactose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin, Urea, Glycerol, Bile salts.

PHYACOR05T: Circulating Body Fluids	4 Credits
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Introduction, Blood, Bone Marrow, White Blood Cells, Immune Mechanisms, Platelets, Red Blood Cells, Blood Types, Plasma, Hemostasis, Lymph, Clinical Implications. Hemoglobin.

PHYACOR05P:	<b>Circulating Body Fluids Lab</b>	2 Credits

Hematological Experiments: Preparation and staining of blood film with Leishman's stain. Identification of the blood corpuscles. Differential count of WBC. Total count of RBC and WBC. Bleeding time and clotting time. Hemoglobin estimation. Preparation of haemin crystal. Preparation and staining of bone marrow. Measurement of diameter of megakaryocyte. Reticulocyte staining. Blood group determination.

#### PHYACOR06T Circulation 4 Credits 1. Origin of the Heartbeat & the Electrical Activity of the heart Introduction. **Origin & Spread of Cardiac Excitation**, Electrocardiogram, Cardiac Arrhythmias. Electrocardiographic Findings in Other Cardiac & Systemic Diseases, hypertrophy and cardiac myopathy. 2. The Heart as a Pump Introduction, Mechanical Events of the Cardiac Cycle, Cardiac Output. 3. Dynamics of Blood & Lymph Flow Introduction, Anatomic Considerations, **Biophysical Considerations**, Arterial & Arteriolar Circulation, Capillary Circulation, Lymphatic Circulation & Interstitial Fluid Volume, Venous Circulation. 4. Cardiovascular regulatory Mechanisms Introduction. Local Regulatory Mechanisms, Substances Secreted by the Endothelium, Systemic Regulation by Hormones, Systemic Regulation by Nervous System.

#### 5. Circulation Through Special Regions

Introduction, Cerebral Circulation,
Anatomic Considerations, Cerebrospinal fluid,
The Blood-Brain barrier, Cerebral Blood Flow,
Regulation of Cerebral Circulation,
Brain Metabolism & Oxygen Requirements, Coronary Circulation,
Splanchnic Circulation,
Circulation of the skin, Placental & Fetal Circulation.
6. Cardiovascular Homeostasis in Health & Disease

Introduction, Compensation for Gravitational Effects, Exercise, Inflammation & Wound Healing, Shock, Hypertension, Heart Failure, stroke.

#### **PHYACOR06P: Circulation Lab**

#### **Cardiovascular Experiments:**

Preparation of Amphibian Ringer solution.

Kymographic recording of the movements of perfused heart of toad.

Study of the effects of changes in perfusion fluid pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine, adrenaline on the movement of heart.

PHYA	4 Credits	
1.	Reflexes	
	Introduction,	
	Monosynaptic Reflexes: The Stretch Reflex,	
	Polysynaptic Reflexes: The Withdrawal Reflex,	
	General Properties of Reflexes.	
2.	Cutaneous, Deep & Visceral Sensation	
	Introduction,	
	Pathways Touch,	
	Proprioception,	
	Temperature.	

2 Credits

Pain, Other Sensations. 3. Arousal Mechanisms, Sleep, & the Electrical Activity of the Brain Introduction, The Reticular Formation & the Reticular Activating System, The Thalamus & the Cerebral Cortex, Evoked Cortical Potentials, The Electroencephalogram, Physiological Basis of the EEG, Consciousness, & Sleep, Interpretation of abnormal EEG pattern. 4. Control of Posture & Movement Introduction, General Principles, Corticospinal & Corticobulbar System, Anatomy & Function, Posture and its regulation, Basal Ganglia, Cerebellum, Movement disorders. 5. The Autonomic Nervous System Introduction, Anatomic Organization of Autonomic Outflow, Chemical Transmission at autonomic Junctions, Responses of Effector Organs to Autonomic Nerve Impulses, Cholinergic and Adrenergic Discharge. 6. Central Regulation of Visceral Function Introduction, Medulla Oblongata, Hypothalamus, Anatomic Considerations, Hypothalamic Function, Relation to Autonomic Function, Relation to Sleep, Relation to Cyclic Phenomena, Hunger, Thirst, Control of Posterior Pituitary Secretion, Control of Anterior pituitary Secretion, Temperature Regulation, fever. 7. Neural Basis of Instinctual Behavior & Emotions Introduction. Anatomic Considerations, Limbic Functions, Sexual Behavior, Fear & Rage, Motivation, 8. Higher Functions of the Nervous System: Conditioned Reflexes , Learning, & Related Phenomena Introduction, Methods, Learning & Memory, Functions of the Neocortex, Disorders relating learning and memory. 9. Clinical Aspect of Nervous System

PHYACOR07P: Functions of the Nervous System Lab	2 Credits
Neurological Experiments:	

Experiments on superficial (plantar) and deep (knee jerk) reflex. Measurement of grip strength. Reaction time by stick drop test. Short term memory test (shape, picture word). Two point discrimination test.

PHYACOR08T: Energy Balance, Metabolism, and Nutrition	4 Credits

Introduction. Energy metabolism. Carbohydrate metabolism. Protein metabolism. Fat and cholesterol metabolism. Integration of carbohydrate, fat and protein metabolism. Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins, vitamins and minerals.

PHYACOR08P: Energy Balance, Metabolism, and Nutrition Lab	2 Credits
Biochemical Estimation:	

Quantitative estimation of glucose and sucrose by Benedict's method.

Quantitative estimation of amino nitrogen [Sorensen's formol titration method (percentage as well as total quantity to be done)].

Estimation of percentage quantity of lactose in milk by Benedict's method.

#### PHYACOR09T: Gastrointestinal Function

 Digestion & Absorption Introduction, Carbohydrates, Proteins & Nucleic Acids, Lipids,

> Absorption of Water & Electrolytes, Absorption of Vitamins & Minerals

#### 2. Regulation of Gastrointestinal Function Introduction, General Considerations.

Gastrointestinal hormones, Mouth & Esophagus, Stomach, Digestive Function of the Stomach. Exocrine Portion of the Pancreas, Liver & Biliary System, Small Intestine, Colon.

#### 3. Gastrointestinal Dysfunctions

PHYACOR09P: Gastrointestinal Function Lab	2 Credits
Dele's Even on the second se	

#### **Dale's Experiments** :

Kymographic recording of normal movements of rat's intestine in Dale's apparatus. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

PHYACOR10T: Respiration	4 Credits
1. Pulmonary Function	
Introduction, Properties of	
Gases, Anatomy of the	
Lungs, Mechanics of	
breathing,	
Gas Exchange in the lungs,	
Pulmonary Circulation,	

**4** Credits

Other Functions of the Respiratory System.

#### 2. Gas Transport Between the Lungs & the Tissues

Introduction, Oxygen Transport, Carbon Dioxide Transport, Respiratory acidosis and alkalosis.

# Regulation of Respiration Introduction, Neural control of Breathing, Chemical Control of Breathing, Nonchemical Influences on Respiration. Respiratory Adjustments in Health & Disease

Respiratory Adjustments in Health & Disea
 Introduction,
 Effects of Exercise,
 Other Forms of Hypoxia,
 Oxygen Treatment,
 Hypercapnia & Hypocapnia,
 Other Respiratory Abnormalities,
 Effects of Increased Barometric Pressure,
 Artificial Respiration.

#### **PHYACOR10P: Respiration Lab**

#### **Respiratory Human Experiments:**

Measurement of peak expiratory flow rate.

Measurement of oxygen saturation by pulse oxymeter before and after exercise.

Measurement of forced expiratory volume (FEV) in first second.

#### PHYACOR11T: Special Senses

#### 1. Vision

Introduction,
Anatomic Considerations,
The Image-Forming Mechanism (accommodation and visual acuity),
The Photoreceptor Mechanism: Genesis of Electrical Responses,
Visual Pathways and effects of lesions of these pathways,
Color Vision,
Other Aspects of Visual Function,
Eye Movements, Errors in visual process.

2. Hearing & Equilibrium

#### Introduction, Anatomic considerations, Hair cells, Mechanism of hearing, Vestibular function, Loss of hearing.

#### 3. Smell & Taste

Introduction, Smell, Receptors & Pathways, Physiology of Olfaction, Taste, Receptor Organs & Pathways, Physiology of Taste.

#### 4. Clinical Aspect of Special Senses

PHYACOR11P: Special Senses Lab

2 Credits

2 Credits

**4** Credits

#### Histological and Human Experiments:

Principles of fixation and staining, Staining and identification of fixed endocrine glands and nervous tissue. Determination of visual acuity by Snellen's chart / Landolt's C chart. Determination of colour blindness by Ishihara chart.

PHYA	ACOR12T: Endocrinology	4 Credits
1.	The Thyroid Gland	
	Introduction,	
	Anatomic Considerations,	
	Formation & Secretion of Thyroid Hormones,	
	Transport of Thyroid Hormones,	
	Effects of Thyroid Hormones,	
	Regulation of Thyroid Secretion,	
	Clinical Correlates.	
2.	Endocrine Functions of the Pancreas & the Regulation of Carbohydrate M	etabolism
	Introduction,	
	Islet Cell Structure,	
	Structure, Biosynthesis, & Secretion of Insulin,	
	Effects of Insulin,	
	Insulin Excess	
	Regulation of Insulin Secretion	
	Glucagon.	
	Other Islet Cell Hormones,	
	Hypoglycemia & Diabetes Mellitus in Humans.	
3.	The Adrenal Medulla & Adrenal Cortex	
	Introduction, Adrenal	
	Morphology, Adrenal	
	Medulla,	
	Structure & Function of Medullary Hormones,	
	Adrenal Cortex	
	Structure & Biosynthesis of Adrenocortical Hormones	
	Effects of Adrenal Androgens & Estrogens, Physiologic	
	Effects of Glucocorticoids,	
	Pharmacologic & Pathologic Effects of Glucocorticoids,	
	Regulation of Glucocorticoid Secretion,	
	Effects of Mineralocorticoids, Regulation	
	of Aldosterone Secretion,	
4	Hormonal Control of Calcium Metabolism & the Physiology of Bone	
т.	Introduction	
	Calcium & Phosphate Metabolism.	
	Bone Physiology,	
	Vitamin D & the Hydroxycholecalciferols,	
	The Parathyroid Glands,	
	Calcitonin,	
_	Effects of Other Hormones & Humoral Agents on Calcium Metabolism.	
5.	The Pituitary Gland	
	Introduction,	
	Morphology,	
	Posterior pituitary normones,	
	of Growth Pituitary	
	Insufficiency.	
	Pituitary Hyperfunction in Humans.	

- Endocrine Functions of the Kidneys, Heart, & Pineal Gland 6. Introduction, The Renin-Angiotensin System, Erythropoietin, The Endocrine Function of the Heart: Atrial Natriuretic Peptide, Pineal Gland. 7. Human chronobiology
  - Biological rhythms; basic concepts and implications.

#### PHVACOR12P: Endocrinology Lab

PHYACOR12P: Endocrinology Lab						
Endocrinological assay / Experiments related to experimental Physiology:						
Study of the effects of oxytocin on uterine contraction.						
Study of the effects of adrenaline on intestinal / uterine movements.						

#### **PHYACOR13T: Reproductive Function** 4 Credits Introduction, Sex Differentiation & Development, Chromosomal Sex, Embryology of the Human Reproductive System, Aberrant Sexual Differentiation, Puberty, Precocious & Delayed Puberty, Menopause, Pituitary Gonadotropins & Prolactin, The male reproductive System: Structure, Gametogenesis & Ejaculation, Endocrine Function of the Testes, Control of Testicular Function,

Abnormalities of Testicular Function, The Female Reproductive system: The Menstrual Cycle, Ovarian Hormones, Control of Ovarian Function, Abnormalities of Ovarian Function, Pregnancy, Placenta Breast development and Lactation, Physiological concepts for a planned family.

PHYACOR13P: Reproductive Function Lab	2 Credits
Reproductive Histology and Biochemistry	

#### Reproductive Histology and Biochemistry: Study of estrous cycle. Staining and identification of kidney and ureters. Estimation of estrogen by spectrophotometric method. Pregnancy test from human urine by kit method.

PHYA	PHYACOR14T: Formation and Excretion of Urine 4 Credits								
1.	Renal Function & Micturition								
	Introduction,								
	Juxta Glomerular Apparatus								
	Function of Malpighian corpuscles and renal tubule, counter-current mecha Water Excretion,	anism,							
	Acidification of the Urine & Bicarbonate Excretion,								
	Regulation of Na <sup>+</sup> & Cl <sup>-</sup> Excretion, Renal Circulation,								
	Diuretics,								
	Disorders of Renal Functions,								

Filling of the Bladder, Emptying of the Bladder, Non-excretory function of kidney.

#### PHYACOR14P: Formation and Excretion of Urine Lab

#### **Renal Biochemistry:**

Identification of normal and abnormal constituents of urine

#### **Ability Enhancement Course (AEC)(Compulsory)**

- **1.** Environmental science
- **2.** English/MIL communication

#### **ENVSAEC01T: Environmental Science**

#### **ENGSAEC01M: English/MIL Communication**

#### **Discipline Specific Electives (DSE)(Four)**

- 1. Biological Statistics
- 2. Microbiology and Immunology
- 3. Sports and Exercise Physiology
- 4. Human Nutrition and Dietetics
- 5. Genetics and Molecular Biology
- 6. Environmental Physiology

#### PHYADSE01T : Biological Statistics

Scope of statistics – Principles of statistical analysis of biological data. Basic concepts – variable, parameter, statistics. Sampling.

Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram.

Parameters.

Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of mean.

Standard score.

Degrees of freedom.

Probability. Normal

distribution.

Student's t-distribution.

Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, Students' 't' test and z score for significance of difference. Distribution-free test - Chi-square test.

PHYADSE01P: Biological Statistics Lab	2 Credits

Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects.

Graphical representation of data in frequency polygon and histogram. Student's 't' test for significance of difference between means.

Demonstration: Statistical analysis and graphical representation of biological data with computer using One way ANOVA etc.

PHYADSE02T: Microbiology and Immunology						4 Credits								
_		-											-	

Bacteria - structure & morphological classification.

2 Credits

4 Credits

Gram positive, gram negative, pathogenic & nonpathogenic bacteria. Sterilization, pasteurization, brief idea about antibiotics.

Bacterial growth curve.

Elementary idea of bacteriostatic and bacteriocidal agents.

Bacterial genetics.

Viruses - Structure and types, Lytic and lysogenic cycle.

Prions – basic ideas and prion diseases.

Overview of immune system.

Idea about innate and acquired immunity.

Immuno-competent cells.

Humoral and cell mediated immunity.

Antigen-antibody interaction.

Immunoglobulin - classification, basic structure and function.

Antigen presentation.

Major Histocompatibility Complex (MHC).

Cytokines. Hypersensitivity Complement

system.

Vaccination - principles and importance of immunization.

Basic principles of immunological detection of pregnancy.

Immunization program - immunization against Polio, Hepatitis-B, Tetanus, Measles,

Whooping cough, Tuberculosis, Rabies through vaccine, AIDS- causative virus, mode of transmission,

effects on human body, preventive measures, and principles of diagnostic test for AIDS (ELISA).

Immunopathology - basic principles of autoimmune disease and transplantation immunology.

<b>ΡΗΛΛΟΣΕ</b> Ο2 <b>Ρ</b> ·	Microbiology	and Imm	unology I ah	
FHIADSEUZF:	MICI UDIOIOgy	anu mm	lunology Lab	

Gram staining of bacteria and identification of Gram positive and Gram negative bacteria Demonstration: Spore Staining, Radial immuno-diffusion.

PHYADSE03T: Sports and	Exercise Physiology

Importance of regular exercise in health and wellbeing.

Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system).

Cardio-respiratory responses during different grades of exercise.

Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery. Aerobic work Capacity: Measurement, physiological factors and applications.

Training: Principles of physical training, Training to improve aerobic and anaerobic power. Effect of overtraining and detraining.

Nutritional supplements and ergogenic aids.

Sports injury and its' management.

Basic idea sports rehabilitation and sports medicine.

PHYADSE03P: Sports and Exercise Physiology Lab	2 Credits

Measurement of blood pressure before and after different grades of exercise.

Recording of recovery heart-rate after standard exercise.

Determination of Physical Fitness Index by Harvard Step Test (Modified).

Determination of  $VO_{2max}$  by queen college step test.

Measurement of body fat percentage. Six

minute walk test.

Determination of endurance time by hand grip dynamometer.

Pneumographic recording of effect of talking, laughing, coughing, breath holding and hyperventilation.

PHYADSE04T: Human nutrition and dietetics	4 Credits
Constituents of food and their significance.	
Basal metabolic rate -factors, determination by Benedict-Roth apparatus. Respirator	y quotient
Specific dynamic action.	
Basic concept of energy and units. Calorific value of foods. Body calorie requirements – adult consumption unit.	
Dietary requirements of carbohydrate, protein, lipid and other nutrients. Balanced formulation of balanced diets for growing child, adult man and woman, pregnan woman. Nitrogen balance, essential amino acids, biological value of proteins. So protein. Protein efficiency ratio and net protein utilization of dietary proteins.	l diet and principles of t woman and lactating upplementary value of
Dietary fibres.	
Vitamins.	
Principle of diet survey.	
Composition and nutritional value of common food stuffs.	
Physiology of starvation and obesity. Sources and physiological significances of vita	nins and minerals

Physiology of starvation and obesity. Sources and physiological significances of vitamins and minerals. Space nutrition.

PHYADSE04P: Human nutrition and dietetics Lab	2 Credits
Nutrition and Dietetics - Diet Survey (Field Study Record):	

a) Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report.

b) A report (hand-written) on the basis of field survey from ONE of the followings: (1) Physiological parameters of human (at least three parameters). (2) Anthropometric measurements on human (at

2 Credits

4 Credits

la

least three parameters). (3) Epidemiological studies on human.

PHYADSE05T: Genetics and Molecular Biology	4 Credits

#### Genetics:

Basic principles of Mendelian genetics - monohybrid and dihybrid, test and back crosses, Bacterial genetics-transformation, transduction, conjugation (mention of F+ /F-, Hfr strain, function of pillus). Extension of Mendelism - Epistasis and its different types present in plants and animals.

Penetrance, expressivity, pleiotropism.

Crossing over and Gene mapping.

Numerical and Structural variations in chromosome - basic concepts of aneuploids and polyploids. Human Cytogenetics - human karyotype, banding technique, use of human cytogenetics in medical science, inborn errors of metabolism, aneuploidy in humans.

Sex determination and sex linkage.

Molecular Biology:

Genes - definition.

DNA- structure, DNA replication, transcription of RNA in prokaryotes, Genetic code– properties and wobble hypothesis, translation in prokaryotes, regulation of gene expression – operon concept: lac operon, gene mutation, DNA repairing processes.

Basic idea of Recombinant DNA technology and its applications, Polymerase chain reaction (PCR) - basic concepts.

PHYADSE05P: Genetics and Molecular Biology Lab	2 Credits			
DNA gel electrophoresis (agarose gel).				
Paper chromatography and Thin Layer Chromatography				
PHYADSE06T · Environmental Physiology	4 Credits			

#### **Environmental Pollutions and Health Hazards**

Definition: hygiene, health and public health.

Air, Water, Food Borne Diseases: causes, symptoms and control.

Food Additives and Adulterants: definition, examples and human health hazards.

Vector Borne Epidemic Diseases: Malaria and Plague-etiology and control.

**Air Pollution:** definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

**Water Pollution:** definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

**Soil Pollution**: causes, health hazards, solid waste management, bioremediation, phytoremediation.

**Sound Pollution:** definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).

**Radionuclide Pollution:** ionizing radiations, effects of ionizing radiation on human health, permissible doses.

**Arsenic Pollution:** sources, sources of arsenic in ground water, drinking water standard forarsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

#### **Environmental management**

Environmental ethics.

Conservation of topsoil, ground water and wild lives; rain water harvesting; sanctuary, national park, biosphere reserve, wildlife (conservation) Act, 1992.

PHYADSE06P: Environmental Physiology Lab	2 Credits

Determination of sound levels by sound level meter and noise index.

Determination of dissolve oxygen in the supplied water samples-supplied water, ground water extracted by shallow and deep tube wells, stream waters, pond water etc. Detection of food additives in different food samples.

Demonstration of kymographic recording of the effects of food additives on the movement of perfused heart of toad and intestinal movements of rat in Dale's bath.

Biochemical estimation of serum glucose, total proteins, SGPT and SGOT

#### **Recommended Text and Reference Books for Physiology (Honours)**

- Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.
- Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Pretices- Hall International. Mc Graw Hill.
- Harper's illustrated Biochemistry, by R.K. Murray and others. Lange Medical Book, International edition, Mc Graw Hill.
- Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.
- Lehninger's Principles of Biochemistry, by D.L. Nelson and M.M. Cox, Worth Publishers Inc.
- Text book of Biochemistry, by E.S. West; W.R.Todd; H.S. Mason; J.T Van Bruggen. The Macmillan Company.
- Biochemistry, by D Das. Academic Publishers.
- Biophysics and Biophysical Chemistry, by D.Das. Academic Publishers.
- Physiology, by R.M. Berne and M.N. Levy, C.V Mosby Co.
- Essential Immunology, by I.M. Roitt, Blackwell Scientific Publications.
- Cellular and Molecular Biology, by E.D.P. De Robertis and E.M.F. De Robertis; Lea and Febiger.
- Molecular Biology of gene, by J.D. Watson; H.N. Nancy and other; Benjamin-Cummings.
- Human Physiology, by Rhoades and Pflanger, Saunder College Publishing.
- Neurobiology, by G.M.Shepherd. Oxford University Press.
- Biochemistry, by L. Stryer, W.H. Freeman and Co.
- The Physiological Basis of Physical Education and Athletics, by W.D. McArdle, F. Katch and V.L Katch. Williams and Wilkins.
- The Text Book of Environmental Physiology, by C. Edger Folk Jr. Lea and Febiger.
- The Text Book of Work Physiology by P.O. Astrand and K. Rodhal. McGraw-Hill Books Co.
- Human factors in Engineering and Design, by E.O. McCormick and M. Sanders. Tata McGraw Hill.
- Sports Physiology, by E.L. Fox, Saunders College Publishing Holt-Saunders.
- The Physiology of Reproduction, Volumes I and II, by, E. knobil and J.D. Neil. Raven Press.
- Practice Biochemistry in Medicine, by Srinivas Rao, Academic Publishers.
- Ross and Wilson Anatomy and Physiology in Health and Illness, by A. Waugh and A. Grant. International Edition, Churchill Livigstone Elesvier.
- Human Physiology, by Stuart Ira Fox, McGraw Hill International edition.



### West Bengal State University

### CBCS curricula and syllabi for UG 2018

## Zoology Honours (Credit values given within brackets)

SEM	COURSES				Total	
SENI	CORE	DSE	GEC	AEC	SEC	credits
I	ZOOACOR01T (4) ZOOACOR01P (2) ZOOACOR02T (4) ZOOACOR02P (2)	-	CEMHGEC01T (4) CEMHGEC01P (2) <b>OR</b> GE course offered by any other science department	ENVSAECO1T (2)		20
п	ZOOACOR03T (4) ZOOACOR03P (2) ZOOACOR04T (4) ZOOACOR04P (2)		CEMHGEC02T (4) CEMHGEC02P (2) <b>OR</b> Any other GEC course offered by any other science department	ENGSAEC01T (2)		20
III	ZOOACOR05T (4) ZOOACOR05P (2) ZOOACOR06T (4) ZOOACOR06P (2) ZOOACOR07T (4) ZOOACOR07P (2)		BOTHGEC01T (4) BOTHGEC01P (2) OR Any other GEC course offered by any other science department		ZOOSSEC001 (2) OR ANY SEC offered by any other dept.	26
IV	ZOOACOR08T (4) ZOOACOR08P (2) ZOOACOR09T (4) ZOOACOR09P (2) ZOOACOR10T (4) ZOOACOR10P (2)		BOTHGEC02T (4) BOTHGEC02P (2) OR Any other GEC course offered by any other science department		ZOOSSEC003 (2) OR ANY SEC offered by any other dept.	26
V	ZOOACOR11T (4) ZOOACOR11P (2) ZOOACOR12T (4) ZOOACOR12P (2)	ZOOADSE01T (4) ZOOADSE01P (2) ZOOADSE02T (4) ZOOADSE02P (2) ZOOADSE03T (4) ZOOADSE03P (2) (ANY TWO TO BE CREDITED)				24

VI	ZOOACOR13T (4) ZOOACOR13P (2) ZOOACOR14T (4) ZOOACOR14P (2)	ZOOADSE04T (4) ZOOADSE04P (2) ZOOADSE05T (4) ZOOADSE05P (2) ZOOADSE06T (4) ZOOADSE06P (2) (ANY TWO TO BE CREDITED)				24
	14	4	4	2	2	140

#### **COURSE DETAILS :**

#### Semester I

**Cores** 

#### **ZOOACOR01T** (Theory, 4 credits= 60 classes): Non-Chordates I

Unit 1: Protista, Parazoa and Metazoa classes

General characteristics and Classification up to classes

Study of Euglena, Amoeba and Paramoecium

Life cycle and pathogenicity of *Giardia intestinalis*, *Leishmania donovani*, *Entamoeba histolytica* and *Plasmodium vivax* 

Locomotion and Reproduction in Protista

Evolution of symmetry and segmentation of Metazoa

#### Unit 2: Porifera

General characteristics and Classification up to classes

Canal system and spicules in sponges

#### Unit 3: Cnidaria

General characteristics and Classification up to classes

Metagenesis in Obelia

Polymorphism in Cnidaria

Corals and coral reefs: types, formation, distribution, conservation significance

#### Unit 4: Ctenophora

General characteristics

19 classes

7 classes

12 classes

4 Classes

#### **Unit 5: Platyhelminthes**

10 Classes

8 Classes

General characteristics and Classification up to classes

Life cycle and pathogenicity of Fasciola hepatica and Taenia solium

#### **Unit 6: Nemathelminthes**

General characteristics and Classification up to classes

Life cycle, and pathogenicity of Ascaris lumbricoides, Ancylostoma duodenale and Wuchereria bancrofti

Parasitic adaptations in helminths

Origin and evolution of parasitic helminths

#### **ZOOACOR01P** (Practicals, 2 credits = 60 classes): Non-Chordates I Lab

1. Study of whole mount of Euglena, Amoeba and Paramoecium, Binary fission and Conjugation in Paramoecium

2. Examination of freshwater pond water collected from different places for diversity of protists in it.

3. Study of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla

4. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora

5. One specimen/slide of any Ctenophore

6. Study of adult Fasciola hepatica, Taenia solium and their life cycles (Slides/microphotographs)

7. Study of adult Ascaris lumbricoides and its life stages (Slides/micro-photographs)

8. To submit a Project Report on any related topic on pond water protozoan or invertebrate diversity/ life cycles of mosquitoes, butterfly/moth etc /coral and coral reefs.

#### Note:

- 1. Only conspicuous characters required to identify the organism to be noted along with the known systematic positions of it (for Protozoans up to Phylum and others up to Class)
- 2. It is wise to study the coloured photographs of the organisms suggested for the study as available from internet sources along with the preserved specimens, if are there, or otherwise.

#### **Text Book:**

- Biology of the Invertebrates by Jan A Pechenik
- Invertebrates by Brusca and Brusca 2<sup>nd</sup> Ed

#### **Referrences:**

- An introduction to Invertebrates by Janet Moore 2<sup>nd</sup> ed.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Bose, Mala. Parasitoses and Zoonoses, New Central Book Agency, 2017.
- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.

# Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites, OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books)

#### **ZOOACOR02T** (Theory, 4 credits= 60 classes): Ecology

#### **Unit 1: Introduction to Ecology**

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.

#### Unit 2: Population

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Unitary and Modular populations

Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion.

Geometric, exponential and logistic growth, equation and patterns, r and K strategies Population regulation - densitydependent and independent factors

Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.

#### Unit 3: Community

Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect. Ecological succession and example of it.

#### Unit 4: Ecosystem

Types of ecosystem with an example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with an example of Nitrogen cycle Human modified ecosystem

#### **Unit 5: Applied Ecology**

Wildlife Conservation (in-situ and ex-situ conservation).

Management strategies for tiger conservation; Wild life protection act (1972)

#### **ZOOACOR02P** (Practicals, 2 credits = 60 classes): Ecology Lab

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided

2. Determination of population density of a natural/hypothetical population. Study of species diversity of a community by quadrat or any other suitable sampling method and calculation of Shannon-Weiner diversity index for the same community.

3. Study of an aquatic ecosystem: Sampling of Phytoplankton and zooplankton, Measurements of temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO2.

4. Excursion: Visit to a National Park/Wild life sanctuary/ any other Protected Forests <u>within West Bengal</u>. Report (including the actual field diary) on the study of the landscape and habitat features, Types of Forests, Major Flora and Fauna, Man-animal conflicts and other problems, Management and conservation measures.

#### 4 classes

20 classes

#### 11 classes

#### 10 classes

#### 5 classes

#### Text book:

- 1. Ecology: Theories and Applications by Peter Stiling; Pearson 4<sup>th</sup> Ed. 2001.
- 2. Ecology: The Experimental Analysis of Distribution and Abundance (Indian Paperback edition) by Charles Krebs
- 3. for Unit 5, also read Conservation Biology: A Primer for South Asia by Kamaljit S. Bawa, Meera Anna Oommen, and Richard B. Primack, University Press, India)

#### **Referrences**:

• A Primer of Ecology by Gotelli; 3<sup>rd</sup> Ed. Sinauer Associates. 2000.

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• <u>Students are encouraged to explore authentic websites (for e.g. different university websites and OCWs) at internet, wikipedia for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)</u>

Semester II

#### ZOOACOR03T (Theory, 4 credits= 60 classes): Non-Chordates II

#### **Unit 1: Introduction to Coelomates**

Evolution of coelom and metamerism

#### Unit 2: Annelida

General characteristics and Classification up to classes Excretion in Annelida

#### Unit 3: Arthropoda

General characteristics and Classification up to classes Vision and Respiration in Arthropoda Metamorphosis in Insects Social life in bees and termites

#### Unit 4: Onychophora

General characteristics and Evolutionary significance

#### Unit 5: Mollusca

General characteristics and Classification up to classes Respiration in Mollusca Torsion and detorsion in Gastropoda Pearl formation in bivalves Evolutionary significance of trochophore larva

#### Unit 6: Echinodermata

General characteristics and Classification up to classes Water-vascular system in Asteroidea Larval forms in Echinodermata Affinities with Chordates

#### Unit 7: Hemichordata

General characteristics of phylum Hemichordata. Phylogenetic relationship with non-chordates and chordates (only recent concept)\*

#### **ZOOACOR03P** (Practicals, 2 credits = 60 classes): Non-Chordates II Lab

1. Study of following specimens:

Annelids - Aphrodita, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria Arthropods - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta, termites and honey bees Onychophora - Peripatus

Molluscs - Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus Echinodermates - Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon Hemichordates- Saccoglossus

2. Digestive system, septal nephridia and pharyngeal nephridia of earthworm 3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm

4. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta

5. To submit a Project Report (mostly literature review) on any related topic to larval forms (crustacean, mollusc and echinoderm)

#### Note:

1. Only conspicuous characters required to identify the organism to be noted. Along with it, the systematic positions of the organism are to be mentioned (up to Class).

2. It is wise to study the coloured photographs of the whole organisms or its parts suggested for the study as available from internet sources along with the preserved specimens, if are there, and otherwise. Dissections of animals other than common pests are discouraged.

#### **Text Book:**

- Biology of the Invertebrates by Jan A Pechenik, Mcgrew-Hill, 2014 Or
- Invertebrates by Brusca and Brusca 2<sup>nd</sup> Ed, Sinauer Associates

#### **Referrence:**

- An introduction to Invertebrates by Janet Moore 2<sup>nd</sup> ed.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Chaudhury, S. (2017). Economic Zoology. New Central Book Agency
- <u>https://www.nature.com/articles/nature16150</u>) for hemichordate phylogenetic relationship\*
- <u>Students are encouraged to explore authentic websites (for e.g. wikipedia, different university</u> websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

#### ZOOACOR04T (Theory, 4 credits= 60 classes): Cell Biology

#### Unit 1: Overview of Cells

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

#### Unit 2: Plasma Membrane

Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions Extracellular Matrix-Cell Interactions

#### Unit 3: Endomembrane System

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

#### **Unit 4: Mitochondria and Peroxisomes**

Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes

#### Unit 5: Cytoskeleton

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

#### Unit 6: Nucleus

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)

#### **Unit 7: Cell Division**

Mitosis and Meiosis Cell cycle and its regulation Cancer (Concept of oncogenes and tumor suppressor genes) Mechanisms of cell death: brief overview

#### **Unit 8: Cell Signaling**

Cell signalling transduction pathways; Types of signaling molecules and receptors GPCR and Role of second messenger (cAMP)

#### **ZOOACOR04P** (Practicals, 2 credits = 60 classes): Cell Biology Lab

- 1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
- 2. Study of various stages of meiosis (in pre-prepared slides and/or in photographs obtained from websites).
- 3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
- 4. Preparation of permanent slide to demonstrate:
  - a. DNA by Feulgen reaction
  - b. Mucopolysaccharides by PAS reaction
  - c. Proteins by Mercurobromophenol blue/Fast Green
- 5. Cell viability study by Trypan Blue staining

#### **Text Book:**

- Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017
- 2. Cell Biology by Gerald Karp; Wiley, 7th Ed. 2013
  - Or

Essentials of Cell Biology by Bruce Albert et al.; W.W. Norton Co., 4th Ed, 2013

Or

Molecular Cell Biology by Hurvey Lodish et al.; W. H. Freeman, 6th Ed.2013

#### **Reference**:

• <u>Students are encouraged to explore authentic websites (for e.g. wikipedia, different university</u> websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

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#### Semester III

#### **ZOOACOR05T** (Theory, 4 credits= 60 classes): Chordates

#### **Unit 1: Introduction to Chordates**

General characteristics and outline classification of Phylum Chordata

#### **Unit 2: Protochordata**

General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. Metamorphosis in Ascidia Chordate Features and Feeding in Branchiostoma

#### **Unit 3: Origin of Chordata**

Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata

#### Unit 4: Agnatha

General characteristics and classification of cyclostomes up to order

#### **Unit 5: Pisces**

General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses Accessory respiratory organ, migration and parental care in fishes Swim bladder in fishes. Classification up to Sub-Classes

#### Unit 6: Amphibia

General characteristics and classification up to living Orders Metamorphosis and parental care in Amphibia

#### Unit 7: Reptilia

General characteristics and classification up to living Orders Poison apparatus and Biting mechanism in Snake

#### Unit 8: Aves

General characteristics and classification up to Sub-Classes Exoskeleton and migration in Birds Principles and aerodynamics of flight

#### **Unit 9: Mammals**

General characters and classification up to living orders Phylogenetic significance of Prototheria Exoskeleton derivatives of mammals Adaptive radiation in mammals with reference to locomotory appendages Echolocation in Microchiropterans and Cetaceans

#### Unit 10: Zoogeography

Zoogeographical realms, Plate tectonic and Continental drift theory, Distribution of birds and mammals in different realms

**Note:** Classification schemes are to be followed as given in Kardong, 2004. All groups are to be studied up to order, except for Mammals up to class.

#### **ZOOACOR05P** (Practicals, 2 credits= 30 classes): Chordates Lab

Lab/field study of -

- 1. Protochordata
  - Herdmania, Branchiostoma,

Colonial Urochordates; Sections of Balanoglossus through proboscis and branchiogenital regions, Sections of Amphioxus through pharyngeal, intestinal and caudal regions, *Herdmania* spicules

- 2. Agnatha
  - Petromyzon, Myxine

#### 3. Fishes

Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetraodon, Anabas, Flat fish

#### 4. Amphibia

Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra

#### 5. Reptilia

Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus Key for Identification of poisonous and non-poisonous snakes

#### 6. Aves

Study of six common birds from different orders (Stork, Owl/Falcon, Sun Bird, Jacanna, Duck)- types of beaks and claws.

#### 7. Mammalia

Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous.

**8.** Mount of weberian ossicles of Mystus or Grass Carp, Pecten from Fowl head, Dissection of Fowl head (Dissections and mounts subject to permission)

Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

#### Note:

- 1. Only conspicuous characters required to identify the animal are to be noted. Along with it, the systematic positions of the animal mentioned (up to Class) and a short note on its habits and habitat are to be noted.
- 2. It is wise to study the coloured photographs of the whole animal and/or its parts mentioned above for the study, as available from internet sources along with the preserved specimens (if, they are already in the museum). New collection/purchase of animals or their body parts, especially for those which are protected by conservation laws are to be avoided. Dissections of animals other than common pests are discouraged.

#### **Text Book:**

- Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. McGraw Hill 4<sup>th</sup> Ed. 2005.
- Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

#### **References:**

- <u>Students are encouraged to explore authentic websites (for e.g. wikipedia, different university</u> websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)
- Comparative Anatomy of the Vertebrates 9<sup>th</sup> Ed (2015) by Kent; McGrew-Hill
- Elements of Chordate Anatomy by Weichert and Presch, 2017, Amazon.in

#### **ZOOACOR06T** (Theory, 4 credits= 60 classes): Physiology: Controlling and Coordinating Systems

#### Unit 1: Tissues

Structure, locations, classification and functions of epithelial tissues, connective tissues, muscular tissues and nerve tissues

#### Unit 2: Bone and Cartilage

Structure and types of bones and cartilages, Ossification

#### Unit 3: Nervous System

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types

#### Unit 4: Muscular system

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fiber

#### **Unit 5: Reproductive System**

Histology of testis and ovary; Physiology of Reproduction

#### **Unit 6: Endocrine System**

Histology and function of pituitary, thyroid, pancreas and adrenal; Classification of hormones; Mechanism of Hormone action; Signal transduction pathways for Steroidal and Non steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones

### **ZOOACOR06P** (Practicals, 2 credits= 30 classes): Physiology: Controlling and Coordinating Systems) Lab

- 1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
- 2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibers and nerve cells
- **3.** Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid
- **4.** Microtomy: Preparation of permanent slide of any five (lung, salivary gland, stomach, small intestine, large intestine only) mammalian (white rat) tissues

#### **Text Book:**

- Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017.
- 2. Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. 6th Edn. Jaypee.

#### 4 classes

6

#### 16

4

10

10

Or

Ganong's Review of Medical Physiology by Barret; 25th Ed, McGrew-Hill, 2016

#### **Reference Books**

- 1. Cormack DH. 2003. PDQ Histology. B.C. Decker Ins., London.
- 2. Gunasegaran JP. 2010. A Text book of Histology and a Practical Guide. Elsevier
- 3. Junqueria LC, Carneiro J. 2005. Basic histology text and atlas.
- 4. Randall D, Burggren W. 2001. Eckert Animal Physiology by. 4th edition. W. H. Freeman.
- 5. Ross MH, Pawlina W. 2010. Histology: A Text and Atlas. Sixth Edition. Lippincott Williams & Wilkins.
- 6. Eroschenko VP. 2008. diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott & Wilkins.

#### **ZOOACOR07T** (Theory, 4 credits= 60 classes): Biochemistry

#### Unit 1: Fundamentals of biochemical reactions and metabolism

Ionization of water, weak acids and bases, buffering and pH changes in living systems Metabolism: Catabolism and Anabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms

#### **Unit 2: Carbohydrates**

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosachharides

Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis

#### **Unit 3: Lipids**

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpinoids. Lipid metabolism: β-oxidation of fatty acids; Fatty acid biosynthesis

#### **Unit 4: Proteins**

Amino acids Structure, Classification, General and Electro chemical properties of α-amino acids; Physiological importance of essential and non-essential amino acids Proteins Bonds stabilizing protein structure; Levels of organization Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids

#### **Unit 5: Nucleic Acids**

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Types of DNA and RNA, Complementarity of DNA, Hypo- Hyperchromaticity of DNA Outlines of nucleotide metabolism

#### Unit 6: Enzymes

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Strategy of enzyme action- Catalytic and Regulatory (Basic concept with one example each)

#### **Unit 7: Oxidative Phosphorylation**

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

#### **ZOOACOR07P** (Practicals, 2 credits= 30 classes): Biochemistry Lab

- 1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
- 2. Paper chromatography of amino acids.
- 3. Quantitative estimation by Lowry Method
- 4. Demonstration of proteins separation by SDS-PAGE.
- 5. Study of the enzymatic activity of Trypsin and Lipase.
- 6. Performing the Acid and Alkaline phosphatase assay from serum/ tissue.

#### **Text Book**

- 1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017.
- 2. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.

#### **Referrences**:

- 1. Principles of Biochemistry by Voet, Pratt and Voet; Wiley International Student Ed. 2012
- 2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
- 4. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

#### Semester IV

#### **ZOOACOR08T** (Theory, 4 credits= 60 classes): Comparative Anatomy

Unit 1: Integumentary System	6 Classes
Structure, function and derivatives of integument in amphibian, birds and mammals	
Unit 2: Skeletal System	6
Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.	
Unit 3: Digestive System	8
Comparative anatomy of stomach; dentition in mammals	

Unit 4: Respiratory System	6
Respiratory organs in fish, amphibian, birds and mammals	
Unit 5: Circulatory System	8
General plan of circulation, Comparative account of heart and aortic arches	
Unit 6: Urinogenital System	6
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	
Unit 7: Nervous System	6
Comparative account of brain, Cranial nerves in mammals	
Unit 8: Sense Organs	4
Classification of receptors, Brief account of auditory receptors in vertebrate	

#### **ZOOACOR08P** (Practicals, 2 credits= 30 classes): Comparative Anatomy Lab

- 1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
- 2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig
- 3. Demonstration of Carapace and plastron of turtle
- 4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal
- 5. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system

#### **Text Book:**

- 1. Comparative Anatomy of the Vertebrates 9th Ed (2015) by Kent; McGrew-Hill
- 2. Elements of Chordate Anatomy by Weichert and Presch, 2017, Amazon.in

#### **References:**

- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons
- Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. McGraw Hill 4<sup>th</sup> Ed. 2005.

#### **ZOOACOR09T** (Theory, 4 credits= 60 classes): Physiology: Life Sustaining system

#### **Unit 1: Physiology of Digestion**

Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids; Digestive enzymes

#### **Unit 2: Physiology of Respiration**

Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments; Carbon monoxide poisoning

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Components of Blood and their functions; Structure and functions of haemoglobin; Haemostasis; Blood clotting system, Fibrinolytic system; Haemopoiesis: Basic steps and its regulation; Blood groups; ABO and Rh factor

#### **Unit 4: Physiology of Heart**

Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibers, Origin and conduction of cardiac impulses; Cardiac Cycle and cardiac output; Blood pressure and its regulation

#### **Unit 5: Thermoregulation & Osmoregulation**

Physiological classification based on thermal biology. Thermal biology of endotherms; Osmoregulation in aquatic vertebrates; Extra-renal osmo-regulatory organs in vertebrates

#### **Unit 6: Renal Physiology**

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Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

# **ZOOACOR09P** (Practicals, 2 credits= 30 classes): Animal Physiology: Life Sustaining system Lab

#### **List of Practicals**

- 1. Determination of ABO Blood group
- 2. Enumeration of red blood cells and white blood cells using haemocytometer
- 3. Estimation of haemoglobin using Sahli's haemoglobinometer
- 4. Preparation of haemin and haemochromogen crystals
- 5. Recording of blood pressure using a sphygmomanometer/digital meter

#### **Text Book:**

- Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017.
- 2. Ganong's Review of Medical Physiology by Barret; 25<sup>th</sup> Ed, McGrew-Hill, 2016

#### **Reference Books**

- 1. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.
- 2. Eroschenko VP. 2008. diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott & Wilkins.
- 3. Fox SI. 2011. Human Physiology. 12th Edn. Mc Graw Hill
- 4. Gunstream SE. 2010. Anatomy and Physiology with integrated study guide. 4th Edn., Mc Graw Hill.
- 5. Guyton AC, Hall JE. 2006. Textbook of Medical Physiology. XI Edn. Hercourt Asia PTE Ltd. W.B. Saunders Company.
- 6. Hill RW, Wyse GA, Anderson M. 2012. Animal Physiology. 3rd Edn. Sineuer Associaes.
- 7. Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. 6th Edn. Jaypee Pub, New Delhi
- 8. Sherwood L. 2013. Human Physiology from cells to systems. 8th Edn., Brooks & Cole
- 9. Tortora GJ, Grabowski S. 2006. Principles of Anatomy & Physiology. XI Edition John Wiley & son
- 10. Vander A, Sherman J, Luciano D. 2014. Vander's Human Physiology: The Mechanism of Body Function. XIII Edn. McGraw Hills

### **ZOOACOR10T** (Theory, 4 credits= 60 classes): Immunology

#### **Unit 1: Overview of Immune System**

Basic concepts of health and diseases, Historical perspective of Immunology, Organs (Primary & Secondary lymphoid organs and its importance) and Cells of the Immune system,

Concept of Haematopoiesis and development of progenitor cells of the Immune system (Brief idea)

#### **Unit 2: Innate and Adaptive Immunity**

Principle of Innate and Adaptive Immunity.

- Components of innate immunity
  - Epithelial barriers (skin and mucosal membranes [concept])
  - Cellular mechanisms (phagocytes, NK cells, mast cells, eosinophils, inflammation [concept])
  - Humoral mechanisms (complement, cytokines, chemokines etc. [concept])
- Components of adaptive immunity
  - Cellular mechanisms (Cell-Mediated Immune System (CMIS) or T-Cell Immunity [concept])
  - Humoral mechanisms (Formation of Plasma B cells and Memory B cells [concept])

#### Unit 3: Antigen, Antigen presentation & MHC

Concept of Antigen, Immunogen, Allergen & Pathogen. Adjuvants and haptens, Factors influencing immunogenicity, Epitope. Types of Antigen Presenting Cells (APC), Structure of Major Histocompatibility Complex (MHC) molecules. Mechanism of antigen presentation and involvement of MHC molecules (both MHC-I & MHC-II) in details. Co-stimulatory molecules on APC.

#### **Unit 3: T Cell development**

Structure of T cell receptors, Co-stimulatory molecules on T cells Concept of synapse between APC & T cells (between MHC≈TCR & between Costimulatory molecules) in details. Central differentiation of T cells; T cell selection in thymus Peripheral differentiation of T cells; Th1 & Th2

#### **Unit 4: Immunoglobulins**

Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production

#### Unit 6: Cytokines & Chemokines

Brief concept on types of Cytokines & Chemokines Cytokines (source & function of IL-1, IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12, Interferons, Tumor Necrosis Factors, Tumor Growth Factors, GM-CSF, M-CSF). Chemokines (source & function of CCL2, CCL3, CCL4, CCL5, CxCL8, CxCL10)

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#### **Unit 7: Complement System**

Components and pathways of complement activation.

Unit 8: Hypersensitivity4Gell and Coombs' classification and brief description of various types of hypersensitivities.4	
<b>Unit 9: Immunology of diseases</b> Malaria, Visceral Leishmaniasis, Filariasis, Dengue and Tuberculosis	6
<b>Unit 10: Vaccines</b> Various types of vaccines. Active & passive immunization (Artificial and natural).	4

## **ZOOACOR10P** (Practicals, 2 credits= 30 classes): Immunology Lab

#### **List of Practical**

- 1. Demonstration of lymphoid organs.
- 2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
- 3. Preparation of stained blood film to study various types of blood cells.
- 4. ABO blood group determination.
- 5. Demonstration of ELISA using kit.

(The experiments can be performed on white rats).

#### Text Book

- 1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017.
- 2. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication

#### **Reference Books**

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
- Abbas, K. Abul and Lechtman H. Andrew (2003.) Basic Immunology E-Book: Functions and Disorders of the Immune System; 2012 Saunders Publication

## Semester V

## ZOOACOR11T (Practicals, 2 credits= 30 classes): Molecular Biology Lab

#### Unit 1: Nucleic Acids

Salient features of DNA and RNA Watson and Crick Model of DNA

## **Unit 2: DNA Replication**

Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

#### **Unit 3: Transcription**

Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.

#### **Unit 4: Translation**

Mechanism of protein synthesis in prokaryotes, Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

#### Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA

Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

#### **Unit 6: Gene Regulation**

Regulation of Transcription in prokaryotes: lac operon and trp operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

#### **Unit 7: DNA Repair Mechanisms**

Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair

#### **Unit 8: Molecular Lab Techniques**

PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing, cDNA technology

#### ZOOACOR11P (Practicals, 2 credits= 30 classes): Molecular Biology Lab

#### List of Practicals

- 1. Demonstration of polytene Chromosome from Drosophila /Chironomid larvae
- 2. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement)
- 3. Agarose gel electrophoresis for DNA

#### **Text Book:**

- 1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017.
- 2. Molecular Biology of The Gene by Watson. 7th Edition. Pearson.

#### **References:**

- Molecular Cell Biology by Harvey Lodish. 7th Edition. W.H. Freeman.
- iGenetics: A Molecular Approach by Peter. J. Russell. 3rd edition. Pearson Benjamin Cummings.
- Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, Cambridge Univ. Press, Paperback

#### **ZOOACOR12T** (Theory, 4 credits= 60 classes): Genetics

**Unit 1: Mendelian Genetics and its Extension** Background of Mendel's experiments Principles of Mendelian inheritance, Incomplete dominance and co-dominance, Epistasis, Multiple alleles, Lethal alleles, Pleiotropy, Sex-linked, sex- influenced and sex-limited inheritance, Polygenic Inheritance.

### Unit 2: Linkage, Crossing Over and Chromosomal Mapping

Linkage and Crossing Over, molecular basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence

### **Unit 3: Mutations**

1. Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Chromosomal aberrations, gene mutations and human diseases (Down's, Klienfelter's, Turner's, Cri du Chat, Sickle cell, Haemophilia, Thallassimia, Albinism – only genetical aspects here, details of physiological consequences not required), Sex chromosomes and sex-linked inheritance

2. Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens

### **Unit 4: Sex Determination**

Mechanisms of sex determination in Drosophila with reference to alternative splicing Sex determination in mammals Dosage compensation in Drosophila & Human

### **Unit 5: Extra-chromosomal Inheritance**

Criteria for extra chromosomal inheritance, Antibiotic resistance in Chlamyadomonas, Kappa particle in Paramoecium Shell spiralling in snail

### Unit 6: Recombination in Bacteria and Viruses

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

## **Unit 7: Transposable Genetic Elements**

Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, LINE, SINE, Alu elements in humans

## **ZOOACOR12P** (Practicals, 2 credits= 30 classes): Genetics

#### **List of Practical**

1. Chi-square analyses

Statistical tests of data and decision making Chi square test for goodness of fit and student t test for comparing means of two small samples from normal populations (paired/unpaired)

- 2. Pedigree analysis of some inherited traits in human
- 3. Identification of chromosomal aberration in Drosophila from photographs

## Text Book

- 1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017.
- Principles of Genetics by Robert Tamarin; McGraw Hill, 7<sup>th</sup> Ed. 2017 Or

Principles of Genetics by Snustad, D.P., Simmons, M.J. (2009). 5th Ed. John Wiley and Sons Inc

#### **Reference Books**

- Developmental biology by Scott. F. Gilbert, 9th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin • Cummings
- Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin Cummings •

## **Semester VI**

## **ZOOACOR13T** (Theory, 4 credits= 60 classes): Developmental Biology

#### **Unit 1: Introduction**

Basic concepts: Phases of Development, Cell-cell interaction, Differentiation and growth, Differential gene expression

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**Unit 2: Early Embryonic Development** 20 Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

#### **Unit 3: Late Embryonic Development** Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta

(Structure, types and functions of placenta)

#### **Unit 4: Post Embryonic Development**

Development of brain and Eye in Vertebrate Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)

#### **Unit 5: Implications of Developmental Biology**

Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis

## **ZOOACOR13P** (Practicals, 2 credits= 30 classes): Developmental Biology Lab

#### **List of Practical**

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)

2. Study of the developmental stages and life cycle of Drosophila from stock culture

3. Study of different sections of placenta (microphotographs/ slides)

4. Project report on Drosophila culture/chick embryo development

## **Text Book:**

<ul> <li>Principles of Development by Wolpert and Beddington; OUP Oxford, 2<sup>nd</sup> Ed.,</li> <li>Essential Developmental Biology by Slack JMW; 3<sup>rd</sup> Ed., Wiley</li> </ul>	2001
ZOOACOR14T (Theory, 4 credits= 60 classes): Evolutionary Biology	
Unit 1: Oigin of earliest life	5
Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes, three domains of life	
Unit 2: Historical review of evolutionary concept Pre-Darwinian Concepts and theories including Lamarckism, Darwininan Theory Neo-Darwinian Synthesis Anti-evolutionary ideas of Creationism and their scientific refusal	7
<b>Unit 3: Evidences in favour of Evolution</b> Fossil records: types of fossils, geological time scale, transitional forms: examples of f evolutionary stages of the modern horses Molecular (universality of genetic code and protein synthesis machinery) evidences	4 Sossils depicting the
Unit 4: Sources of variations Heritable variations present in natural populations (classical study of Lewontin and Hu Drosphila, as example)	3 1bby, 1966 in
<ul> <li>Unit 5: Population genetics:</li> <li>Concept of Populations and calculation of allele frequencies in a population</li> <li>Hardy-Weinberg Law and equilibrium (derivations, applications of law to find gene ar frequencies in human Populations)</li> <li>Evolutionary forces disrupting H-W equilibrium-</li> <li>Natural selection: Definition as the non-differential rate of reproductions and survivals concept of fitness, selection coefficient, Types of natural selection with examples- Dis Directional.</li> <li>Genetic Drift- outline of its mechanism, basic concepts and examples of founder's effect phenomenon;</li> <li>Role of Gene flow and Mutation rates in changing allele frequencies in a population (Models)</li> </ul>	16 ad genotype of competing alleles, rupting, Stabilizing, ect, bottleneck No mathematical
Unit 6: Products of evolution Inter-population variations: clines, races, Species concepts and modes of speciation (ju Allopatric, Sympatric and Parapatric speciation models with examples ), Isolating med Adaptive radiations/ macroevolution as exemplified by Galapagos finches	10 ist outlines of chanisms
Unit 7: Extinctions Major mass extinctions in the history of life and their impacts on biodiversity on earth	2 (brief descriptions)
Unit 8: Origin and evolution of man Unique hominin characteristics contrasted with primate characteristics (including social	6 al and cultural ones),

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.

2. Developmental Biology by Gilbert, S. F. (2010), IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA

#### **References:**

Primate phylogeny: from Dryopithecus leading to Homo sapiens, Molecular evidences of human origin and migrations (brief outline)

#### **Unit 8: Molecular Phylogeny**

The basic concept of molecular phylogeny, Neutral theory of molecular evolution, molecular clock (brief introductions) Example of evolution in vertebrate globin genes

7

## ZOOACOR14P (Practicals, 2 credits= 30 classes): Evolutionary Biology Lab

### **List of Practicals**

1. Study of fossils from models/ photographs- Direct ancestors of horses, Archaeopteryx

2. Study of homology and analogy from suitable specimens (from Photographs/models)

3. Verification of Hardy-Weinberg equilibrium in a population by chi square analysis

5. Collection of a sample of height, weight, age, sex data from at least 100 individuals and applying of different statistical analyses (frequency distribution, mean, mode, standard deviations, correlations, etc) and graphical representations.

#### **Text Book:**

- 1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Published by Pearson Copyright © 2017.
- Evolution by Ridley, M. 3<sup>rd</sup> Ed.(2004) Blackwell publishing Or

Evolutionary Biology Douglas, J. Futuyma (1997); Sinauer Associates

#### **Reference:**

- Evolution by Barton et al, 1<sup>st</sup> Ed. 2007 Cold Spring Harbor Lab Press
- Why Evolution is True by Jerry Coyne; 2010, Penguin India
- Strickberger's Evolution by Hall and Halgrimmson; 5<sup>th</sup> Revised Ed., 2013, Jones and Bartlett,

### 

## **DSE: DISCIPLINE SPECIFIC ELECTIVE Courses**

## Semester V

## (any two courses to be credited for honours)

## **ZOOADSE01T** (Theory 4 Credits = 60 classes): Animal Behaviour and Chronobiology

#### **Unit 1: Introduction to Animal Behaviour**

- A brief history of animal behaviour studies including the works of Fabre, Darwin, Von Frisch, Lorenz, Tinbergen, Jane Goodal, Biruté Galdikas, Dian Fossey, Salim Ali, Gopal Bhattacharyya, M. K. Chandrashekhar, Raghavendra Gadagkar.
- 2. The objectives of modern animal behaviour studies: Tinbergen's four questions.

- 3. Methods of studying behaviours: Observation vs Watching, Ad libitum observations, Focal animal studies, Instantaneous scan, etc.
- 4. Branches of Animal Behaviour Studies

## Unit 2: Behaviours of Individuals

- 1. Reflexes and Orientations
- 2. Instinct
- 3. Learning: Imprinting and other Programmed Learning, Habituation, Innovations and Cultural Transmission / Social Learning

## Unit 3: Social and Sexual Behaviour

- 1. Social Behaviour: Concept of Sociality, Types of animal Society with examples, Altruism
- 2. Communications in animals- different types (e.g. pheromones, visuals, tactile, acoustics, etc) with common examples
- 3. Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
- 4. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

## **Unit 4: Introduction to Chronobiology**

- 1. Historical developments in chronobiology;
- 2. Biological oscillation: the concept of Average, amplitude, phase and period
- 3. Adaptive significance of biological clocks

## Unit 5: Biological Rhythm

- 1. Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms;
- 2. Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms;
- 3. Photoperiod and regulation of seasonal reproduction of vertebrates; Role of melatonin.

## **ZOOADSE01P** (Practical, 2 Credits=60 Classes): Animal Behaviour and Chronobiology Lab

## List of Practical

- 1. To study nests (non-invasively) and nesting habits of the birds and social insects (e.g. Social Wasps) .
- 2. To study the behavioural responses of rice weevil /wood lice to dry and humid conditions.
- 3. To study geotaxis behaviour in earthworms.
- 4. To study the phototaxis behaviour in insects/defensive behaviour in mosquito larvae.

5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park (within West Bengal) to study behavioural activities of animals and prepare a short report.

- 6. Study and actogram construction of locomotor activity of suitable animal models.
- 7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

## Text Book:

- 1. Animal Behaviour: Mechanisms. Ecology. Evolution by Drickamar, Vessey, 5<sup>th</sup> Ed. Jakob; McGraw Hill.
- 2. Survival Strategies by Raghavendra Gadagkar, University Press

#### **Reference**:

• An Introduction to Animal Behaviour by Manning and Dawkins; 5<sup>th</sup> Ed. Cambridge Univ. Press

- Measuring Behaviour: An Introductory Guide by Martin and Bateson; 3<sup>rd</sup> Ed.Cambridge Univ. Press
- Introduction to Behavioural Ecology by Krebs and Davies; Wiley-Blackwell

## **ZOOADSE02T** (Theory 4 Credits = 60 classes): Entomology (Insects and their Biology)

#### **Unit 1: Introduction**

General Features of Insects Distribution and Success of Insects on the Earth

#### Unit 2: Insect Diversity and Classifications 15

Classifications of Arthropods with special reference to Insects (Insects are to be classified up to order with estimated species richness of the orders globally, in India and in West Bengal. Conspicuous/important families/Genera/species of each order have to be noted with their peculiar habits and habitats)

#### Unit 3: General Morphology of Insects (brief outlines)

External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits Thorax: Wings and wing types, Types of Legs adapted to diverse habitats, Peculiar Abdominal appendages and genitalia - only brief introduction.

## **Unit 4: Physiology of Insects**

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system (brief outlines only) Photoreceptors: Types, Structure and Function (brief introductions) Metamorphosis: Types and Neuroendocrine control of metamorphosis (introductory)

## **Unit 5: Insect Society**

Social insects: different types of social insects with brief outlines of their social systems Trophallaxis in social insects such as ants, termites and bees

## **Unit 6: Insect Plant Interaction**

Outline of the concept of co-evolution, role of allo-chemicals in host plant mediation, Host-plant selection by phytophagous insects; Major insect pests in paddy (brief introductions)

## Unit 7: Insects as Vectors

Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important vectors

## **ZOOADSE02P** (Practical, 2 Credit=60 Classes): Biology of Insects Lab

## List of Practical

- 1. Study of life cycle of Mosquito
- 2. Study of different kinds of antennae, legs and mouth parts of insects (any three variants of each)
- 3. Mounting of insect wings, spiracles and genitalia of any insect
- 4. Methodology of collection, preservation and identification of insects.
- 5. Morphological studies of various castes of Apis, Camponotus, any Termite (e,g, Odontotermes) 1

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- 6. Study of major insect pests of paddy and their damages
- 7. Study of Mulberry silk moth as beneficial insect

#### **Text Book**:

- 1. The Insects: Structure and function, Chapman, R. F., Cambridge University Press,
- 2. A general text book of entomology, Imms , A. D., Chapman & Hall,

#### **Reference**s

- Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
- Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
- The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
- Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
- Physiological system in Insects, Klowden, M. J., Academic Press, USA
- Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA
- Medical Entomology, Hati A. K., Allied Book Agency, 2010

## ZOOADSE03T (Theory, 4 Credit=60 Classes): Endocrinology

#### **Unit 1: Introduction to Endocrinology**

General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

#### Unit 2: Epiphysis, Hypothalamo-hypophysial Axis

Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction; Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms; Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland.

#### **Unit 3: Peripheral Endocrine Glands**

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis; Hormones in homeostasis, Disorders of endocrine glands

#### **Unit 4: Regulation of Hormone Action**

Mechanism of action of steroidal, non-steroidal hormones with receptors Bioassays of hormones using RIA & ELISA; Estrous cycle in rat and menstrual cycle in human; Multifaceted role of Vasopressin & Oxytocin; Hormonal regulation of parturition

## **ZOOADSE03T** (Practical, 2 Credit=60 Classes): Endocrinology Lab

#### List of Practical

- 1. Dissect and display of Endocrine glands in rat.
- 2. Study of the permanent slides of all the endocrine glands
- 3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland
- 4. Estimation of plasma level of any hormone using ELISA
- 5. Designing of primers of any hormone

#### **Text Book:**

- 1. Hall JE. 2015. Guyton and Hall Textbook of Medical Physiology. 13th Edition. Saunders publication.
- 2. Ross MH, Pawlina W. 2010. Histology: A Text and Atlas. Sixth Edition. Lippincott Williams and Wilkins.

### 16

4

## 16

#### 14

3. Norris DO, Carr JA. 2013. Vertebrate Endocrinology. 5 editions Academic Press;

#### **References:**

- 4. Fox T, Brooks A, Baidya B. 2015. Endocrinology. JP Medical, London.
- 5. Gardner DG, Shoback D. 2011. Greenspan's Basic and Clinical Endocrinology. 9<sup>th</sup> Edn. McGraw Hill Lange.
- 6. Goodman HM. 2000. Basic Medical Endocrinology. 4th Edn. Academic Press.
- 7. Jameson JL. 2010. Harrison's Endocrinology. 2nd Edn. McGraw Hill.
- 8. Melmed S, Conn PM. 2005. Endocrinology: Basic and Clinical Principles. 2nd Edn. Humana Press.
- 9. Melmed S, Polonsky K, Larsen PR, Kronenberg H. 2016. William's Text Book of Endocrinology. 13<sup>th</sup> Edn. Elsevier.
- 10. Molina PE. 2013. Endocrine Physiology. 4th Edn. McGraw Hill Lange.
- 11. Neal JM. 2000. Basic Endocrinology; An Interactive Approach. Blackwell Science.
- 12. Norris DO. 2007. Vertebrate Endocrinology. 4th Edn. Elsevier Academic Press.
- 13. Strauss JF, Barbieri RL. 2014. Yen & Jaffe's Reproductive Endocrinology. Elsevier Sounders

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## Semester VI

#### (Any two courses to be credited for honours)

4

14

10

16

#### **ZOOADSE04T** (Theory 4 Credits = 60 classes): Fish and Fishery

#### **Unit 1: Introduction and Classification**

General description of fish Feeding habit, habitat and manner of reproduction Classification of fish (up to Subclasses) with important examples

#### **Unit 2: Morphology and Physiology**

Types of fins and their modifications; Locomotion in fish; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ, Bioluminescence

#### **Unit 3: Fisheries**

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fishery resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

#### **Unit 4: Aquaculture**

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

#### **Unit 5: Fish in research** 6

Transgenic fish, Zebra fish as a model organism in research

## **ZOOADSE04P** (Practical, Credits = 60 classes): Fish and Fishery

#### **List of Practical**

1. Morphometric and meristic characters of fishes in relation to identifications of species (with locally cultured non-indigenous fishes)

2. Study of external salient features in Petromyzon, Myxine, Pristis, Chimaera, Exocoetus,

Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas (all from photographs)

- 3. Study of different types of scales (through permanent slides/ photographs).
- 4. Study of crafts and gears used in Fisheries

5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids

- 6. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias
- 7. Project Report on a visit to any fish farm/ pisciculture unit/Zebra fish rearing Lab.

#### **Text Book**:

Q. Bone and R. Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.

#### Reference

- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press,
- von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
- Chaudhuri, S. (2017), Economic Zoology. New Central Book Agency

## **ZOOADSE05T** (Theory, 4 Credits = 60 classes): Parasitology

#### **Unit 1: Introduction to Parasitology**

Brief introduction of Parasitism and other animal associations, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship and zoonosis

#### Unit 2: Parasitic Protists 15

15 Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax*, *Plasmodum falciparum and Toxoplasma gondii* 

#### Unit 3: Parasitic Platyhelminthes 15

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciola hepatica*, *Paragonimus westermani*, *Schistosoma haematobium*, *Taenia solium*, *Echinococcus granulosus* and *Hymenolepis nana* 

#### **Unit 3: Parasitic Nematodes**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis*. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode)

3

#### Unit 4: Parasitic Arthropoda

Mosquitoes and flies as vectors of human pathogen Biology, importance and control of myiasis causing diptera Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius* 

#### **Unit 6: Parasitic Vertebrates**

2

A brief account of parasitic vertebrates; Cookiecutter Shark, Candiru, Hood Mockingbird and Vampire bat

## **ZOOADSE05P** (Practical, 2 Credits = 60 classes): Parasitology

#### **List of Practicals**

- Study of life stages of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs
- Study of adult and life stages *of Fasciola hepatica*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
- Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/micro photographs .
- Study of plant parasitic root knot nematode, Meloidogyne from the soil sample
- Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
- Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by product]

#### **Text Book:**

Chatterjee K.D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd

#### **References**:

- Bose, M.(2017). Parasitoses and Zoonoses. New Central Book Agency(P) Ltd
- Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
- Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
- Noble, E.R. and Noble G.A. (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger
- Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
- Rattan Lal, Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

## **ZOOADSE06T** (Theory, 4 Credits = 60 classes): Wildlife and Conservation

<b>Unit 1: Introduction to Wild Life</b> Values of wild life; Importance of conservation; Causes of depletion of Wildlife in India;	5
<b>Unit 2: Evaluation and management of wild life</b> Forest habitats: major forest types of India and West Bengal Forest covers estimation: remote sensing and GIS	12
Unit 3: Management of habitats Management of Successional wild habitats Forest fire Restoration of degraded wild habitats	8
(The above topics should be learnt mostly in reference to the protected areas in West Bengal)	
<b>Unit 4: Population estimation</b> Population and population density estimations: different methods in practice Sex Ratio computation and Fertility status	10
Unit 5: Wildlife conservation practices in India Traditional Conservation ethics and practices in India Conservation strategies and Practices: Wildlife Acts (IUCN, WPA of India, CITES etc)	5
<b>Unit 6: Management planning of wild life in protected areas</b> Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbence.	5
Unit 7: Man and Wildlife Causes and consequences of human-wildlife conflicts; Mitigation of conflict – an overview; Wildlife/Ecotourism advantages and disadvantages	5
Unit 8: Protected areas	10

Major wildlife areas in India (all from West Bengal): Sanctuaries, National Parks, Tiger and other Wildlife Reserves, Biosphere reserves, etc. Community reserve: concepts and examples Management challenges in Tiger reserve

## **ZOOADSE06P** (Practical, 2 Credits = 60 classes): Wildlife and Conservation

#### List of Practicals

1. Identification of common local flora, mammalian fauna, avian fauna, herpeto-fauna

2. Demonstration of basic equipments needed in wildlife studies use, care and maintenance (Compass,

Binoculars, Range Finders, Global Positioning System, Various types of Cameras and lenses)

3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.

4. Demonstration of different field techniques for flora and fauna

5. Quadrat and other methods for ground cover assessment, Height-Girth relationships in trees, Canopy cover assessment in a patch of vegetations.

6. Trail / transect monitoring for abundance and diversity estimation of mammals and birds, butterflies (direct and indirect evidences)

#### Text Book:

- 1. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
- 2. Conservation Biology: A Primer for South Asia by Kamaljit S. Bawa, Meera Anna Oommen, and Richard B. Primack, Atree and University Press

### **References**:

- 1. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Coexistence? Cambridge University.
- 2. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
- 3. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
- 4. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

## **General Electives**

# [GEC offered by the Dep. of Zoology are for the students studying with other (i.e. not offered by the dept .of Zoology) honours level core courses]

#### Same as offered as core courses for the BSc general students

ZOOHGEC01T: Animal Diversity	
Theory (Credits 4)	Class
Unit-1 Kingdom Protista	
General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al.,	3
1980); Locomotory Organelles and locomotion in Protozoa	
Unit-2 Phylum Porifera	
General characters and classification up to classes; Canal System in Sycon	3
Unit-3 Phylum Cnidaria	
General characters and classification up to classes; Polymorphism in Hydrozoa	3
Unit-4 Phylum Platyhelminthes	
General characters and classification up to classes; Life history of Taenia solium	3
Unit-5 Phylum Nematoda	
General characters and classification up to classes; Life history of Ascaris lumbricoides and its	3
parasitic adaptations	
Unit-6 Phylum Annelida	
General characters and classification up to classes; Nephridia in Annelida	3
Unit 7 Phylum Arthropoda	
General characters and classification up to classes; Vision in insect, Metamorphosis in Insects	5
Unit-8 Phylum Mollusca	
General characters and classification up to classes; Respiration in Pila	3
Unit-9 Phylum Echinodermata	

General characters and classification up to classes; Water-vascular system in Asterias	4
Unit-10 Protochordates	
General features; Feeding in Branchiostoma	2
Unit-11 Agnatha	
General features and classification up to classes (Young, 1981)	2
Unit-12 Pisces	
General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in Fishes	3
Unit-13 Amphibia	
General features and Classification up to living orders (Duellman & Trueb, 1986);	3
Metamorphosis in Toad	
Unit-14 Reptiles	
General features and Classification up to living Subclass (Young, 1981); Poisonous and non-	4
poisonous snakes, Biting mechanism in snakes	
Unit-15 Aves	
General features and Classification up to orders (Young, 1981); Flight adaptations in birds	3
Unit-16 Mammals	
Unit-16 Mammals Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in <i>Cavia</i>	3
Unit-16 Mammals Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in <i>Cavia</i> Suggested Readings [Consult Latest Editions]	3
Unit-16 Mammals         Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in <i>Cavia</i> Suggested Readings [Consult Latest Editions]         1. Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole.	3

- 3. Kardong, K.V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
- 4. Kent, G.C. & Carr, R.K. (2001). Comparative anatomy of the Vertebrates. 9thEd. McGraw Hill.
- 5. Romer, A.S. & Parsons, T.S. (1986). The vertebrate body. 6thEd. Saunders College Pub.

6. Ruppert E. E., Fox, R. & Barnes R. D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks Cole.

7. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

#### ZOOHGEC01P: Animal Diversity Lab (Credits 2)

#### 1. Spot identification of the following specimens:

Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Euspongia,, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male and female Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria and Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Passer, Psittacula, Alcedo, Sorex, Pteropus, Funambulus, Suncus

- 2. Study of the following permanent slides: Transverse section of male and female Ascaris
- 3. Identification of poisonous and non-poisonous snakes
- 4. An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

#### Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology

2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

ZOOHGEC02T, Physiology and Biochemistry		
Theory (Credits 4)	Class	
Unit-1 Nerve and muscle	8	
1. Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its		
propagation in myelinated and non-myelinated nerve fibres.		
2. Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction.		
Unit-2 Digestion		
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids		
Unit-3 Respiration	5	

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood **Unit-4 Excretion** 5

6

7

4

#### Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

#### Unit-5 Cardiovascular system

Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

#### **Unit-6 Reproduction and Endocrine Glands**

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adrenal 8

#### Unit 7 Carbohydrate: Structure and Metabolism

Introduction to Carbohydrates, Structure & Types of Carbohydrates, Isomerism, Introduction to Intermediary metabolism: Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Electron transport chain 5

#### Unit-8 Lipid: Structure and Metabolism

Introduction to Lipids: Definitions; fats and oils; classes of lipids; Lipoproteins; Biosynthesis and β oxidation of palmitic acid

#### Unit-9 Protein: Structure and metabolism

Proteins and their biological functions, functions of amino acids, physicochemical properties of amino acids. Peptides – structure and properties; primary structure of protein, secondary, tertiary and quaternary structures. Transamination, Deamination and Urea Cycle.

#### Unit-10 Enzymes

Introduction, Classification of Enzymes, Mechanism of action,

Enzyme Kinetics, Inhibition and Regulation

#### **Suggested Readings**

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry, VI Edn. W.H Freeman & Co.

2. Chatterjea, MN and Shinde, R (2012). A Textbook of Medical Biochemistry. 8th Edn. Jaypee Pub., N.Delhi

3. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper'sIllustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.

6. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole

7. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.

8. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill 9. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.

#### **ZOOHGEC02P:** Physiology and Biochemistry Lab (Credits 2)

1. Preparation of haemin crystals

2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, small intestine, liver, lung, kidney

3. Oualitative tests to identify functional groups of carbohydrates in given solutions: Glucose (Benedict's test),Sucrose (Iodine test)

4. Quantitative estimation of total protein in given solutions by Lowry's method.

5. Study of activity of salivary amylase under optimum conditions.

ZOOHGEC03T: Insect, Vectors and Diseases		
Theory (Credits 4)	Class	
Unit-1 Introduction to Insects	6	
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with		
respect to feeding habit		
Unit-2 Concept of Vectors	6	
Brief introduction to Vectors (mechanical and biological). Reservoirs, Host-vector relationship, A	daptations	

as vectors, Host specificity			
Unit-3 Insects as Vectors	8		
Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera			
Unit-4 Dipteran as Disease Vectors	14		
Study of important Dipteran vectors – Mosquitoes, Sand fly, Houseflies			
Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis			
Control of mosquitoes			
Unit-5 Siphonaptera as Disease Vectors	6		
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus	fever;		
Control of fleas			
Unit-6 Siphunculata as Disease Vectors	4		
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse			
Unit-7 Hempitera as Disease Vectors	6		
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Cont	rol and		
prevention measures			
ZOOHGEC03P: Insect Vectors and Diseases Lab (Credits 2)			
List of Practical			
1. Mounting and Study of different kinds of mouth parts of insects			
2. Spot identification of following insect vectors through permanent slides/photographs: <i>Aedes, Culex, Anopheles,</i>			
Pediculus humanuscapitis, Pediculus humanuscorporis, Phithiruspubis, Xenopsylla cheopis, Cimex lectularius,			
Phlebotomus argentipes, Musca domestica			
3. Study of different diseases transmitted by above insect vectors			
4. Submission of a project report on any one of the insect vectors and disease transmitted			
Suggested Readings			
1. Anathakrishnan : Bio resources Ecology 3rdEdition			
2. Goldman : Limnology, 2ndEdition			
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition			
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition			
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies			
6. Welch : Limnology Vols. I-II			
7. Wetzel : Limnology, 3rdedition			

ZOOHGEC04T, Environment and Public Health			
Theory (Credits 4)	Class		
Unit 1: Introduction			
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and			
persistent substances in the environment, Dose response evaluation, Exposure assessment			
Unit 2: Climate Change			
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate	10		
change on public health			
Unit 3: Pollution			
Air, water, noise pollution sources and effects, Pollution control	5		
Unit 4: Waste Management Technologies			
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste	15		
disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste			
from thermal power plants.			
Unit 5: Diseases			
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid,	10		
filariasis			
Suggested Readings [Consult Latest Editions]			
1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 19	999.		
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management	Handbook",		
McGraw Hill Inc., New York, 1996.			
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and son	s, Singapore,		
1998.			
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V. I	N. University		
Press, New York, 2003.			
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with			
applications, Prentice Hall, New Jersey 1997.			
ZOOHGEC03P: Environment and Public Health Lab (Credits 2)			
1. To determine pH, Cl, SO4, NO3 in soil and water samples from different locations.			

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## **Skill Enhancement Course (SEC)**

## [Offered by the Department of Zoology]

#### **ZOOSSEC001** (2 credits = 30 classes/hours ): Aquarium Fish Keeping Class

## **Unit 1: Introduction to Aquarium Fish Keeping**

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes , problems of releasing aquarium fishes into natural habitats.

## **Unit 2: Biology of Aquarium Fishes**

Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish

## Unit 3: Food and feeding of Aquarium fishes

8

6

Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator

Unit 4: Fish Transportation	3
Live fish transport - Fish handling, packing and forwarding techniques.	
Unit 5: Maintenance of Aquarium	3
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage	
Industry	

## **ZOOSSEC002** (2 credits = 30 classes/hours ): VERMICOMPOST PRODUCTION

- 1. Natural role of earthworms in soil fertility
- 2. Concept of Vermicompost- the need for it
- 3. Productions:
  - a. Suitable worm species and their availabity- for Large scale/small scale, Climate and Temperature
- 4. Feedstock for small scale or home farming / large scale or commercial
- 5. Operations and maintenance
  - a. Smells
  - b. Moisture
  - c. Pest species
  - d. Worms escaping
  - e. Nutrient levels
- 6. Harvesting
- 7. Properties of the vermicompost
- 8. Benefits of vermicompost
- 9. Use as soil conditioner
- 10. Applications

#### **Reference and contacts:**

- The Complete Technology Book on Vermiculture and Vermicompost by NPCS Board of Consultants and Engineers; Asia Pacific Business Press, 2004
- Vermicompost production training in 24 Parganas- North: <u>http://www.swanirvar.in/help.php</u>
- Audio-visual training material: <u>https://www.google.co.in/search?rlz=1C1CHZL\_enIN766IN766&ei=2Kz2Wr6yDoPIvgTLw6aYDQ</u> <u>&q=vermicompost+preparation&oq=vermicompost&gs\_l=psy-</u> <u>ab.1.0.0i71k118.0.0.08499.0.0.0.0.0.0.0.0.0.0.0.1c..64.psy-</u> <u>ab..0.0.0...0.RNrPR98LJOg#kpvalbx=1</u>
- <u>https://www.youtube.com/watch?v=sQKI0Y7fj24</u>
- <u>https://www.youtube.com/watch?v=oGf7Oe7oP4Y</u>
- <u>http://www.ivri.nic.in/services/vermi.aspx</u>

# WEST BENGAL STATE UNIVERSITY



# DRAFT SYLLABUS FOR THREE-YEAR DEGREE COURSE IN ZOOLOGY (GENERAL) UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

(With effect from the session 2018-2019)

## BSc General with Zoology (Credit values given within brackets)

## Core Courses for Zoology (CC)

Core Course (CC)			
CC- 1A: Animal Diversity	CC-1B: Human Physiology and	CC-1C: Insect Vector	CC-1D: Environment
	Biochemistry	and diseases	and Public Health

## **Choices for Discipline Specific Electives (DSE)**

Discipline Specific Elective (DSE) Any Four (2) Course from 1 to 4				
Applied Zoology	Food Nutrition and Health	Aquatic Biology	Immunology	

## Choices for Skill Enhancement Courses (SEC)

Skill Enhancement Course-1 & Skill Enhancement Course-2, any two course from 4			
Aquarium Fish Keeping	Vermicompost		

Sem	Core*	DSE	GE	AECC	SEC	Total credits
I	ZOOGCOR01T (4) ZOOGCOR01P (2) (Animal Diversity) CEMGCOR01T (4) CEMGCOR01P (2) BOTGCOR01T (4) BOTGCOR01T (4)			ENVSAEC01T (2)		20
п	ZOOGCOR02T (4) ZOOGCOR02P (2) (Human Physiology & Biochemistry) CEMGCOR02T (4) CEMGCOR02P (2) BOTGCOR02T (4) BOTGCOR02P (2)			ENGSAEC01T (2)		20
ш	ZOOGCOR03T (4) ZOOGCOR03P (2) (Insect Vectors and Diseases) CEMGCOR03T (4) CEMGCOR03P (2) ZOOGCOR03T (4) ZOOGCOR03T (4)				ZOOSSEC01M (2) (Aquarium Fish Keeping) OR An SEC offered by any other department	20
IV	ZOOGCOR04T (4) ZOOGCOR03P (2) (Environment and Public Health) CEMGCOR04T (4) CEMGCOR04P (2)				ZOOSSEC02M (2) Vermicompost Production OR An SEC offered by any other department	20

	BOTGCOR04T (4) BOTGCOR04P (2)					
V		ZOOGDSE01T (4) ZOOGDSE01P (2) (Applied Zoology) OR ZOOGDSE02T (4) ZOOGDSE02P (2) (Food Nutrition and Health)  BOTGDSE01T (4) BOTGDSE01P (2) OR BOTGDSE02T (4) BOTGDSE01T (4) CEMGDSE01T (4) CEMGDSE01P (2) OR CEMGDSE02T (4) CEMGDSE02T (4) CEMGDSE02T (4) CEMGDSE02P (2)			An SEC offered by any other department	20
VI		ZOOGDSE03T (4) ZOOGDSE03P (2) (Aquatic Biology) OR ZOOGDSE04T (4) ZOOGDSE04P (2) (Immunology) BOTGDSE03T (4) BOTGDSE03T (4) BOTGDSE04T (4) BOTGDSE04T (4) CEMGDSE03T (4) CEMGDSE03T (4) CEMGDSE04T (4) CEMGDSE04T (4) CEMGDSE04T (4) CEMGDSE04T (4)			An SEC offered by any other department	20
Total number of	12	6	0	2	4	120

ZOOGCOR01T: Animal Diversity	
Theory (Credits 4)	Class
Unit-1 Kingdom Protista	
General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al.,	3
1980); Locomotory Organelles and locomotion in Protozoa	
Unit-2 Phylum Porifera	
General characters and classification up to classes; Canal System in Sycon	3
Unit-3 Phylum Cnidaria	
General characters and classification up to classes; Polymorphism in Hydrozoa	3
Unit-4 Phylum Platyhelminthes	
General characters and classification up to classes; Life history of Taenia solium	3
Unit-5 Phylum Nematoda	
General characters and classification up to classes; Life history of Ascaris humbricoides and its	3
parasitic adaptations	
Unit-6 Phylum Annelida	
General characters and classification up to classes; Nephridia in Annelida	3
Unit 7 Phylum Arthropoda	
General characters and classification up to classes; Vision in insect, Metamorphosis in Insects	5
Unit-8 Phylum Mollusca	
General characters and classification up to classes; Respiration in <i>Pila</i>	3
Unit-9 Phylum Echinodermata	
General characters and classification up to classes; Water-vascular system in Asterias	4
Unit-10 Protochordates	
General features; Feeding in Branchiostoma	2
Unit-11 Agnatha	
General features and classification up to classes (Young, 1981)	2
Unit-12 Pisces	
General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in Fishes	3
Unit-13 Amphibia	
General features and Classification up to living orders (Duellman & Trueb, 1986);	3
Metamorphosis in Toad	
Unit-14 Reptiles	
General features and Classification up to living Subclass (Young, 1981); Poisonous and non-	4
poisonous snakes, Biting mechanism in snakes	
Unit-15 Aves	
General features and Classification up to orders (Young, 1981); Flight adaptations in birds	3
Unit-16 Mammals	
Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in Cavia	3
Suggested Readings [Consult Latest Editions]	
1. Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole.	

2. Brusca, R. C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates.

- 3. Kardong, K.V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
- 4. Kent, G.C. & Carr, R.K. (2001). Comparative anatomy of the Vertebrates. 9thEd. McGraw Hill.

5. Romer, A.S. & Parsons, T.S. (1986). The vertebrate body. 6thEd. Saunders College Pub.

6. Ruppert E. E., Fox, R. & Barnes R. D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks Cole.

7. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

#### ZOOGCOR01P: Animal Diversity Lab (Credits 2)

#### 1. Spot identification of the following specimens:

Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Euspongia,, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male and female Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria and Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Passer, Psittacula, Alcedo, Sorex, Pteropus, Funambulus, Suncus

2. Study of the following permanent slides: Transverse section of male and female Ascaris

3. Identification of poisonous and non-poisonous snakes

4. An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

#### Suggested Readings:

- 1. Chatterjee and Chatterjee: Practical Zoology
- 2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

ZOOGCOR02T, Physiology and Biochemistry	
Theory (Credits 4)	Class
Unit-1 Nerve and muscle	8
1. Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential a	and its
propagation in myelinated and non-myelinated nerve fibres.	
2. Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction.	
Unit-2 Digestion	5
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids	
Unit-3 Respiration	5
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxid	e in blood
Unit-4 Excretion	5
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
Unit-5 Cardiovascular system	6
Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impul	se,
Cardiac cycle	
Unit-6 Reproduction and Endocrine Glands	7
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction	luction:
hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adren	nal
Unit 7 Carbohydrate: Structure and Metabolism	8
Introduction to Carbohydrates, Structure & Types of Carbohydrates, Isomerism, Introduction to Inte	ermediary
metabolism: Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Electron transp	ort chain
Unit-8 Lipid: Structure and Metabolism	5
Introduction to Lipids: Definitions; fats and oils; classes of lipids; Lipoproteins; Biosynthesis and $\beta$ o	xidation
of palmitic acid	
Unit-9 Protein: Structure and metabolism	5
Proteins and their biological functions, functions of amino acids, physicochemical properties of amir	no acids.
Peptides – structure and properties; primary structure of protein, secondary, tertiary and quaternary	structures.
Transamination, Deamination and Urea Cycle.	Γ.
Unit-10 Enzymes	4
Introduction, Classification of Enzymes, Mechanism of action,	
Enzyme Kinetics, Inhibition and Regulation	
Suggested Readings	
1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edn. W.H Freeman & Co.	.1.
2. Chatterjea, MIN and Shinde, R (2012). A Textbook of Medical Biochemistry. 8th Edn. Jaypee Pl	ID.,
N.Delli	D <sub>v</sub> #
J. Guyton, A.C. and Han, J.E. (2011). Texibook of Medical Physiology, All Edition, Harcourt Asia	ΓVL.
A Murray R K Granner D K Mayes P A and Rodwell V W (2009) Harper's Illustrated Bioch	mistry
XXVIII Edition Lange Medical Books/Mc Graw3Hill	ciiiisti y.
5 Nelson D L. Cox M M and Lehninger A L. (2009) Principles of Biochemistry IV Edition W	ИН
Freeman and Co.	
6. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole	
7. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology. XII Edition. J	ohn
Wiley & Sons, Inc.	
8. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McC	Fraw Hill
9. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.	

#### ZOOGCOR02P: Physiology and Biochemistry Lab (Credits 2)

1. Preparation of haemin crystals

2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, small intestine, liver, lung, kidney

3. Qualitative tests to identify functional groups of carbohydrates in given solutions: Glucose (Benedict's test),Sucrose (Iodine test)

4. Quantitative estimation of total protein in given solutions by Lowry's method.

5. Study of activity of salivary amylase under optimum conditions.

ZOOGCOR03T: Insect, Vectors and Diseases	
Theory (Credits 4)	Class
Unit-1 Introduction to Insects	6
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth par	ts with
respect to feeding habit	
Unit-2 Concept of Vectors	6
Brief introduction to Vectors (mechanical and biological), Reservoirs, Host-vector relationship, A	daptations
as vectors, Host specificity	_
Unit-3 Insects as Vectors	8
Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera	
Unit-4 Dipteran as Disease Vectors	14
Study of important Dipteran vectors – Mosquitoes, Sand fly, Houseflies	
Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis	
Control of mosquitoes	
Unit-5 Siphonaptera as Disease Vectors	6
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus	fever;
Control of fleas	
Unit-6 Siphunculata as Disease Vectors	4
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse	
Ùnit-7 Hempitera as Disease Vectors	6
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Cont	trol and
prevention measures	
ZOOGCOR03P: Insect Vectors and Diseases Lab (Credits 2)	
List of Practical	
1. Mounting and Study of different kinds of mouth parts of insects	
2. Spot identification of following insect vectors through permanent slides/photographs: <i>Aedes, Cult</i>	ex,Anopheles,
Pediculus humanuscapitis, Pediculus humanuscorporis, Phithiruspubis, Xenopsylla cheopis, Cimex lectulari	us,
Phlebotomus argentipes, Musca domestica	
3. Study of different diseases transmitted by above insect vectors	
4. Submission of a project report on any one of the insect vectors and disease transmitted	
Suggested Readings	
1 Anathakrishnan : Bio resources Ecology 3rdEdition	
2. Coldman : Limpology 2ndEdition	
2. Goldman : Linnology, 2ndEdition	
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition	
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition	
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies	
6. Welch : Limnology Vols. I-II	
7. Wetzel : Limnology, 3rdedition	
8. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency	

ZOOGCOR04T, Environment and Public Health		
Theory (Credits 4)	Class	
Unit 1: Introduction		
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and	10	
persistent substances in the environment, Dose response evaluation, Exposure assessment		
Unit 2: Climate Change		
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate	10	
change on public health		
Unit 3: Pollution		
Air, water, noise pollution sources and effects, Pollution control	5	
Unit 4: Waste Management Technologies		
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste	15	
disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste		
from thermal power plants.		
Unit 5: Diseases		
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid,	10	
filariasis		
Suggested Readings [Consult Latest Editions]		
1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.		
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.		
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore,		
1998.		
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V. N. University		
Press, New York, 2003.		
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with		
applications, Prentice Hall, New Jersey 1997.		
6. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency		
ZOOGCOR03P: Environment and Public Health Lab (Credits 2)		
1. To determine pH, Cl, SO4, NO3 in soil and water samples from different locations.		

## Discipline Specific Electives (DSE)

DSE 1 Credits: 6	
ZOOGDSE01T: Applied Zoology	
Theory (Credits 4)	Class
Unit-1 Introduction to Host-parasite Relationship	3
Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoono	sis
Unit-2 Epidemiology of Diseases	7
Transmission, Prevention and control of diseases: Tuberculosis, Typhoid	
Unit-3 Rickettsia and Spirochetes	3
Brief account of Rickettsia prowazekii, Borrelia recurrentis and Treponema pallidum.	
Unit-4 Parasitic Protozoa	6
Life history and pathogenicity of Entamoeba histolytica, Plasmodium vivax and Trypanosoma gambiense	
Unit-5 Parasitic Helminthes	4
Life history and pathogenicity of Ancylostoma duodenale and Wuchereria bancrofti	
Unit-6 Insects of Economic Importance	8
Biology, Control and damage caused by Helicoverpa armigera, Pyrilla perpusilla and Papilio demoleus,	
Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum	
Unit-7 Insects of Medical Importance	8
Medical importance and control of Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla che	opis
Unit-8 Animal Husbandry	3
Preservation of semen and artificial insemination in cattle	
Unit-9 Poultry Farming	4
Principles of poultry breeding, Management of breeding stock and broilers, Processing and preserva	ation of
eggs	

#### Unit-10 Fish Technology 4 Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed **Suggested Readings** 1. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors. 2. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers. 3. Banerjee, G.C. (). Animal husbandry. 4. Banerjee, G.C. (). Animal husbandry. 5. Chatterjee, K. D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors(P) Ltd 6. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR). 7. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K. 8. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher 9. Kumar and Corton. Pathological Basis of Diseases. 10. Paniker, C.K.J., Ghosh, S. [Ed] (2013). Paniker's Text Book of Medical Parasitology. Jaypee, New Delhi. 11. Parija, S.C. Text book of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi 12. Park, K. (2007). Preventive and Social Medicine. XVI Edition. B.B Publishers. 13. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall. 14.RatanLalIchhpujaniandRajeshBhatia.MedicalParasitology,IIIEdition,JaypeeBrothersMedicalPublishers(P )Ltd.,NewDelhi 15. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency 16. Chaudhuri, S. (2017). Economic Zoology, New Central Book Agency ZOOGDSE01P: Applied Zoology, Lab (Credits 2) 1. Study and Identification of Plasmodium vivax, Entamoeba histolytica, Ancylostoma duodenale and Wuchereria *bancrofti* and their life stages through permanent slides/photomicrographs or specimens. 2. Study and Identification of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla. 3. Study and Identification of insect damage to different plant parts/stored grains through damaged products/photographs. 4. Identifying features and economic importance of Nilaparvata lugens, Apion corchori, Scirpophaga incertulus, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum 5. Visit to poultry farm/ animal breeding centre/ vector biology/ parasitology Centre. Submission of visit report 6. Maintenance of freshwater aquarium. DSE 2 Credits: 6 **ZOOGDSE02T:** Food, Nutrition and Health Theory (Credits 4) Class Unit 1: Basic concept of food and nutrition 6 Food Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups- adults, pregnant and lactating mothers, infants, school children, adolescents and elderly 16 **Unit 2: Nutritional Biochemistry** Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions 14 Unit 3: Health Introduction to health- Definition, concept of health and disease Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome

Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention

Common ailments- cold, cough, and fevers, their causes and treatment

Concepts of Nutrigenomics and health informatics

Unit 4: Food hygiene and Community health	14
Potable water- sources and methods of purification at domestic level	
Food and Water borne infections: Bacterial infection: cholera, typhoid fever, dysentery; Viral infect	ion:
hepatitis, poliomyelitis, Protozoan infection: Amoebiasis, Giardiasis; Helminths infection: Taenias	is,
Ascariasis, Vector borne diseases: Malaria and Dengue, their transmission, causative agent, sources	s of
infection, symptoms and prevention	
Brief account of food spoilage: Causes of food spoilage and their preventive measures	
SUGGESTED READINGS	
1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth E	2d; 2007;
New Age International Publishers	
2. Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.	
3. Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.	
4. Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.	
5. Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co.	
Pvt Ltd.	
6. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.	
7. Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.	
8. Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) L	.td.
9. Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing	
ZOOGDSE02P: Food Nutrition and Health, Lab (Credits 2)	
1To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric	
2. Lactose and calcium estimation in food by titrimetry	
3. Methylene Blue Reductase Test (MBRT) of milk. Gram staining of bacteria.	
4. Study of the stored grain pests and mosquito vectors (Anopheles, Culex and Aedes) from slides/	
hotograph (Sitophilus oryzae Trogoderma graparium identification habitat and food sources da	mage

photograph (Sitophilus oryzae, Trogoderma granarium, identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.

5. Project- Undertake computer aided diet analysis and Anthropometric nutritional assessment for different age groups.

OR

Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price OR

Study of nutrition labelling on selected foods

DSE 3 Credits: 6	
ZOOGDSE03T: Aquatic Biology	
Theory (Credits 4)	Class
Unit-1 Aquatic Biomes	10
Brief introduction to the aquatic biomes: Fresh water ecosystem(lakes, wetlands, streams an	d rivers),
estuaries, intertidal zones, oceanic pelagic zone, marine bentinic zone and coral reels	20
Unit-2 Freshwater Biology	20
Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemic	ical
Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bi	carbonates,
Phosphates and Nitrates, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cy	cles in
Lakes (Nitrogen, Sulphur and Phosphorous).	
Streams: Different stages of stream development, Physico-chemical environment,	
Adaptation of hill- stream fishes.	
Unit-3 Marine Biology	10
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Co	ral reefs,
Sea weeds.	
Unit-4 Management of Aquatic Resources	10
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication	n,
Management and conservation (legislations), Sewage treatment; Water quality assessment-	BOD and
COD.	
Suggested Readings	
1. Anathakrishnan : Bio resources Ecology 3rdEdition	
2. Goldman : Limnology, 2ndEdition	
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition	
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment. 1stEdition	

5. Trivedi and Goyal : Chemical and biological methods for water pollution studies

6. Welch : Limnology Vols. I-II

7. Wetzel : Limnology, 3rdedition

8. Chaudhuri, S. (2017). Economic Zoology, New Central Book Agency

#### ZOOGDSE03P: Aquatic Biology, Lab (Credits 2)

1. Determine the area of a lake using graphimetric and gravimetric method.

2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.

3. Determine the amount of transparency, Dissolved Oxygen, and Free Carbon dioxide, in water collected from a nearby lake / water body.

4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.

5. A Project Report on a Sewage treatment plant/Marine bio reserve/ Fisheries Institutes.

### DSE 4 Credits:6

DSE 4 Cicuits.0	-	
ZOOGDSE04T: Theory (Credits 4) Immunology	Class	
Unit-1 Overview of the Immune System	5	
Introduction to basic concepts in immunology, components of immune system, principles of inn	late and	
adaptive immune system		
Unit-2 Cells and Organs of the Immune System	8	
Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs)	of the	
immune system		
Unit-3 Antigens	5	
Basic properties of antigens, B and T cell epitopes, haptens and adjuvants		
Unit-4 Antibodies	8	
Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interaction	ons as tools for	
research and diagnosis		
Unit-5 Working of the immune system	12	
Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation	and	
processing, Basic properties and functions of cytokines, Complement system: Components and J	pathways	
Unit-6 Immune system in health and disease	10	
Gell and Coombs' classification and brief description of various types of hypersensitivities, Intro	duction to	
concepts of autoimmunity and immunodeficiency		
Únit-7 Vaccines	2	
General introduction to vaccines, Types of vaccines		
Suggested Readings		
1. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Ed	dition.	
SaundersP ublication.		
2. Abbas, K. Abul and Lechtman H. Andrew (2011.) Basic Immunology: Functions and Disord	ers of Immune	
System. Saunders Elsevier Publication.		
3. Delves, Martin, Burton and Roitt (2006). Roitt's Essential Immunology. 11th Edn. Blackwell Pub.		
4.Kindt, T.J., Goldsby, R.A., Osborne, B.A. and Kuby, J(2006). Immunology, VIE dition. W.H. Freeman and Compa		
ny.		
5. Parija, SC (2012). Text book of Microbiology and Immunology. 2nd Edn. Elsevier.		
6. Playfair, JHL and Chain, BM (2001) Immunology at a glance. 7th Edn. Blackwell Pub.		
7. Virella, G (2007). Medical Immunology 6th Edn. Informa Healthcare.		

## ZOOGDSE04P: Immunology, Lab (Credits 2)

- 1. Demonstration of lymphoid organs in human through model/ photograph.
- 2. Histological study of spleen, thymus and lymph nodes through slides/photographs
- 3. Preparation of stained blood film to study various types of blood cells.
- 4. ABO blood group determination

## Skill Enhancement Courses (SEC)

ZOOSSEC01M: Credits:2 Aquarium Fish Keeping	
Aquarium Fish Keeping	Class
Unit 1: Introduction to Aquarium Fish Keeping	2
The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic speci	ies of
Aquarium Fishes	
Unit 2: Biology of Aquarium Fishes	10
Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such a	s Guppy,
Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish	-
Unit 3: Food and feeding of Aquarium fishes	7
Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquariun	n fish as larval
predator	-
Unit 4: Fish Transportation	3
Live fish transport - Fish handling, packing and forwarding techniques.	
Unit 5: Maintenance of Aquarium	3
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry	

ZOOSSEC02M (2 credits): Vermicompost Production		
Vermicompost Production		
Unit 1: Introduction to Vermicompost Production	4	
Natural role of earthworms in soil fertility, Concept of Vermicompost- the need for it		
Unit 2: Productions	8	
Suitable worm species and their availabity- for Large scale/small scale, Climate and Temperatu	re, Feedstock	
– for small scale or home farming / large scale or commercial		
Unit 3: Operations and maintenance	8	
Smells, Moisture, Pest species, Worms escaping, Nutrient levels		
Unit 4: Harvesting		
Unit 5: Properties of the vermicompost		
Unit 6: Benefits of vermicompost		
Unit 7: Use as soil conditioner		
Unit 8: Applications of vermicompost 1		
Unit 9: Visit to Vermicompost centre and Submission of Report		
Suggested References		
1. <u>https://en.wikipedia.org/wiki/Vermicompost</u>		
You tube audio-visual training:		
2.https://www.google.co.in/search?rlz=1C1CHZL_enIN766IN766&ei=2Kz2Wr6yDoPIv	/gTLw6aYD	
Q&q=vermicompost+preparation&oq=vermicompost&gs_l=psy-		
ab.1.0.0i71k118.0.0.0.8499.0.0.0.0.0.0.0.0.0.001c64.psy-		
ab0.0.00.RNrPR98LJOg#kpvalbx=1		
3. https://www.youtube.com/watch?v=sQKI0Y7fj24		
4. <u>https://www.youtube.com/watch?v=oGf7Oe7oP4Y</u>		
5. http://www.ivri.nic.in/services/vermi.aspx		
6. Vermicompost production training in 24 Parganas- North: <u>http://www.swanirvar.in/help.php</u>		
	-	

Vide Resolutions taken at U.G.BOS Meeting, C&M WBSU dt. 23.5.2018. and in concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

## WEST BENGAL STATE UNIVERSITY



## Department of Commerce & Management DRAFT OF THE SEMESTER-WISE COURSE STRUCTURES

## Final Draft Syllabus B.Com. (General) Course

## UNDER THE CHOICE BASED CREDIT SYSTEM (CBCS) Recommended by the University Grants Commission (UGC)

[to be implemented from the Academic Session 2018-19]

 $^{\odot}$  Department of Commerce & Management, West Bengal State University.

1

Vide Resolutions taken at U.G.BOS Meeting, C&M WBSU dt. 23.5.2018. and in concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

#### **CONTENTS**

Page No.

A. Syllabus Structure B. Detailed Syllabus C. Medium of Instructions for the Examinees	03 - 05 -	04 38 39
<ul> <li>D. Question Pattern for the Semester-End Examination</li> <li>E. Specialisation of Teachers for Teaching and Evaluation of Different papers/subjects/modules</li> </ul>	39 -	41 42

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2

#### Three year B.Com. General Course Semester-wise Structure of Syllabus CBCS to be effective from the Academic Session 2018-19

Year 1 : Sem	ester 1	
Paper No.	Subject	Credit
FACGCOR01T	Financial Accounting I	6
FACGCOR02T	Principles & Practice of Management	6
ENGLCOR01T	English – 1	6
ENVSAEC01T	Environmental Studies	2
	Total	20

#### Year 1 : Semester 2

Paper No.	Subject	Credit
FACGCOR03T	Cost & Management Accounting	6
FACGCOR04T	<b>Business Mathematics &amp; Statistics</b>	6
ENGLC0R02T	English - 2	6
ENGSAEC01M	Language : English	2
	Modern Indian Language	
	Total	20

#### Year 2 : Semester 3

Paper No.	Subject	Credit
FACGCOR05T	Business Regulatory Framework	6
FACSSEC01M	Information Technology & its Business Application	2
FACGCOR06T	Financial Accounting II	6
ENGLCOR03M	Modern Indian Language - 1	6
	Total	20

#### Year 2 : Semester 4

Paper No.	Subject	Credit
FACSSEC02M	Tax Returns & Filing of Tax Returns	2
FACGCOR07T	Direct & Indirect Taxation	6
FACGCOR08T	Business Economics	6
ENGLCOR04M	Modern Indian Language – 2	6
	Total	20

#### Year 3 : Semester 5

Paper No.	Subject	Credit
FACGGEC01T	Auditing	6
FACSSEC03M	Entrepreneurship Development	2
FACGDSE01T	DSE 1 TO DSE 6 from Group-A	6+6
То	(Any two DSEs are to be chosen) [For details	
FACGDSE06T	see Table-1]	
	Total	20

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3
iear 5 : Semester 6		
Paper No.	Subject	Credit
FACGGEC02T	Marketing Management & Human Resource	6
	Management	
FACSSEC04M	Business Communication & e-commerce	2
FACGDSE07T	DSE 7 TO DSE 12 from Group-B	6+6
То	(Any two DSEs are to be chosen) [For details	
FACGDSE12T	see Table-2]	
	Total	20
	Grand Total	120

#### Vear 3 · Semester 6

#### **DISCIPLINE SPECIFIC ELECTIVE COURSES**

Course Code	Course Name
FACGDSE01T	Banking & Insurance
FACGDSE02T	Corporate Accounting
FACGDSE03T	Consumer Behaviour & Customer Relationship
	Management
FACGDSE04T	Product & Pricing Management and Marketing
	Communication
FACGDSE05T	Fundamentals of Computer
FACGDSE06T	DBMS and Networking

Table-1 : Group-A

Notes : Students must opt for FACGDSE01T and FACGDSE02T for Finance Specialisation, FACGDSE03T and FACGDSE04T for Marketing Specialisation and FACGDSE05T and FACGDSE06T for Systems & Operations Specialisation.

#### Table-2 : Group-B

Course Code	Course Name
FACGDSE07T	Financial Statement Analysis
FACGDSE08T	Business Ethics & Corporate Governance
FACGDSE09T	Retail Management and Marketing of Services
FACGDSE10T	Rural Marketing and International Marketing
FACGDSE11T	Internet & WWW and Functional e-Business System
FACGDSE12T	Computer Applications and e-Business Applications – Practical

Notes : Students must opt for FACGDSE07T and FACGDSE08T for Finance Specialisation, FACGDSE09T and FACGDSE10T for Marketing Specialisation and FACGDSE11T and FACGDSE12T for Systems & Operations Specialisation.

4

#### Year 1: Semester 1

FINANCIAL ACCOUNTING - I

Paper 1: Semester 1

Subject Code: FACGCOR01T

Full Marks: 75

[Internal assessment <u>–</u>25 Marks; Semester-end Examination – <u>50 Marks</u>] Total Credits: 6 [90 Hours] TOTAL CLASS HOURS: 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

Unit	Торіс	Details	Hours
1	Introduction	<ul> <li>Nature of accounting; Users of accounting information; Qualitative characteristics of accounting information.</li> <li>Double entry book keeping system – Basic accounting equation, meaning of assets, liabilities, equity, revenue and expenses. Accounting Cycle - Recording of transaction: Journal, Ledger and preparation of Trial Balance.</li> <li>Bases of accounting; Cash Basis and Accrual Basis.</li> <li>Basic concepts and conventions: entity, money measurement, going concern, cost, realization, accruals, periodicity, consistency, prudence (conservatism), materiality, matching and full disclosures.</li> </ul>	05
2	Determination of business income	<ul> <li>Revenue recognition: Meaning of revenue; objective; timing of recognition. Recognition of expenses</li> <li>Inventories: meaning. Significance of inventory valuation. Lower of cost or market rule; Inventory ascertainment and reconciliation.</li> <li>The nature of depreciationAccounting concept of depreciationFactors in the measurement of depreciationMethods of computing depreciation: Straight Line Method and Diminishing Balance Method; Disposal of depreciable assets; Change in estimate and method of charging depreciation. Accounting for depreciation: Asset-depreciation, Asset-provision.</li> <li>Reserves and provisions: Meaning; Objective; Types &amp; Accounting.</li> <li>Capital and revenue expenditures and receipts (general introduction only).</li> <li>Adjustment and rectification entries</li> </ul>	15
3	Introduction to Accounting Standard	Financial Accounting Standards: Concept, Benefits, Procedure for issuing accounting standards in India. Need for a global standard, IFRS (concept only).	

5

	Introduction to Accounting Theory	Concept of accounting theory; Relation with practice; GAAP; Capital – Capital Maintenance concepts; Limitations of Historic Cost accounting; Introduction to Fair Value accounting .	15
4	Final accounts of Trading Concern	Preparation of financial statements of sole proprietorship business entities from a trial balance – Manufacturing, Trading, P/L A/c and Balance Sheet.	15
5	Financial statements from Incomplete records and of NPO	Preparation of financial statements: a) from incomplete records b) of non-profit organization	15
6	Accounting for special sales transaction	<ul> <li>Consignment: Basic features; Difference with sales. Recording in the books of Consignor – at cost &amp; at invoice price, Valuation of unsold stock; Ordinary commission. Treatment and valuation of abnormal &amp; normal loss. Special commission; Del cruder commission (with and without bad debt) – Concept of Consignment Debtors; Recording in the books of Consignee.</li> <li>Accounting for sale on approval.</li> </ul>	
	Sectional and Self balancing ledger	• Concept of sectional balancing, Self balancing Ledger: advantages; Recording process; preparation of Adjustment accounts.	25
	Insurance claim for loss of stock and for loss of profit	<ul> <li>Loss of stock: Physical &amp; ownership concept; Concept of under-insurance and average clause; Computation of claim – with price change; Consideration of unusual selling line; price reduction etc.</li> <li>Loss of profit: Concept – Insured &amp; uninsured standing charges, GP rate, Short sales and increased cost of working, Average clause and computation of claim (simple problems).</li> </ul>	
			90**

\*\* including 15 hours for tutorial.

# Notes: Relevant Accounting Standards issued by the Institute of Chartered Accountants of India are to be followed.

#### Suggested Reading

- Sulk, Growl, Gupta: Advanced Accountancy Vol. I, S Chan
- \* R. L. Gupta & Radheswamy, Advanced Accountancy Vol. I, S. Chand
- Maheshwari & Maheshwari, Advanced Accountancy Vol. I, Vikash Publishing House Pvt. Ltd.
- Sehgal & Sehgal, Advanced Accountancy Vol. I, Taxman Publication
- ◆ B. Banerjee, Regulation of Corporate Accounting & Reporting in India, World Press.

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6

- Hanif & Mukherjee, Financial Accounting, McGraw Hill
- Frank Wood, Business Accounting Vol 1, Pearson
- Tulsian, Financial Accounting, Pearson
- ✤ Accounting Standards issued by ICAI
- Mukherjee & Mukherjee, Financial Accounting, Oxford Publishing House.

#### **PRINCIPLES AND PRACTICE OF MANAGEMENT**

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#### Paper 2 : Semester 1 Paper Code : FACGCOR02T

## Full Marks: 75

[Internal assessment <u>– 25 Marks</u>; Semester-end Examination – <u>50 Marks</u>] Total Credits : 6 [90 Hours] TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit 1. Introduction**

Management - Concept, Importance, Functions; Management as profession; Management as Science and Art, Universality of management; Levels of management; Managerial tasks and skills. Different Schools of Management Thought: Classical School--- Contributions of Taylor and Fayol; Neo-classical School---Human Relations approach and Behavioural Science approach.

#### Unit 2. Planning

Concept, Importance, Types, Steps, Barriers to effective planning and remedial measures; Strategic Planning---Concept; Forecasting---Concept, Techniques

#### Unit 3. Organizing

Concept, Importance, Principles, Departmentation – Need, Basis, Principles; Delegation of Authority--- Elements, Steps, Barriers; Centralization and Decentralization of Authority; Span of Management -Concept and determining factors.

#### **Unit 4: Directing and Staffing**

Concept of directing, Importance of directing, Leadership: Concepts, Importance, Types, Leadership Traits, Tannenbaum & Schmidt's Model, Blake & Mouton Model, Staffing: Concept & importance

#### Unit 5. Motivation, Co-ordination and Control

Motivation: Concepts, Importance, McGregor, Maslow and Herzberg theory of motivation, Co-ordination & Control: Concepts, Significance, Principles, Techniques, Steps, Control: Concepts, Importance and tools

#### **Suggested Readings**

- Koontz and Weirich, Essentials of Management, Tata McGraw Hill, New Delhi.
- ◆ Drucker, P F, Management Challenges for the 21st Century, Butterworth, Oxford.
- Luthans, F, Organizational Behavior, McGraw Hill, New York.
- ✤ Allen, L A, Management and Organisation, Tokyo.
- Stoner and Freeman, Management, PHI, New Delhi.
- Griffin, R W, Management, Houghtan Miffin, Boston.
- \* Tripathy, P C, Reddy, P N, Principles of Management, Tata McGraw Hill, New Delhi.
- Ravichandran, K, Nakkiran, S, Principles of Management, Avinash Paperbacks, Delhi.

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#### [20 L]

[10 L]

#### [20 L]

[20 L]

### 7

### [20 L]\*

- Jwalkar, Ghanekar & Bhivpathaki, Principles & Practice of Management, Everest Publishing House.
- \* L = 1 Hour.

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#### Year 1 : Semester 2

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#### **COST AND MANAGEMENT ACCOUNTING**

#### Subject Code : FACGCOR03T

Full Marks: 75

#### [Internal assessment <u>– 25 Marks</u>; Semester-end Examination – <u>50 Marks</u>] Total Credits: 6 [90 Hours]

#### TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

UNII	Topic	Content	nours
1	Introduction	Definition of costing, Objectives of Cost Accounting And Management Accounting, Cost Accounting Vs. Management Accounting, Installing a good Cost Accounting System, Essentials of good Cost Accounting System, Cost concepts, terms and classification of costs:(Cost, cost object, types of cost, classification of costs, Direct and Indirect cost, Element wise, Function wise ,Behavior wise , Sunk Cost, Opportunity cost, Costing Methods and Techniques(introduction only)	10 L*
2	Materials Material Costs	<ul> <li>Purchase of materials: Organization, Purchase procedure, Documentation, Determination of material purchase costs.</li> <li>Storage of materials: Need of storage, location and types, Functions of store keeper, requisition, receipt and issue and transfer of materials, storage record, accounting for material cost.</li> <li>Materials Control: Organization Tools : JIT purchase ; various stock levels; EOQ and ABC Analysis; Periodic Inventory; Perpetual inventory, Physical Verification; Discrepancies of stock and their treatment, Methods of Pricing Material Issues: FIFO,LIFO and Weighted Average, Treatment of Normal and Abnormal Loss of materials.</li> </ul>	10 L
3	Labour Employee Cost And incentive systems	Introduction, Recording Labour cost: Attendance and Pay roll Procedures (Time-Keeping, Time- Booking, Payroll procedure, payment of Wages- Piece rate, Differential piece rate, Time rate); Idle Time( Causes and treatment in Cost Accounting). Overtime (its effect and treatment in Cost Accounting) Labour Turnover( causes, impact and methods of calculating labour turn over). Main Principles for sound system of wage incentive shames, labour utilization; System of wage payment and incentives ( Halsey, Halsey-Weir, Rowan and Emerson). Systems of Incentive Schemes for indirect Worker; Component of wages cost for costing purpose.	15 L
4	Overhead	*Introduction : Definition, classification of overhead. Cost	00 I
	and	Statement-Functional and Benavioral.	20 L

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8

	Cost statement	*Manufacturing overheads: Allocation and Apportionment of overhead; Absorption of overhead ; various methods and their application; treatment of under-absorption/over-absorption of overheads. *Administration and Selling & Distribution Overheads and their charging : an introduction only. *Preparation of Cost Sheet and estimation	
5	Cost Book- keeping	Non-Integrated System: Meaning & Features; Ledgers Maintained ; Accounts prepared ; General/ Cost Ledger Adjustment Accounts; Meaning of closing balance in various accounts; Disadvantages. Reconciliation: Need for reconciliation; Items causing differences between Cost and Financial profits and their reconciliation.	10 L
6	Costing Methods	Job Costing (Job Cost Cards and data bases, collecting direct costs of each job, Attributing overhead costs to jobs, Application of job-costing), Batch Costing. Contract Costing – Progress payments, Retention money, Escalation clause, Contract accounts ,Accounting for material, Accounting for plant used in a contract, Contract profit and Balance Sheet entries. Service Costing and output costing: Introduction; Motor Transport Costing only. Process Costing : Meaning, Features, Process Vs. Job costing, Principles of cost ascertainment for materials, Labour & Overhead; Normal Loss and Abnormal Loss and Gain and preparation of Process Accounts. Inter process profit (Simple cases).)	25 L
			90 L**

\*\* including 15 hours for tutorial.

#### Suggested Readings

- ✤ B, Banerjee, Cost Accounting ,PHI
- ♦ M. Y. Khan & P. K. Jain Management Accounting, TMH
- ✤ Bhattacharyya, Ashish K. Cost Accounting for Business Managers, Elsevier.
- ✤ Hanif, M. Cost & Management accounting, Mc. Graw Hill.
- ✤ Mitra , J.K. Cost & Management Accounting, Oxford.

\* L = 1 Hour.

#### **BUSINESS MATHEMATICS AND STATISTICS**

\_\_\_\_\_

#### Paper 3: Semester 2 Subject Code : FACGCOR04T Total No. of Credits - 06 Full Marks 75 [Internal Assessment: 25 Marks Semester End Examination: 50 Marks] TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

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10

concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU. **Unit 1: Set Theory** 

Definition of Set and its presentation. Different types of Sets- Null Sets, Finite & Infinite Sets, Subsets, Universal Set, Power Set etc. Set Operations- Laws of Algebra of Sets, Venn diagram.

#### **Unit 2: Matrices and Determinants:**

Definition of a matrix, Types of matrices; Equality, Addition, Subtraction, and Multiplication; Transpose of a matrix; Determinant of a square matrix, Values of determinants up to third order; Properties of Determinants, minors and co-factors, Adjoint of a Matrix, Elementary row and column operations, Inverse of a matrix; Solution of a system of linear equations (having unique solution and involving not more than three variables) using matrix inversion Method and Cremer's Rule. [10 L]

#### **Unit 3: Basic Mathematics for Finance**

Functions and their types – linear, quadratic, polynomial, exponential, logarithmic; Concepts of limit and continuity of a function.

Concept of differentiation; Rules of differentiation – simple standard forms. Maxima and Minima of functions (involving first and second order differentiation) relating to cost, revenue and profit.

Different types of Interest Rates, concept of Present Value – Present Value and Annuity, Compounding & Discounting, amount of Annuity - Valuation of Simple Loans.

#### **Unit 4: Basics of Statistics**

Collection, classification of data, Primary & Secondary data, Tabulation of data, Graphs and charts, Frequency distribution, Diagrammatic presentation of frequency distribution.

#### Unit 5: Measure of Central Tendency & Dispersion

Measures of Central Tendency including arithmetic mean, geometric mean and harmonic mean: properties and applications; mode and median.

Measures of Variation: absolute and relative. Range, quartile deviation and mean deviation; Variance and Standard deviation: calculation and properties. [15 L]

#### **Unit 6: Bivariate Analysis**

Simple Linear Correlation Analysis: Meaning, and measurement. Karl Pearson's coefficient and Spearman's rank correlation.

Simple Linear Regression Analysis: Regression equations and estimation. Relationship between Correlation and regression coefficients. [20 L]

#### Unit 7: Time-based Data: Index Numbers and Time-Series Analysis

Meaning and uses of index numbers; Construction of index numbers: Aggregative and average of relatives - simple and weighted, Components of time series; additive and multiplicative models; Trend analysis: Finding trend by moving average method and Fitting of linear trend line using principle of least squares.

#### Suggested Readings

- ✤ Ghosh and Saha, Business Mathematics and Statistics, New Central Book Agency (P) Ltd.
- \* M. Raghavchari, Mathematics for Management, Tata McGraw-Hill.
- S. Baruah, Basic Mathematics and its application in Economics, McMillan.
- \* R. S. Bhardwaj, Mathematics for Economics and Business, Excel Books.
- ◆ P. K. Giri and J.Banerjee, Introduction to Business Mathematics, Academic Publishers.

#### (04 L)\*

[05 L]

[20 L]

[16 L]

- ◆ R.G.D. Allen, Mathematical Analysis for Economists, McMillan.
- ✤ G. C. Beri, Business Statistics, Tata McGraw-Hill.
- ✤ J. K. Sharma, Business Statistics, Pearson Education.
- Nag and Nag, Advanced Business Mathematics and Statistics
- D. Sengupta, Application of Calculas, Books & Allied.
- Dr. Ranjit Dhar, Business Mathematics & Statistics, Dishari.
- ♦ J. Chakrabarti, Business Mathematics and Statistics, Dey Book Concern.
- ✤ Maity and Ghosh, Calculus, Central.
- Singh J. K., Business Mathematics. Himalaya Publishing House.
- \* N.G. Das, Statistical Methods in Commerce, Accountancy and Economics
- \* Hazarika, Padmalochan. A Textbook of Business Mathematics. S. Chand
- Trivedi, Business Mathematics, Pearson
- ♦ Sanyal & Das, Introduction to Linear Programming, U.N. DHUR & SONS PVT. LTD.

#### \* L = 1 Hour.

#### Year 2 : Semester 3

#### **BUSINESS REGULATORY FRAMEWORK**

### Paper 1 : Semester 3 Subject Code : FACGCOR05T **Total No. of Credits - 06**

#### Full Marks 75

#### [Internal Assessment: 25 Marks **Semester End Examination: 50** Marks]

#### TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

1 The Indian Contract	a) Contract – meaning, characteristics and kinds,	
Act,1872	<ul> <li>Essentials of a valid contract</li> <li>b) Offer and acceptance (Definition, Rules, Communication and Revocation of offer and acceptance)</li> <li>c) Consideration (Definition, Elements, Types, Rules), "No Consideration No Contract" and its exceptions; Capacity to Parties (Definition and Types)</li> <li>d) Consent, Free consent, Coercion, Undue Influence, Fraud, Misrepresentation, Mistake</li> <li>e) Legality of objects and Consideration</li> <li>f) Void and Voidable agreements – Definition, Types and Distinction</li> <li>g) Discharge of a contract – Modes of discharge, Breach and Remedies against breach of contract</li> <li>h) Specific Contracts - Contingent contracts, Quasi,</li> </ul>	20 L
	<ul> <li>g) Discharge of a contract – Modes of discharge,</li> <li>Breach and Remedies against breach of contract</li> <li>h) Specific Contracts - Contingent contracts, Quasi,</li> <li>Contract of Indemnity, Guarantee, Bailment,</li> <li>Pledges</li> </ul>	

2	The Sales of goods Act, 1930	<ul> <li>a) Contract of sale, meaning and difference between sale and agreement to sell</li> <li>b) Conditions and warranties</li> <li>c) Transfer of ownership in goods including sale by a non-owner</li> <li>d) Unpaid seller - meaning, rights of an unpaid seller against the goods and the buyer</li> </ul>	10 L
3	The Partnership Laws 3A. The Partnership Act, 1932	<ul> <li>a. Definition - Partner, Partnership</li> <li>b) Nature and Characteristics of Partnership</li> <li>c) Types of Partners</li> <li>d) Registration of a Partnership Firms and consequences of non-registration</li> <li>e) Rights and Duties of Partners</li> <li>f) Dissolution of firms - meaning and grounds</li> </ul>	10 L
	3B. The Limited Partnership Act, 2008	<ul> <li>a) Definition</li> <li>b) Salient Features of LLP</li> <li>c) Advantages and disadvantages of LLP</li> <li>d) Differences between: LLP and Partnership, LLP and Company</li> <li>e) Incorporation of LLP</li> </ul>	10 L
4	The Negotiable Instrument Act,1881	<ul> <li>a) Definition, Features, Types, Parties of Negotiable Instruments: Promissory</li> <li>Note, bill of exchange, Cheque (Definition and Types)</li> <li>b) Endorsement: Types of Endorsement</li> <li>c) Holder and Holder in Due Course, Privileges of Holder in Due Course.</li> <li>d) Dishonour of Negotiable Instruments: Modes, Consequences, Notice of Dishonour; Noting and Protesting</li> <li>e) Discharge of Negotiable Instruments: Meaning and Modes</li> </ul>	20 L
5	The Consumers Protection Act,1986	<ul> <li>a) Objectives and features of Consumers Protection Act</li> <li>b) Definitions - Complainant, Complaint, Consumer, Consumer Dispute, Defect, Deficiency, District Forum, Person</li> <li>c) Unfair trade practices</li> <li>d) Consumer Protection Council (Central, State and District - their constitutions and objectives)</li> <li>e) Consumer Dispute Redressal Agencies: Composition and jurisdiction of District forum, State Commission and National Commission</li> </ul>	10 L
6	Electronic Commerce Act, 1998	<ul> <li>a) Definitions: Computer, Electronic signature, Internet, Information.</li> <li>b) Formation and Validity of Electronic Contracts (e- contracts) (Section 15)</li> <li>c) Effectiveness between parties(Section 16)</li> </ul>	10 L
			90 L**

\*\* including 15 hours for tutorial.

Notes : If any new provision is enacted in place of the existing provisions, the syllabus will accordingly include such new provisions in place of existing provisions with effect from such date as prescribed West Bengal State University. Similarly if any existing provision becomes redundant due to changes, it will be *left out of the syllabus*)

#### Suggested Readings

- Tulsian & Tulsian, Business Laws, S.Chand
- ✤ Kapoor N.D., Business Laws, Sultan Chand
- Das S.K. & Roy P., Business Regulatory Framework, OUP
- Gulsan S.S., Business Laws, Excel Books
- Roychowdhury, Bhattacharjee & Datta, Business Regulatory Framework, Elegant Publishers.
- Bhadra, Satpati and Mitra, Ainer Ruprekha (Bengali Version), Dishari.

\* L = 1 Hour.

### **INFORMATION TECHNOLOGY & ITS BUSINESS APPLICATIONS**

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Paper 2 : Semester 3 Subject Code : FACSSEC01M Total No. of Credits - 02 Full Marks 25

#### [Internal Assessment: 15 Marks **Semester-End Examination: 10** Marks]

#### TOTAL CLASS HOURS : 45 [LECTURE HOURS 15 & PRACTICAL HOURS 30]

#### <u>Module</u> I

#### Information Technology and Its Application in Business (Theory) **Unit 1: Information Technology and Business** [15 L]\* Concepts of data, information and computer based information system, impact of information technology on business [business data processing, intra-organizational and inter-organizational communication by using network technology, business process outsourcing and knowledge process outsourcing], types of Information System-Transaction Processing System (TPS), Management Information System (MIS), Decision Support System (DSS), Knowledge Management System (KMS) and their implementation at managerial levels [operational, tactical and strategic].

#### **Module II** Information Technology and Its Application in Business (Practical)

#### **Unit 2 : Word Processing**

Working with word document- Editing text, Find and Replace text, Formatting, Spell check, Autocorrect, Auto text; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, Macros, Drop cap; Tables: Inserting, Filling and formatting a Table, Inserting Pictures and Video; Mail Merge- including linking with Database, Printing documents.

Creating Business Documents using the above facilities

**Unit 2: Preparing Presentations** 

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[05 L]

[05 L]

Basics of presentations: Slides, Fonts, Drawing, Editing; Inserting: Tables, Images, texts, Symbols, Media; Design; Transition; Animation, Hyperlink and Slideshow. **Creating Business Presentations using above facilities.** 

#### **Unit 3: Spreadsheet and Computerised Accounting**

[20 L]

Managing worksheets- Formatting, Entering data, Editing, and Printing a worksheet; Handling operators in formula, Project involving multiple spreadsheets, Organizing Charts and graphs, Pivot Table.

**Spreadsheet Functions:** Mathematical [SUMIF, SQRT, SUBTOTAL, SUMPRODUCT etc.], Statistical [AVERAGE, STDEV, VAR, CORRELATION, REGRESSION etc.], Financial [PMT, RATE, PV, FV, NPER, IRR, NPV, Data Table Etc.] Logical [AND, OR, IF etc.], Date and Time, lookup and reference, Database and Text functions. **Tally** – Basic Features.

#### Suggested Readings

- Thareja, IT & Application, Oxford.
- ✤ Aurora, Computer Fundamentals, Vikash.
- Sinha & Sinha, Fundamentals of Computers, BPB Publications.
- Dhar, P., Fundamental of IT and Its Application in Business, Abhijay Publishing House.
- ♦ Norton, P. (2001). Introduction to computers. TMH
- Rajaraman, V. (2004). Introduction to Information Technology. PHI.
- Cyganski Information Technology: Inside and outside (Pearson, 1st Edition).
- Basandra SK Computers Today (Galgotia, 1st Edition).
- Leon A and Leon M Introduction to Computers (Leon Vikas, 1st Edition).

\* L = 1 Hour.

### FINANCIAL ACCOUNTING II

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Paper 3 : Semester 3

#### Subject Code : FACGCOR06T

#### Total No. of Credits - 06

#### Full Marks 75

#### [Internal Assessment: 25 Marks Semester End Examination: 50

Marks]

TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

Unit	Topic	Details	Hours
1.	Partnership	Profit and Loss Appropriation Accounts	20
	Accounts - I	Capital & Current A/C, Correction of appropriation	
		items with retrospective effect.	
		Change in Constitution of Firm	
		Change in profit sharing ratio, Admission, Retirement,	
		Retirement cum Admission - treatment of Goodwill,	
		revaluation of assets and liabilities (with/without	
		alteration of books), treatment of reserves and	
		adjustment relating to capital, treatment of Joint Life	
		Policy, Death of a Partner.	
2.	Partnership	Accounting for Dissolution of Firm	25
	Accounts - II	Insolvency of one or more partner, Consideration of	

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		private estate and private liabilities, Piecemeal	
		distribution (Surplus Capital basis and Maximum	
		Possible Loss Basis).	
		Conversion of Partnership into Limited Company	
3.	Branch	Concept of Branch, Types of Branches.	10
	Accounting	Synthetic Method - Preparation of Branch Account,	
		Branch Trading & P/L Account (at cost and at invoice	
		price) – normal and abnormal losses.	
		Analytical Method – Preparation of Branch Stock	
		Adjustment Account (at cost and at invoice price) -	
		normal and abnormal losses.	
4.	Hire Purchase	Meaning, Difference with Instalment payment system,	13
	and Instalment	Allocation of Interest.	
	Payment	Partial and Complete Repossession. Concept of	
	System	Operating and Financial Lease (Theory only).	
5.	Departmental	Concept, Objectives of preparation of departmental	10
	Accounts	accounts.	
		Apportionment of common cost, Preparation of	
		Departmental Trading & P/L Account, Consolidated	
		Trading & P/L Account, Inter departmental transfer of	
		goods at cost; cost plus and at selling price and	
		elimination of unrealized profit.	
6.	Investment	Preparation of Investment Account – treatment of	12
	Accounts	brokerage, STT, cum and ex – interest, Valuation of	
		Investment under FIFO and Average method.	
		Preparation of Investment Account for Shares (with	
		Right Shares, Bonus Shares and Sale of Right).	
		Transfer of securities (Simple problem).	
			90**

#### \*\* including 15 hours for tutorial.

#### Notes : Companies' Accounting Standards Rules 2005 as amended from time to time are to be followed.

#### Suggested Readings

- Sukla , Grewal, Gupta : Advanced Accountancy Vol. I & II, S Chand.
- R.L.Gupta & Radheswamy, Advanced Accountancy Vol. I & II, S Chand.
- ◆ Maheshwari & Maheshwari, Advanced Accountancy Vol. I & II, Vikash Publishing House Pvt. Ltd.
- Sehgal & Sehgal, Advanced Accountancy Vol. I & II, Taxman Publication.
- ✤ Basu Amitabha, Principles and Applications of Accounting Vol. II, Tee Dee Publications.
- Hanif & Mukherjee, Financial Accounting Vol. II, McGraw Hill.
- ✤ Accounting Standards issued by ICAI.

#### Year 2 : Semester 4

### **TAX RETURNS & FILING OF TAX RETURNS** Paper 1 : Semester 4 Subject Code : FACSSEC02M Total No. of Credits - 02

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#### Full Marks 25

### [Internal Assessment: 15 Marks Semester-End Examination: 10 Marks]

#### TOTAL CLASS HOURS : 45 [LECTURE HOURS 15 & PRACTICAL HOURS 30]

#### **UNIT 1: Income Tax Returns**

a) PAN and TAN- Procedure for application of PAN/TAN; Defective Return, Revised Return, Belated Return, Provisions regarding TDS from salary, interest on securities, horse racing, lottery.

b) Advance Tax (simple problems).

c) Interest- Interest u/s 234A, 234B, 234C, (simple problems)

d) Different Forms of Returns

e) Different TDS Returns

#### UNIT 2: E-filing of Tax Returns

a) Preparation and submission of the Income Tax Returns (ITR-1 and ITR-2) offline/online for individual taxpayer, EVC.

b) View form 26AS, Upload return, View e-file returns, e-verification

c) Use of e-tax calculator (including interest calculation u/s 234A, 234B, 234C)

d) E-Pay tax (Challan No. ITNS 280 and ITNS 281)

e) e-TDS Return filing

**Notes : For Project Work -** Assignment based on each and every topic should be prepared.

#### Suggested Readings

 Software: Singhania, V.K., E-Filing of Income Tax Returns and Computations of Tax, Taxmann

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Software: "Excel Utility", incometaxindiaefiling.gov.in.

#### \* L = 1 Hour.

#### DIRECT & INDIRECT TAXATION Paper 2 : Semester 4 Subject Code : FACGCOR10T Total No. of Credits - 06 Full Marks 75 [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks]

**Objective** – To provide basic knowledge of principles and provisions of Income Tax and GST Laws.

#### Module I : Income Tax

**UNIT 1: a) Basic Concepts of Direct and Indirect Taxes;** Definitions under IT Act: Assessee, Previous year, Assessment year, Person, Income, Sources of income, Heads of income, Gross total income, Total income; **b) Residential Status and Incidence of Tax of Individual Assessee; c) Exempted income** – u/s 10(1), 10(10), 10(10A), 10(10AA),

(15 L)\*

[30 L)

10(10D), 10(11), 10(12), 10(13A), 10(14), 10(15), 10(34), 10(35), 10(38).

#### UNIT 2: Computations of Taxable Income under the head:

a) Salaries and b) Income from House Property

**UNIT 3: a) Profits and Gains of Business or Profession** [sec. 28, 32, 36(1), 36(1)(ii), 36(1)(iii), 36(1)(vii), 37, 40A(3), 43B]; b) Capital Gains: Meaning and types of capital assets, simple computation of STCG and LTCG; c) Income from Other Sources: Basis of charge excluding deemed dividend (20 L)

UNIT 4: Set off and carry forward of losses; Deductions u/s 80 - 80C, 80CCC, 80CCD, 80CCE, 80D, 80E, 80G, 80GG, 80TTA; Rebate u/s 87A; Computation of total income and tax liability of individual assessee. (15 L)

**UNIT 5: Filing of Returns:** Due date of filing return, different types of returns, PAN, TDS – Basic Concept; Different types of assessment (Basic concepts only); Advance tax for individuals – due dates for advance payment of tax. **(05 L)** 

#### Module 2 : Goods & Service Tax

**UNIT 6:** Goods and Services Tax – Concept, GST council; Pre- and post-GST indirect tax structure in India; Types of GST – Central GST, State/UT GST and Integrated GST; Rates of GST; Registration; Meaning of taxable event; Meaning of goods and services; Supply of goods and services; Input tax, Input tax credit for payment of SGST, CGST, UTGST and IGST; Reverse Charge – Meaning; Composition Levy – Meaning, advantages and disadvantages of Composition Levy, Payment of GST and filing of returns.

(15 L)

(15 L)

(20 L)

**Notes:** [If any new legislation/provision is enacted in place of the existing legislation/provision, the syllabus will be modified accordingly to include such new legislation/provision in place of existing legislation/provision with effect from such date as prescribed by the West Bengal State University. Similarly, if any existing provision becomes redundant due to changes, it will be left out of the syllabus.]

#### Suggested Readings

- Singhania, M. and Singhania, V., Students' guide to Income Tax including GST, Taxmann.
- ✤ Ahuja and Gupta, Systematic Approach to Taxation Containing Income Tax and GST, Wolters Kluwer.
- ♦ V.S. Datey, GST Law & Practice with Customs & FTP, Taxmann.
- ✤ Raj K Agrawal and Shivangi Agrawal, Indirect Taxes, Bharat.
- Sengupta, C.H., *Simplified Approach to Direct & Indirect Taxes*, Dey Book Concern.
- Publication on GST by the Institute of Chartered Accountants of India (www.icai.org).
- Publication on GST by the Central Board of Excise and Customs (www.cbec.org).
- Relevant Bare Acts and Rules.

#### P.S. Latest edition of the books may be read.

#### **BUSINESS ECONOMICS**

#### Paper 3 : Semester 4

Paper Code : FACGCOR08T

#### Full Marks: 75

[Internal assessment – 25 Marks; Semester-end Examination – 50 Marks] **Total Credits: 6 [90 Hours]** TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit 1: Consumer Theory**

Indifference curve approach: Consumer's preferences; Budget line; Consumer's equilibrium; Income consumption curve, Price consumption curve and the derivation of demand curve for a commodity (Normal, Inferior, Giffen); Hicksian decomposition of price Effect into income and substitution effect.

#### Unit 2: Demand & Supply

(a) Demand and Supply: Law of demand, Determinants of demand, Movements vs. shift in demand curve, Exceptions to the law of demand, Determinants of Supply, Movement along a supply curve vs. shift in supply curve; Market equilibrium and price determination.

(b) Measurement of various Elasticity of demand, Elasticity of supply.

#### **Unit 3: Production and Cost**

(a) Production: Concept of production and production function, Homogeneous production function; Law of variable proportions; Isoquant: definition and properties, Return to scale.

(b) Costs: Costs in the short run and in the long run.

#### **Unit 4: Market Structure**

(a) Perfect Competition: Assumptions --Theory of a firm under perfect competition, Demand and Revenue, Equilibrium of the firm in the short run and long run.

(b) Monopoly: Short-run and long-run equilibrium of monopoly firm, Concept of supply curve under monopoly, Allocation inefficiency and dead-weight loss monopoly, Price discrimination.

(c) Imperfect Competition: Difference between perfect competitions, monopoly and imperfect competition; (i) Monopolistic Competition: Assumptions; Short run and Long run Equilibrium. (ii) Oligopoly, Duopoly – basic characteristics.

#### **Unit 5 : National Income**

National Income Accounting, Concepts of GDP, GNP, NNP, NDP, Real and Nominal National Income, Circular flow of income

#### Unit 6 : Money and Inflation

Concept of demand for and supply of money --Quantity theory of money and Keynesian theory of demand for money, Measures of money supply, High powered money, Concept of Inflation, Demand-pull and cost push theories of inflation, Monetary and fiscal policies to control inflation.

#### **Suggested Readings**

- Gould & Ferguson, Micro Economic Theory
- Banerjee & Majumdar, Business Economics and Business Environment, ABS
- Banerjee & Majumdar, Banijjik Arthaniti –o-Banijjik Paribesh (Bengali)
- Dwivedi, D.N., Managerial Economics, Vikash Publications
- Mankiw.N.G., Principles of Microeconomics, Cengage

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[12 L]

# [18 L]\*

[18 L]

[12 L]

Das, P. & Sengupta A., Economics , Oxford

Samuelson & Nordhaus, Macroeconomics, McGraw Hill

\* L = 1 Hour.

Year 3 : Semester 5

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#### AUDITING

### Paper 1 : Semester 5 Subject Code : FACGGEC01T Total No. of Credits - 06 Full Marks 75

[Internal Assessment: 25 Marks **Semester-End Examination: 50** Marksl

TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit** –**I** : Introduction

Auditing : Introduction, meaning, objectives, basic principles and techniques, advantages and limitations, classification of audit. Audit planning and procedures relevant documents. Internal control-internal check and internal audit, vouching and verification of Assets and liabilities (including relevant SAP's)

#### **Unit-II: Audit of Companies**

Audit of limited companies: Company auditor - qualifications and disqualifications, Appointment, Rotation, Removal, Remuneration, Rights and Duties, Auditor's Report, Liabilities of Statutory Auditors under the Companies Act, 2013.

Divisible profits and dividend with special reference to depreciation, provisions and reserves as per Companies Act, 2013.

#### **Unit-III: Audit Report and Certificate**

Audit Report- Definition, features, scope, value of Auditors Report, difference between Audit Report and Certificate, Types of Audit Report, Contents of Audit Report as per Companies Act, 2013, True and Fair View.

#### **Unit- IV: Audit of different Institutions**

Audit of Educational Institutions, Library, Hospital, Club, Hotel, Transport Company and co-operative societies.

Audit of Local Govt.-Gram Panchayat, Panchayat -Samity and Zilla-Parishad, Municipality and Municipal Corporation.

#### **Unit-V : Special Areas of Audit**

Special features of Cost Audit, Management Audit, Tax Audit, Social Audit, Environmental Audit, Energy Audit.

#### Suggested Readings

- \* Ravinder Kumar and Virender Sharma, Auditing Principles and Practices, PHI Learning
- VAruna Jat, Auditive, Taxale Publication
- Tandon, et al. Practical Auditing, S.Chand
- ✤ Basu, S.K. Auduting , Pearson
- Gangapadhyay and Sengupta .Auditing, Dey Books Concern

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(25 L)

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#### (15 L)

Sengupta, R.N. Practical Guide to Auditing ,New Central Book Agency Pvt.Ltd.

\* L = 1 Hour.

#### ENTREPRENEURSHIP DEVELOPMENT

#### Paper 2: Semester 5 Subject Code : FACSSEC03M Total No. of Credits - 06 Full Marks 75 [Internal Assessment: 25 Marks **Semester-End Examination: 50** Marks] TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit-I: Introduction**

Meaning, elements, determinants and importance of entrepreneurship and creative behaviour; Dimensions of entrepreneurship: intrapreneurship, technopreneurship, cultural entrepreneurship, international entrepreneurship, netpreneurship, ecopreneurship, and social entrepreneurship.

Unit-II: Entrepreneurship and Micro, Small and Medium Enterprises [18 L] Basic concept of business houses, Role of business houses and family business in India; The contemporary role models in Indian business: their values, business philosophy and behavioural orientations; Conflicts in family business and its resolution.

#### **Unit-III: Sustainability of Entrepreneurship**

Public and private system of stimulation, support and sustainability of entrepreneurship; Role of Central Government and State Government in promoting entrepreneurship; Requirement, availability and access to finance, marketing technology, industrial assistance, and accommodation, Role of industries/entrepreneur's associations and self-help groups; The concept, role and functions of business incubators, angel investors, venture capital and private equity fund

#### Unit-IV: Sources of business ideas and tests of feasibility

Significance of writing the business plan/ project proposal; Contents of business plan/ project proposal; Designing business processes, location, layout, operation, planning & control; preparation of project report; Project submission/ presentation and appraisal thereof by external agencies, such as financial/non financial institutions.

#### **Unit-V: Mobilization of Resources**

Mobilizing resources for start-up -- Accommodation and utilities; Preliminary contracts with the vendors, suppliers, bankers, principal customers: Basic start-up problems

#### Suggested Readings

- Kuratko and Rao, Entrepreneurship: A South Asian Perspective, Cengage Leaning.
- \* Robert Hisrich, Michael Peters, Dean Shepherd, Entrepreneurship, McGraw-Hill Education
- ✤ Desai, Vasant. Dynamics of Entrepreneurial Development and Management. Himalaya
- Holt, Entrepreneurship: New Venture Creation, Pearson

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#### [30 L]

# [18 L]\*

# [12 L]

[12 L]

- Singh, Nagendra P. Emerging Trends in Entrepreneurship Development. New Delhi: ASEED.
- SS Khanka, Entrepreneurial Development, S. Chand & Co, Delhi.
- \* K Ramachandran, Entrepreneurship Development, McGraw-Hill Education
- Reddy, Entrepreneurship: Text & cases, Cengage Learning.

#### \* L = 1 Hour.

**DISCIPLINE-SPECIFIC ELECTIVE SUBJECTS** 

#### A. Accounting & Finance Specialisation

#### BANKING AND INSURANCE

Paper DSE1 : Semester 5

Subject Code : FACGDSE01T Total No. of Credits - 06

### **Full Marks 75**

#### [Internal Assessment: 25 Marks **Semester-End Examination: 50** Marks]

TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit-1: Introduction**

Origin of banking: definition, banker and customer relationship, General and special types of customers, Types of deposits, Origin and growth of commercial banks in India. Financial Services offered by banks, changing role of commercial banks, types of banks.

#### **Unit-2: Cheques and Paying Banker**

Crossing and endorsement - meaning, definitions, types and rules of crossing. Duties, Statutory protection in due course, collecting bankers: duties, statutory protection for holder in due course, Concept of negligence.

#### **Unit-3: Bank Lending**

Principles of sound lending, Secured vs. unsecured advances, Types of advances, Advances against various securities, NPA Management.

#### **Unit-4: Internet Banking**

Meaning, Benefits, Home banking, Mobile banking, Virtual banking, E-payments, ATM Card/Biometric card, Debit/Credit card, Smart card, NEFT, RTGS, ECS (credit/debit), E-money, Electronic purse, Digital cash.

#### **Unit-5: Insurance**

Basic concept of risk, Types of business risk, Assessment and transfer, Basic principles of utmost good faith, Indemnity, Economic function, Proximate cause, Subrogation and contribution, Types of insurance: Life and Non-life, Re-insurance, Need for coordination. Power, functions and Role of IRDA, Online Insurance.

#### Suggested readings:

#### [15 L]

[15 L]\*

[15 L]

[15 L]

[30 L]

Agarwal, O.P., Banking and Insurance, Himalaya Publishing House. Satyadevi, C., Financial Services Banking and Insurance, S.Chand. Suneja, H.R., Practical and Law of Banking, Himalya Publishing House. Chabra, T.N., Elements of Banking Law, Dhanpat Rai and Sons. Arthur, C. and C. William Jr., Risk Management and Insurance, McGraw Hill. Saxena, G.S; Legal Aspects of Banking Operations, Sultan Chand and Sons. Varshney, P.N., Banking Law and Practice, Sultan Chand and Sons. Jyotsna Sethi and Nishwan Bhatia, Elements of Banking and Insurance, PHI Learning.

\* L = 1 Hour.

#### **CORPORATE ACCOUNTING**

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Paper DSE2 : Semester 5 Subject Code : FACGDSE02T Total No. of Credits - 06 Full Marks 75

#### [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks]

TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

UNIT	AREA/TOPIC	HOURS
UNIT-1	COMPANY FINAL ACCOUNTS	
	✤ Introduction of Company Act relevant for preparation	3
	of Statement of Profit and Loss Account and Balance	
	Sheet	
	✤ Preparation of Statement of Profit and Loss Account	10
	and Balance Sheet of domestic company	
	Schedule III of the Companies Act 2013, treatment of	2
	Tax Transfer to Reserve, Dividend applicable Tax ( out	
	of Profit and Reserve)	
UNIT-2	Introduction of company and Accounting for Shares	
	and Debentures	
	<ul> <li>Documents of a Company: Maintenance of books of</li> </ul>	1
	accounts including Statutory Books and Annual	
	Return	
	• Meaning and types of shares ;Rules and Regulations	1
	according to Company Act 2013 relevant to issue and	
	Accounting for issue and forfeiture re-issue of shares-	8
	pro-rata, other than cash, to Promoters: Meaning of	Ũ
	Debenture, Issue and Redemption of Debenture	
	✤ Bonus Shares and Right Shares- Rules and	1
	Accounting Procedures	
	<ul> <li>Underwriting of Shares- Rules and Accounting</li> </ul>	2
	Procedures	
	<ul> <li>Employees Stock Option Plan- Rules and Accounting</li> </ul>	2

	procedure for ESOP and ESPS.	
Unit-3	Buy back of Shares and Redemption of Preference	
	Shares	
	<ul> <li>Rules and accounting for buy back</li> </ul>	2
	$\boldsymbol{\diamondsuit}$ Redemption of Preference Shares ( with and without	3
	Bonus Shares)	
Unit-4	Valuation of Goodwill and Shares	
	✤ Goodwill: Meaning and types; Valuation of goodwill	4
	using different methods, need for valuation	
	<ul> <li>Valuation of Equity Shares (both fully and partly paid)</li> </ul>	8
	by using intrinsic value and yield value method &fair	
	value, cum-dividend and ex-dividend; majority and	
	minority point of view. Valuation of Preference Shares,	
	Bonus Shares, Right Shares	
UNIT-5	Amalgamation, Absorption and Reconstruction of	
	Company:	
	✤ Amalgamation- meaning and differences, causes of	10
	amalgamation, Recommendation and Application of	
	AS-14 (old), Business Combination (Ind AS-	
	103). Accounting for Amalgamation in the nature of	
	merger and in the nature of purchase. Absorption of	
	Company ( with inter-company investment) Schemes	
	for Amalgamation	
	Reconstruction- Internal and External-Provisions	10
	rules and accounting Schemes for internal	10
	reconstruction	
UNIT-6	Liquidation of Companies	
	<ul> <li>Meaning, types and procedures</li> </ul>	1
	<ul> <li>Statement of Affairs</li> </ul>	5
	<ul> <li>Liquidator's final statement of accounts</li> </ul>	5
		0
UNIT-7	Accounting for Holding Company	
	<ul> <li>Meaning, Legal requirements, relevant accounting standard</li> </ul>	2
	Statiualu	
	Consolidation Procedure as per AS 21(old) and	10
	relevant terms and issues as per Ind AS 27	
	◆ Preparation of Consolidated Balance Sheet (Simple	
	Holding)	
	<u>.</u>	90**

\*\* including 15 hours for tutorial.

#### Suggested Reading

- Sukla, Grewal, Gupta: Advanced Accountancy Vol. II, S Chand
- \* R. L.Gupta & Radheswamy, Advanced Accountancy Vol. II, S. Chand
- Maheshwari & Maheshwari, Advanced Accountancy Vol. II, Vikash Publishing
- Sehgal & Sehgal, Advanced Accountancy Vol. I II, Taxman Publication
- ✤ Hanif & Mukherjee, Financial Accounting, Vol III, TMH
- Frank Wood, Business Accounting Vol II, Pearson
- V.K.Goyal, Corprate Accounting, Excel Books
  Rajasekaran, Corporate Accounting, Pearson
- ✤ Accounting Standards issued by ICAI

\* L = 1 Lecture Hour.

#### **B.** Marketing Specialisation

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#### **CONSUMER BEHAVIOUR & SALES MANAGEMENT**

#### Paper DSE3 : Semester 5 Subject Code : FACGDSE03T

#### Total No. of Credits - 06

#### **Full Marks 75**

#### [Internal Assessment: 25 Marks **Semester-End Examination: 50**

**Marks**]

TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit 1: Consumer Behaviour – Concept and Overview**

Concept of Consumer Behaviour, model of consumer decision-making -- input, process, output. Steps in the process - need identification, information search, evaluation of alternatives, purchase decision, post-purchase behaviour.

#### **Unit 2: Factors Affecting Consumer Behaviour**

Internal: Needs and motives, perception, learning, attitudes, personality and lifestyle. External: Family, Reference groups, social class and culture.

#### **Unit 3: Consumer Versus Organisatonal Buying Behaviour**

Characteristics, Consumer versus organizational buying behavior, factors affecting organizational buying behavior. (5L)

#### **Unit 4: Sales Force Management**

Objectives, Strategies, Structure, Size of Sales Force; Compensation of Sales Force. Recruitment, Selection, Placement, Transfer, Training and Development, and Grievance, Handling of Sales Force; Motivating, Leading and Communicating with the Sales Force; Performance Evaluation of Sales Force.

#### **Unit 5: Sales Management Process**

Nature and Importance; Personal Selling as a Career; Steps in Personal Selling -Prospecting, Pre-approach and qualifying. Methods of Approaching a Customer; Presentation – Planning, Process and Styles; Handling Customer Objections; Types of Objections; Negotiations- Bargaining approaches, Bargaining Strategies and Tactics during Negotiation. (15L)

#### Unit 6: Salesmanship and Buyers' Behaviour

Functions and Qualities of a Salesman; Understanding Buyer Behaviour and Buyer-Interactions; Product knowledge; Customer Knowledge; Relationship Seller Management, Types of Selling; Effective Sales Process; Executing and Following up of Sales Order.

#### **Suggested Readings:**

Consumer Behaviour – Schiffman & Manuk, PHI.

Consumer Behaviour – Soloman, PHI.

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(20 L)\*

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# [15 L]

- Consumer Behaviour Loudon & DellaBitta, TMH
- Cundiff, Still and Govoni, Sales Management, PHI, New Delhi.
- Smith, R., Sales Management, PHI, New Delhi.

\* L = 1 Hour.

# PRODUCT & PRICING MANAGEMENT AND MARKETING COMMUNICATION

#### Paper DSE4 : Semester 5 Subject Code : FACGDSE04T

### Total No. of Credits - 06

Full Marks 75

#### [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks]

TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### **Unit 1: Product**

Meaning & concept of Product, features, importance, classification, Levels of Product Service: Meaning & features. Classification of Services. Product Mix – length, width, depth, consistency, BCG Matrix. PLC – concept, features and strategies, uses and limitations, different shapes of PLC.

#### **Unit-2: New Product Development**

New Product – Definition, stages of New Product Development, factors affecting new product development, adoption process, diffusion of industrial innovation. New Product failure- reasons, test marketing – definition, advantages and disadvantages. Meaning & functions of Packaging, packaging strategies, packing notes and packing lists, Package Aesthetics, legal & ethical aspects of packaging, features of good packaging. Concept & Importance of Branding, Brand Selection Process; strategies, brand positioning, brand repositioning strategies, leader positioning and follower positioning.

#### **Unit-3: Pricing**

Concept & Importance of Pricing, features of pricing, factors determining effective pricing, process of price setting, pricing objectives and methods, resale price maintenance – concept, advantages, disadvantages, importance of price in consumer buying process, various aspects of service pricing, price cartel, Pricing in Indian context, regulatory price environment.

#### **Unit 4: Marketing Communications**

Concept & Importance of Marketing Communication, Steps involved in the process of Communication, Barriers to Marketing Communication, Marketing Communication Mix: Concept & Elements, Concept and Importance of Advertising, Sales Promotion, Personal Selling & Publicity, Advertising Media: Types. New Trends in Marketing Communication.

#### **Unit-5: Advertising Process**

Advertising Appeal, Copy Writing, Headline, Illustration, Message, Copy Type, Campaign Planning, Different Types of Media, Media Planning, Scheduling. Advertising

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Agency Roles, Relationships with Clients, Role of Advertising Department, Measuring Advertising Effectiveness, Legal and Ethical Aspects of Advertising.

#### Unit 6: Sales Promotion

[15L]

Meaning, Nature and Function, Types, Sales Promotion Techniques (Sample Distribution, Coupon, Price off, premium plan, Consumer contests, Displays Demonstration, Trade Fairs and Exhibitions, Role of Sales force, Limitation of Sales Promotion.

#### Suggested Readings:

- Kotler and Kellar, Marketing Management, Pearson.
- William and Ferrell, Marketing, Houghton Miffin McGraw-Hill.
- Neelamegham, Marketing in India: Cases and Readings, Vikas Publishing.
- Majumder, Product Management in India, PHI.
- Srivastava, R. K., product Management & New product Development, Excel Book.
- Ramaswamy and Namakumari, Marketing Management, Macmillan India.
- Srinivasan Case Studies in marketing: The India Context, PHI.
- Batra and Myers, Advertising Management, Prentice Hall
- Sengupta, Brand Positioning Strategies for Competitive Advantage, TMH
- Cundiff, Still and Govoni, Sales Management, Prentice Hall
- Rossiter and Percy, Advertising and Promotion Management, MacGraw-Hill Sundage,
- Fryburger and Rotzoll, Advertising Theory and Practice, AITBS
- Belch and Belch, Advertising and Promotion, McGraw Hill

\* L = 1 Hour.

#### C. Systems & Operations Specialisation

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#### **FUNDAMENTALS OF COMPUTER**

#### Paper DSE5 : Semester 5

### Subject Code : FACGDSE05T Total No. of Credits – 06 [5+1]

#### Full Marks 75

#### [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks]

#### TOTAL CLASS HOURS : 105 [LECTURE HOURS 75 & PRACTICAL HOURS 30]

#### **Unit 1 :Digital Computer Systems**

Evolution of Digital Computer Systems – supercomputer, mainframe, minicomputer, server, microcomputer, workstation; Mobile Computing; Block Diagram of Digital Computer Systems; Functioning of Microprocessor; Data processing - Machine Instruction Cycle; Computer Hardware I/O Components; Computer Memory Hierarchy.

#### Unit 2 :Computer Software

Programming languages – Low level and High level; Systems Software - Machine language, Assembly Language, Operating Systems – features, types; Systems Control Programs - Disk Operating System and Batch File Programming; Language processors -

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#### [15 L]\*

[15 L]

Translator, Compiler and Interpreter ;High level language - Application Software, Utility Software, Open Source OS & software; Software Security Issues, Ethical Hacking.

#### **Unit 3 :Number System and Binary Arithmetic**

Positional Number Systems - Decimal, Binary, Octal, Hexadecimal; Data Representation - decimal-binary& alphanumeric representation (BCD, EBCDIC, Gray Code, Unicode, ASCII); Fixed Point and FloatingPoint Representation; Binary Arithmetic - Addition, Subtraction, Multiplication; Signed Number Representation - One's Complement, Two's Complement.

#### Unit 4 : Logic Gates and Boolean Algebra

Digital Logic Gates; Boolean Algebra; Representation of Boolean function - Truth Table, Logic Diagrams, Simplified Circuits.

#### Unit 5 :Basic Programming Techniques - an Overview

Program execution modes - Batch, Online, Time-sharing; Procedure-Oriented Programming (POP) - Algorithm and Flowcharting techniques to a given problem (branching, looping); Object-Oriented Programming (OOP) - meaning of Object, Class, Data Abstraction & Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing; Benefits & applications of OOP; Structured Programming.

#### Unit 6 : Programming in Basic / C/ C++(Practical)

Basic Syntax; Saving, Running, Merging, Erasing Programs, Getting Data into the Memory, Restore Statement; Workings with constants & variables, arithmetic expressions, relational expressions, printer controls, jumping (GO TO statement), branching (IF..THEN statement), looping (FOR..NEXT statement), subscripted variables, functions & subroutines.

Note : (Alternative if not covered in other modules) Unit 6 : Computerized Accounting -**Practical** Tally.

#### **Suggested Readings**

- \* Turban, Rainer, Porter. Introduction to Information Technology. Wiley India.
- ✤ Mano, Morris. Computer System Architecture. PHI India.
- Thareja, R. Information Technology and Its Applications in Business. Oxford India.
- Dhar, P. Computer Application in Business. ABS Publishing House.
- ♦ Jana, Samanta. Overview of Information Technology & its Applications in Business, NCBA.
- Salagurusamy, E. Object-Oriented Programming with C++. Tata MG Hill.
- ✤ Balagurusamy, E. Programming in Basic. Tata MGHill.
- ✤ Kanetker,Y. Let Us C. BPB Publ.

\* L = 1 Hour.

### **DATABASE MANAGEMENT SYSTEM & NETWORKING**

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Paper DSE6 : Semester 5 Subject Code : FACGDSE06T Total No. of Credits – 06 [5+1] Full Marks 75

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[15 L]

[15 L]

[15 L]

[30 L]

#### [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks]

#### TOTAL CLASS HOURS : 105 [LECTURE HOURS 75 & PRACTICAL HOURS 30]

Unit 1. Introduction to DBMS: Concepts of database and database managementsystem(DBMS). Data abstraction. Architecture – three schema architecture.Administration roles.[15 L]\*

Unit 2. Data models & Languages : hierarchical model, network model and relational model. Database languages: Data Definition Language (DDL), Data Manipulation Language (DML), and Data Control Language(DCL). [15 L]

Unit 3. SQL – An Overview: SQL constructs, embedded SQL , Query & Query Optimization Techniques. (Practical) [30 L]

Unit 4. Database Design & Normalisation : Design phases - conceptual, logical and physical . ER diagram and model. Database Normalisation: Concept. Normal forms - 1NF, 2NF, 3NF, BCNF. (15 L)

Unit 5. Indexing; Single level indexing - Primary, Clustering, Secondary. Multilevel indexing. (15 L)

Unit 6 : Networking Internet and E-Communication : Data Transmission, Goal ofNetwork, Network Architecture, LAN, WAN, Various Topologies, Communication Media,Basic Network Concepts, Client-server Concept, Internet – concept, history,Development in India,[15 L]

#### **Suggested Readings:**

- ✤ Korth, Data Base System Concepts, TMH
- ✤ Leon, Data Base Management System, VIKAS
- Ivan Bayross, PL/SQL Programming
- The Complete reference Office Xp- Stephan L. Nelson, Gujulia Kelly (TMH)
- Science and Communication Engineering R. Rajaram (SCITECH)
- Dhar, Pranam, Computer Application in Business, ABS Publishing House.
- Sinha, P.K., Priti Sinha (2002). Foundation of computing. BPB Publications.
- ♦ James, A. O'Brien (2005). Introduction to Information Systems. TMH
- ♦ Norton, P. (2001). Introduction to computers. TMH.

\* L = 1 Hour.

#### Year 3 : Semester 6

MARKETING MANAGEMENT AND HUMAN RESOURCE MANAGEMENT Paper 1 : Semester 6 Subject Code : FACGGEC02T Total No. of Credits - 6 Full Marks 75 [Internal Assessment: 25 Marks Semester End Examination: 50 Marks]

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#### **Total Credits: 6 [90 Hours]** TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

#### Module: I - Marketing Management (3 Credit)

#### **Unit – 1: Introduction to Marketing Management**

Marketing Management: Definition, Nature & Importance, Distinction between selling & marketing. Traditional & Modern Concept of marketing. Concept of Marketing Environment: Micro & Macro environment of marketing. Marketing Mix: Concept & Elements. Consumer Behaviour: Meaning, Nature & Importance. Consumer decision making Process. Market Segmentation: Concept, Definition & Importance. Bases of Market segmentation. Factors determining Market Segmentation.

#### Unit – 2 : Product & Pricing

Product: Meaning & importance, Classification, Product Mix. Product life Cycle: Definition, Stages, Marketing Strategies in each stage. New product Development Process. Concept & Importance of Branding, Packaging, labeling. Price & Pricing: Concept & importance, Pricing methods & policies. Factors to be considered in pricing of a product.

#### **Unit - 3 : Physical Distribution & Promotion**

Distribution Channels: Meaning and Importance, Types of Distribution Channel. Factors determining choice of Distribution Channel. Promotion: Meaning & Importance, Promotion Mix- Elements. Concepts of Advertising, Salesmanship, Sales promotion & Publicity. Functions of advertising, essential qualities of Good salesmen.

#### Suggested readings:

- Kotler & Keller, Marketing Management, Pearson.
- Venugopal, P., Marketing Management, Sage.
- Bhagwati, Pillai, Marketing Management, S.Chand.
- Ramaswamy and Namakumari, Marketing Management, McMillan.
- Dr Pranam Dhar, Monalisa Maity & Bidhan Baidya, Fundamentals of Marketing Management & Human Resource Management, International Publishing House.
- Sushil Mukherjee & Kallol Saha, Marketing Management & Human Resource Management, B.B. Kundu Grandsons.

#### Module : II Human Resource management (HRM) ( 3 credit)

#### Unit – 4 : Fundamentals of HRM

Meaning and concept of HRM. Evolution & Developments of HRM (in brief). Nature, objectives, importance, scope and functions of HRM, Job Analysis - Definition, Human resource planning- Definition, features, objectives and needs. Levels of Human resource planning. Process of Human resource planning in an organization.

#### Unit - 5 : Acquisition & Development of Human Resource

Recruitment of Human resources - Sources (internal & external)Advantages and disadvantages of internal and external sources of recruitment. Selection of Human resources - Definition, concept , significance and steps involved in selection process. Needs, objectives, and benefits of Training and Development. Difference between training and education. Different Training methods, their comparative advantages and disadvantages. A brief idea of staff welfare programmes and fringe benefits.

#### Unit – 6 : Maintenance of Human Resource

#### [15 L]

[15 L]

#### [15 L]

[15 L]

[15 L]

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[15 L]\*

Job evaluation- Definition, Objectives, procedures and advantages. Job Analysis-Definition, uses , process, purpose methods and aspects (Job description & Job specification).

Performance Appraisal - Meaning, objectives, methods of appraisal (brief concept of all traditional and modern methods along with their advantages and disadvantages). Potential Appraisal – objectives and requirements, Remuneration System.

Industrial Relations- definition features & objectives, Factors influencing industrial relations. Conditions for sound industrial relations. Importance of industrial relations. Systems approach to industrial relations.

#### Suggested Readings :

- Prof. A. K. Ghosh: Human Resource Management (with cases) : Manas Publications.
- Dr. P. Dhar, M. Maity & B. Baidya : Fundamentals of Marketing & Human Resource Management: International Publishing House.
- Sushil Mukherjee & Kallol Saha, Marketing Management & Human Resource Management, B.B. Kundu Grandsons
- C. B. Mamoria & S. V. Gankar: Human Resource Management : McGraw Hill
- V.S.P. Rao : Human Resource Management : (Excel Books)
- P. Subba Rao: Essentials of Human Resource Management and Industrial Relations- Text Cases and Games : Himalaya Publishing House
- Michael Armstrong : A Hand Book of Human Resource Management : Kogan Page Ltd.
- M. S. Saiyadin: Human Resource Management : Tata McGraw Hill
- Gary Dressler : Human Resource Management : Prentice Hall
- DeCenzo Robbins: Personnel/Human Resource Management: Prentice Hall.
- K. Aswathappa, Human Resource Management, Himalaya Publishing House.

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\* L = 1 Hour.

### BUSINESS COMMUNICATION & E-COMMERCE Paper 2 : Semester 6 Subject Code : FACSSEC04M

### Total No. of Credits - 06

Full Marks 75

[Internal Assessment: 25 Marks Semester-End Examination: 50 Marks]

TOTAL CLASS HOURS : 90 [LECTURE HOURS 75 & TUTORIAL HOURS 15]

Unit	Detailed	Hours
	Module I	
	<b>Business Communication</b>	
1.	Introduction	8
	Definition, objectives, importance, elements, process,	
	forms, models, principles of effective communication,	
	barriers to communication and remedial measures.	
2.	Types of Communication	08
	Formal and informal communication, Grapevine,	

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	Characteristics of corporate communication,	
	Characteristics of corporate communication,	
	Communication network	
3.	Tools of Communication	08
	Emergence of communication technology, Modern Forms	
	of communication, Fax, Email, Video Conferencing	
4.	Drafting	21
	Notice, Circular, Resolution & Minutes, Report, CV	
	writing, Business letter writing- Offer letter, Quotation,	
	Status enquiry, Confirmation, Execution, Refusal and	
	cancellation of order, Recommendation, Credit collection,	
	Claim, Bank loan	
	Module II	
	E-Commerce	
5.	Introduction	10
	E-Commerce-meaning, nature, concepts, types,	
	Advantages of E-commerce; forces behind e-commerce, e-	
	governance [meaning, types, significance, and real life	
	examples].	
6.	E-commerce business models	10
	Concept, Type: Business to Consumer (B to C), Business	
	to Business (B to B), Business to Government (B to G),	
	Consumer to Consumer (C to C), Consumer to Business	
	(C to B)	
7.	Digital Payment	20
	Methods of e-payments [Debit Card, Credit Card, Smart	
	Cards, e-Money], electronic or digital wallet, digital	
	signature (procedures, working and legal provisions),	
	payment gateways [Core Banking Solution or CBS,	
	Mobile Payment, UPI, NCPI, International Payments],	
	Online banking [meaning, concepts, importance,	
	electronic fund transfer, automated clearing house,	
	automated ledger posting], risks involved in e-payments.	
8.	New Trends in E-Commerce	05
	Social Commerce-concept, definition, features; Digital	
	Marketing-definition, objectives, methods, limitations;	
	Advertisement in Social Media-objectives, advantages and	
	disadvantages, procedures	
	Total Lecture Hours	90**

\*\* including 15 hours for tutorial.

#### Suggested readings

Anjanee, S. & Bhavana Adhikari, Business Communication, TMH Chaturvedi & Chaturvedi, Business Communication : Concepts, Cases and Applications, Pearson M.K.Shegal & Vandana Khetarpal, Business Communication, Excel Books Dhar, Maity and Baidya, Fundamentals of Business Communication & E-commerce; International Publishing House, Kolkata; May, 2018. R.K.Madhukar, Business Communication, Vikash Publishing House Pvt. Ltd. Rao, Kumar & Bindu, Business Communication, Cengage Khanna, Puja, Business Communication, Vikash Raman & Sharma, Technical Communication, Oxford Lesikar, Flatley et al, Business Communication, McGraw Hill P. T. Joseph, E-Commerce: An Indian Perspective, PHI Learning

Henry Chan, Raymond Lee, Tharam Dillon, Elizabeth Chang, *E-Commerce: Fundamentals and Applications*, Wiley. Laudon, *E-Commerce*, Pearson Education India Schneider G., E-Business, Cengage Bhaskar, B., E-Commerce, McGraw Hill

#### **DISCIPLINE-SPECIFIC ELECTIVE SUBJECTS**

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#### A. Accounting & Finance Specialisation

#### FINANCIAL STATEMENT ANALYSIS Paper DSE7 : Semester 6 Subject Code : FACGDSE07T Total No. of Credits - 6 Full Marks 75 [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks] TOTAL CLASSES: 90 [LECTURE CLASS 75 & TUTORIAL CLASS 15]

**UNIT 1: Introduction to Financial Statements Analysis:** Nature and Component of Financial Statements; Meaning and needs of FSA; Sources of financial information; Parties interested in FSA; Techniques of financial statement analysis – Comparative Statement – meaning, preparation, uses, merits and demerits; Common-size Statement – meaning, preparation, uses, merits and demerits; Trend Analysis – meaning, determination, uses, merits and demerits. [20 L]\*

**UNIT 2: Ratios for FSA:** Meaning, objective, classification of financial ratios; Advantages and limitations; Computation, analysis and interpretation of important ratios for measuring – liquidity, solvency, capital structure, profitability and managerial effectiveness; Preparation of financial statements and statement of proprietor's fund from the given ratios. **(20 L)** 

**UNIT 3: Fund Flow and Cash Flow Statements:** Concept of fund, Meaning and objectives of fund flow statement, various sources and applications, advantages & limitations of fund flow statement; Meaning and objectives of cash flow statement, difference with fund flow statement, Preparation and presentation of cash flow statement as per relevant Accounting Standard; analysis and interpretation of the cash flow position. (20 L)

**UNIT 4: Equity Analysis:** Value and price; Dividend Discount Model; Deciding the appropriate cash flow for discounting; Free cash flow to the firm; Free cash flow to equity; Price-Earnings Ratio; Why P/E multiples vary; Du Pont Formula.

#### (20 L)

**UNIT 5: Corporate Distress Prediction:** Concept, causes and symptoms of corporate financial distress; Prediction of corporate distress using Altman Z-score, multiple discriminant analysis and decision-tree analysis. (10 L)

#### Suggested Readings

• Lev, Financial Statement Analysis-a new approach, Prentice Hall.

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#### Vide Resolutions taken at U.G.BOS Meeting, C&M WBSU dt. 23.5.2018. and in 33 concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

- Foster G, Financial Statement Analysis, Prentice Hall.
- White, Sondhi & Fred, Analysis and Use of Financial Statement, John Wiley.
- Bernstein & Wild, Financial Statement Analysis; theory, application 85 interpretation, McGraw Hill.
- Bhattacharyva, Asish K., Introduction to Financial Statement Analysis, Elsevier.
- Ormiston, Understanding Financial Statement, Pearson.
- Subramanyam, K.R. and Wild, Financial Statement Analysis, McGraw Hill.

#### \* L = 1 Lecture Hour.

**BUSINESS ETHICS & CORPORATE GOVERNANCE** Paper DSE8 : Semester 6 Subject Code : FACGDSE08T Total No. of Credits - 6 **Full Marks 75** [Internal Assessment: 25 Marks **Semester-End Examination: 50** Marks]

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TOTAL CLASSES: 90 [LECTURE CLASS 75 & TUTORIAL CLASS 15]

#### **Module I : Business Ethics**

Internal Assessment: 12.5 marks, Semester-end Examinations: 25 marks

#### **Unit1: Introduction**

Nature of business ethics; ethics and morality; ethics versus law; Kohlberg's six stages of moral development; teleological approach; deontological approach;

#### Unit 2 : Social Aspects of Business Ethics

Stakeholder theory; stakeholder mapping; ethical leadership; ethical leadership styles; traits of an ethical leader;

**Unit 3: Managing Ethical Dilemmas** [15 L] Meaning and nature of ethical dilemma; characteristics of ethical dilemmas; the dilemma resolution process; common ethical dilemma in finance, marketing and HRM

### Module II **Corporate Governance**

Internal Assessment: 12.5 marks, Semester-end Examinations: 25 marks

**Unit 1: Framework of Corporate Governance in India** [15 L] Meaning; American, European, Japanese and Indian models of corporate governance; corporate boards and its powers, responsibilities; board committees and their functions; shareholders grievance committee; investors relation committee; risk management committee; audit committee; corporate governance reforms in the Companies Act, 2013

Unit 2: Major Corporate Scandals in India and Whistle-blowing policy [15 L] Case study of few Corporate Scams in India - Satyam Computers, Kingfisher Group, Punjab National Bank; The Concept of Whistle-blowing policy; types of whistleblowers; the whistle-blower legislation across countries; recent developments in India

# [15 L]\*

33

[15 L]

#### Unit 3: Corporate Social Responsibility (CSR)

[15 L] Concept of CSR, Corporate Philanthropy; Relationship of CSR with Corporate Sustainability, CSR and Business Ethics, CSR and Corporate Governance; CSR provisions under the Companies Act 2013

#### Suggested Readings

- Fernando, A.C., Business Ethics: An Indian Perspective, Pearson Education
- Murthy, C.V.S., Business Ethics Text and Cases, Himalaya Publishing House
- ◆ Fernando, A.C., Corporate Governance: Principles, Policies and Practices, Pearson Education
- ♦ Bajpai, G.N., The Essential Book of Corporate Governance, Sage
- ◆ ICSI, Study Material of Professional Programme, Module 2, Paper 6, Ethics, Governance and Sustainability

\* L = 1 Lecture Hour.

#### **B.** Marketing Specialization

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### **RURAL MANAGEMENT & MARKETING OF SERVICES** Paper DSE9 : Semester 6 Subject Code : FACGDSE09T Total No. of Credits - 6 Full Marks 75

#### [Internal Assessment: 25 Marks **Semester-End Examination: 50** Marksl

#### TOTAL CLASSES: 90 [LECTURE CLASS 75 & TUTORIAL CLASS 15]

Unit	Detailed	Hours
	Module I : Retail Management	
1.	Introduction to Retail Management	20
	Meaning/Definition of Retail Management; Importance;	
	Functions.	
	Retail Formats	
	Concept; Types of Retailing – Multi Channel Retailing,	
	Single	
	Retailing in India	
	Present scenario of retailing in India; Factors determining	
	Growth of Retailing in India; Impact of Retail in Nation's	
	Economy;	
2.	Pricing in Retail	15
	Concept of Pricing in Retailing; Factors affecting Retail	
	Pricing;	
	Importance of Retail Pricing.	
3.	Promotion in Retail	10
	Need and Objective of Promotional Mix in Retailing;	
	Promotional Mix and Strategy development; Customer	
	Relationship Management.	
	Module II : Marketing of Services	
4.	Introduction to Services Marketing – Overview	10

	Concept of services; Types; Function; Nature; Characteristics; Understanding Services Customers; Impact of service marketing in the economy of a country. Managing Services Quality; Relationship marketing – Concept;	
	Service Communication Mix; Communication Strategy	
5.	<b>Issues in Marketing Mix of Services</b> Service- Product or Packages; Pricing in Services; Place in Services; Promotion of Service; People in Services; Physical Evidence; Process Management.	15
6.	Service Marketing in Non-profit and profit Organizations Travel and Tourism; Financial Services; Information Technology Services; Media Services; Health Care Services; Educational Services	15
	Total Lecture Hours	90**

\*\* including 15 classes for tutorial.

#### Suggested readings

- ✤ Madaan, Fundamentals of Retailing, Tata McGraw-Hill
- Pradhan, S., Retailing Management, McGraw Hill
- Seshanna & Prasad, Retail Management, McGraw Hill
- Berman, Evans & Mathur, Retail Management, Pearson
- Verma, H. V., Services Marketing, Pearson
- Venugopal and Raghu, Services Marketing, Himalaya Publishing Ltd.
- Ravi Shankar, Services Marketing : The Indian Perspective, Excel Books
- Rampal & Gupta, Services Marketing, Concepts, Applications & Cases, Galgotia
- ✤ Apte, Services Marketing, Oxford University Press.

#### \* L = 1 Lecture Hour.

### **RURAL MARKETING & INTERNATIONAL MARKETING** Paper DSE10 : Semester 6 Subject Code : FACGDSE10T Total No. of Credits - 6 Full Marks 75 [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks]

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TOTAL CLASSES: 90 [LECTURE CLASS 75 & TUTORIAL CLASS 15]

#### Unit 1: Rural Marketing – An Overview [20 L]\*

Concept, scope and importance, rural vs. urban marketing, Current trends in Rural Markets in India. Characteristics, Attitude and Behaviour, Buying patterns and factors influencing rural consumer.

#### Unit 2: Rural Products & Organisations – Different Types [25 L]

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Types of products - seeds, fertilizers, agro chemicals and their markets, Role of Government and other Organizations in Marketing Agricultural Products. Types of Cooperative marketing, Structure of co-operations, Problems of Rural Marketing and Agricultural Marketing.

#### **Unit 3: International Marketing - An Overview** [10 L] Definition of international marketing, domestic vs. international marketing, process of internationalization, EPRG framework.

**Unit 4: International Marketing Environment** [10 L]

Economic -cultural - culture and its characteristics, influence of culture on consumption decisions, political and legal environment.

#### Unit 5: International Marketing Strategy & Documentation [25 L]

International product life cycle, branding, Promotion strategies, standardization versus adaptation; Distribution: methods of entry into foreign markets, foreign market channels; International pricing methods: transfer pricing, dumping, countertrade, factors affecting pricing. Process of importing and exporting; Documentation: certificate of origin, bill of lading, letter of credit.

#### **Suggested Readings:**

- ♦ J, Paul & R, Kapoor, International Marketing, TMH.
- Vasudeva: International Marketing: Excel Books.
- Cherulinam: International Marketing: Himalaya.
- Mathur, U.C., Rural Marketing, Excel Books.
- Mamoria, Agricultural Marketing, Himalaya Publishing House.
- Rajagopal, Management of Rural Business, Wheeler.

\* L = 1 Hour.

#### C. Systems & Operations Specialization

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#### **INTERNET & WWW AND FUNCTIONAL E-BUSINESS SYSTEM** Paper DSE11 : Semester 6 Subject Code : FACGDSE11T Total No. of Credits - 06 [5+1] **Full Marks 75** [Internal Assessment: 25 Marks **Semester-End Examination: 50** Marks] TOTAL CLASS HOURS : 105 [LECTURE HOURS 75 & PRACTICAL HOURS 30]

#### Module I: INTERNET AND WORLD WIDE WEB

Unit 1. Working of the internet with TCP/IP: Origin of TCP/IP. TCP/IP communication architecture, Internet Architecture, Working of TCP/IP,TCP/IP

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Applications - FTP, Telnet, Simple Mail Transfer Protocol, Network File System. (Practical) (30 L)\*

**Unit 2. Internet Concepts:** WWW, Internet and E-Commerce, Linking to the Internet, Internet Address, Internet Tools- Information Retrieval tools (ftp, Gopher),Communication Tools(Email, FTP, Telnet, Usenet), Multimedia Information Tools(Home page),Information Search Tools( Archie, Veronica, WAIS). Domain Name System. (10 L)

**Unit 3. Intranet and Extranet:** Intranet, Intranet vs. Groupware, Intranet Hardware, Intranet Software, Intranet Services (Web (HTTP) Publishing, HTML,), Communication Systems (Email, Fax), Software used in Electronic mail, Electronic Meeting Systems(Audio conferencing, Video Conferencing, Groupware), Extranet. **(06 L)** 

**Unit 4. Internet Security:** Security on the internet, Network and Website Security Risks, Site Hacking, Security Incidents on the internet security and email, network and website security, Firewall(Concept, Components and Constituents, Benefits), Enterprise wide security Framework, secure physical infrastructure). **(10 L)** 

#### Module II: FUNCTIONAL E-BUSINESS SYSTEM

**Unit 1. Applications of E-Business:** Direct Marketing and Selling, Value Chain Integration, Supply Chain Management, Corporate Purchasing, Financial and Information Services, Obstacles in adopting E-Business Applications. **(05 L)** 

**Unit 2. E-Strategy:** Information and Strategy, The virtual value chain planning E-Business project, E-Business strategy and knowledge management. **(04 L)** 

**Unit 3. Customer-effective Web design:** Requirements of Intelligent Websites, Website Goals and Objectives, planning the budget, analyzing website structure, fixed versus flexible webpage design, choosing a page size, website development tools, design alternatives, outsourcing web design, testing and maintaining websites. **(20 L)** 

**Unit 4. Mobile Commerce-** Wireless Spectrum, WAP - Origins of WAP, WAP Architecture, Wireless Datagram Protocol(WDP), Short Message Services, General Packet Radio Service(GPRS), Wireless Technology (CDMA, GSM), Different generations in Wireless Communication, Mobile commerce and its future in India. **(20 L)** 

#### Suggested Readings

- S. Jaiswal, Doing Business on the Internet E-COMMERCE (Electronic Commerce for Business), Galgotia Publications.
- P.T.Joseph, E-Commerce An Indian Perspective, S.J., PHI.
- Kenneth C. Laudon, Carol Guerico Traver, 3.E-Commerce Business, Technology, Society, Pearson Education.
- Schneider, E-Commerce, Thomson Publication.

\* L = 1 Lecture Hour.

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#### COMPUTER APPLICATION & E-BUSINESS APPLICATION (Practical) Paper DSE12 : Semester 6 Subject Code : FACGDSE12T

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#### Total No. of Credits - 06 Full Marks 75 [Internal Assessment: 25 Marks Semester-End Examination: 50 Marks] TOTAL CLASS HOURS : 180 [PRACTICAL HOURS 180]

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<u>Module I</u> COMPUTER APPLICATION (Practical) Internal Assessment: 12.5 marks Semester-end Examinations: 25 marks Total : 37.5 marks

Unit 1: C++[ 30 L]\*Unit 2: Use of Accounting software package – TALLY[ 60 L]

#### <u>Module II</u> E-BUSINESS APPLICATION (Practical) Internal Assessment: 12.5 marks Semester-end Examinations: 25 marks Total : 37.5 marks

Unit 1: HTML & DHTML Unit 2: JAVA [60 L] [30 L]

1. Oops Concept and Introduction to JAVA. 2. An overview of Java. 3. Data Types - variables and arrays. 4. Operators, Control statements. 5. Classes and objects. 6. Inheritance. 7. String and string buffer. 8. Exception handling. 9. Applets.

#### Suggested Readings:

- Turban, Rainer and Potter, Introduction to Information Technology, Wiley.
- ITLESL, Introduction to Information Technology, Pearson.
- Sinha & Sinha, Fundamentals of Computers, BPB Publication.
- Ramesh Behl, Information Technology for Management, TMH.
- Turban, Rainer and Potter (2003). Introduction to information technology. John Wiley and sons.
- Sinha, P.K., Priti Sinha (2002). Foundation of computing. BPB Publications.
- ♦ James, A. O'Brien (2005). Introduction to Information Systems. TMH
- ♦ Norton, P. (2001). Introduction to computers. TMH
- ✤ Rajaraman, V. (2004). Introduction to Information Technology. PHI.
- Cyganski Information Technology: Inside and outside (Pearson, 1st Edition).
- Basandra SK Computers Today (Galgotia, 1st Edition).
- Leon A and Leon M Introduction to Computers (Leon Vikas, 1st Edition).
- Leon Fundamentals of Information Technology, (Vikas)
- Kakkar DN, Goyal R Computer Applications in Management (New Age, 1st Edition).

#### \* L = 1 Lecture Hour.

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# $\frac{\text{SECTION} - C}{\text{MEDIUM OF INSTRUCTION FOR THE EXAMINEES}}$

Resolved unanimously that the Question Papers for the General Candidates will be set in both Bengali and English. They can also answer in English/Bengali Language.

#### <u>SECTION – D</u>

#### PROPOSED QUESTION PATTERN IN THE SEMESTER-END EXAMINATIONS for Three year B.Com. General Course Semester wise Structure of Syllabus CBCS To be effective from the Academic Session 2018-19

Year 1: Sem	ester 1			
Subject Code	Subject	Marks in each Question	No. of Questions to be Answered	No. of Questions to be set
FACGCOR01T	Financial Accounting I	10	2	3
		15	2	3
FACGCOR02T	Principles & Practice of Management	2	5	8
		5	4	6
		10	2	4

#### Year 1: Semester 2

Paper No.	Subject	Marks in each Question	No. of Questions to be Answered	No. of Questions to be set
FACGCOR03T	Cost & Management Accounting I	10	2	3
		15	2	3
FACGCORO4T	Marketing Management and Human	2	5	8
	Resource Management	5	4	6
		10	2	4
FACHGEC02T	Business Mathematics & Statistics	2	5	8
		5	4	6
		10	2	4

#### Year 2: Semester 3

Paper No.	Subject	Marks in each Question	No. of Questions to be Answered	No. of Questions to be set
FACGCOR05T	Business Regulatory Framework	2	5	8
		5	4	6
		10	2	4
FACGCOR06T	Direct Taxation	10	2	3
		15	2	3
FACGCOR07T	Financial Accounting II	10	2	3

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# $\label{eq:solutions} \mbox{Vide Resolutions taken at U.G.BOS Meeting, C&M WBSU dt. 23.5.2018. and in concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU.} 40$

		15	2	3
FACHGECO3T	Business Communication & E-	2	5	8
	Commerce	5	4	6
		10	2	4
FACSSEC01M	Information Technology & its Business	10	1	10
	Application	15	Practical	

#### Year 2: Semester 4

Subject Code	Subject Marks each Questi		No. of Questions to be Answered	No. of Questions to be set
FACGCOR08T	Company Law	2	5	8
		5	4	6
		10	2	4
FACGCOR09T	Indirect Taxation	10	2	3
		15	2	3
FACGCOR10T	Cost & Management Accounting II	10	2	3
		15	2	3
FACHGEC04T	Entrepreneurship Development	2	5	8
		5	4	6
		10	2	4
FACSSEC02M	Tax Returns & Filing of Tax Returns	10	1	10
		15	Practical	

#### Year 3: Semester 5

Subject Code	Subject	Marks in each Question	No. of Questions to be Answered	No. of Questions to be set
FACGCOR11T	Auditing	2	5	8
		5	4	6
		10	2	4
FACGCOR12T	Indian Financial System	2	5	8
		5	4	6
		10	2	4
FACGDSE01T	DSE 1 : Banking & Insurance	2	5	8
	_	5	4	6
		10	2	4
FACGDSE02T	DSE 2 : Corporate Accounting	10	2	3
		15	2	3
MKTGDSE03T	DSE 3 : Consumer Behaviour	2	5	8
	and Sales Management	5	4	6
		10	2	4
MKTGDSE04T	DSE 4 : Product & Pricing	2	5	8
	Management and Marketing	5	4	6
	Communication	10	2	4
SYOGDSE05T	DSE 5 : Fundamentals of	2	5	8
	Computer	5	4	6
		10	2	4
		25	Practical	
SYOGDSE06T	DSE 6 : DBMS and	2	5	8
	Networking	5	4	6

 ${f C}$  Department of Commerce & Management, West Bengal State University. 40

# Vide Resolutions taken at U.G.BOS Meeting, C&M WBSU dt. 23.5.2018. and in concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

	10	2	4
	25	Practical	

#### Year 3: Semester 6

Subject Code	Subject Marks i each Questio		Subject Marks in each Question		Subject Code Subject		No. of Questions to be Answered	No. of Questions to be set
FACGCOR13T	Financial Management	10 15	2	3				
FACGCOR14T	Research Methods & Project Work	5	35	5				
FACGDSE07T	DSE 1 : Financial Statement Analysis	10 15	2 2	3 3				
FACGDSE08T	DSE 2 : Business Ethics & Corporate Governance	10 15	2 2	3 3				
MKTGDSE09T	DSE 3 : Consumer Behaviour and Sales Management	2 5 10	5 4 2	8 6 4				
MKTGDSE10T	DSE 4 : Rural Marketing and International Marketing	2 5 10	5 4 2	8 6 4				
SYOGDSE11T	DSE 1C: Internet & WWW and Functional e-Business System	2 5 10 25	5 4 2 Practical	8 6 4				
SYOGDSE12T	DSE 2C: Computer Applications and e-Business Applications – Practical	2 5 10 25	5 4 2 Practical	8 6 4				

Vide Resolutions taken at U.G.BOS Meeting, C&M WBSU dt. 23.5.2018. and in 42 concurrence with CBCS Guidelines provided by UGC, WBSCHSE and WBSU.

## SECTION – E

## SPECIALISATION OF TEACHERS FOR TEACHING AND EVALUATION OF **DIFFERENT PAPERS/SUBJECTS/MODULES**

for

## Three year B.Com. General Course Semester wise Structure of Syllabus CBCS To be effective from the Academic Session 2018-19

Subject/Module/Paper	Specialisation of Teachers for Teaching and Evaluation
Business Economics	M.A./M.Sc. in Economics
Business Mathematics & Statistics	M.Sc. Mathematics/Statistics or
	M.Sc. in Economics with
	Specialisation in Econometrics
Information Technology & its	M.C.A. or M.Sc. in Computer
Business Applications	Science or M.Com with sufficient
	knowledge in IT
Indian Financial System	M.A. /M.Sc. in Economics and/or M.Com
Research Methods & Project Work	Any teacher teaching at the B.Com
	(Honours) Course may guide the
	students for the Project Work
Tax Returns & Filing of Returns	M.Com with sufficient knowledge
	in IT, who are conversant with the
	Accounting and Taxation Softwares
	and its applications
DSE 1A, 2A, 3A and 4A	M.Com with Accounting & Finance
	Specialisation
DSE 1B, 2B, 3B and 4B	M. Com/M.B.A. with Marketing
	Specialisation
DSE 1C, 2C, 3C and 4C	M.C.A. or M.Sc. in Computer
	Science or M.Com with
	specialization or
	additional/diploma in Computer
	Applications and e-Business
Papers/Subjects/Modules other	M.Com
than those mentioned above	

\*\* In case of any extra-ordinary situation, the Chairperson – UG BOS is empowered to take decision regarding teaching/evaluation, in concurrence with the Hon'ble Vice-Chancellor, WBSU, as directed.

> Recommended by UG BOS in Commerce & Management At its meeting held on 06.06.2018. with the CBCS Committee, WBSU.

> > Sd/-Dr. Pranam Dhar Chairperson.



# Draft CBCS Syllabus for Undergraduate Courses in Geography

TO BE EFFECTIVE FROM THE ACADEMIC SESSION 2018-19

West Bengal State University March, 2018

# Choice Based Credit System (CBCS): Syllabus in Geography

INTRODUCTION: In compliance with recent directives from the University Grants Commission, the undergraduate syllabus for Geography is reframed into Choice Based Credit System following the model syllabus prepared by the West Bengal State Council of Higher Education.

The main objective of this new curriculum is to give the students a holistic understanding of the subject putting equal weightage to the core content and techniques used in Geography. The syllabus tries to give equal importance to the two main branches of Geography: Physical and Human.

The principal goal of the syllabus is to enable the students to secure a job at the end of the undergraduate programme. Keeping this in mind and in tune with the changing nature of Geography, adequate emphasis is rendered on applied aspects of the subject such as emerging techniques of mapping and field-based data generation. The syllabus emphasises on development of basic skills of the subject, so that everyone need not go for higher studies in search of professional engagement or employment.

LEARNING OUTCOMES: This syllabus is designed to impart basic knowledge on geography as a spatial science and train the undergraduates to secure employment in the sectors of geospatial analysis, development and planning, mapping and surveying.

## Contents

- 1. Scheme for CBCS Curriculum for Geography Honours (B.Sc.)
- 2. Core Courses Syllabus for Geography Honours
- 3. Department Specific Elective Courses Syllabus for Geography Honours
- 4. Syllabus of Generic Elective Courses offered by Geography department for other Honours students
- 5. Scheme for CBCS Curriculum for Geography General (B.Sc.)
- 6. Core Courses Syllabus for Geography General
- 7. Department Specific Elective Courses Syllabus for Geography General
- 8. Skill Enhancement Courses Syllabus common for Honours and General

# 1. Scheme for the CBCS Curriculum for Geography Honours (B.Sc.)

Course Type	Total	Credits		
B.Sc. Honours	Courses	THEORY + PRACTICAL	THEORY + TUTORIAL*	
Core Course: Geography (C)	14	14×4 = 56	14×5 = 70	
		14×2 = 28	14×1 = 14*	
Discipline Specific Electives (DSE)	4	4×4 = 16	4×5 = 20	
		4×2 = 08	4×1 = 04*	
Generic Electives (GE)	4	4×4 = 16	4×5 = 20	
		4×2 = 08	4×1 =0 4*	
Ability Enhancement Compulsory	2	2×2 = 04	2 × 2=04	
Courses (AECC)				
Skill Enhancement Courses (SEC)	2	2×2 = 04	2 × 2=04	
Total	26	140	140	

## 1.1 Credit Distribution across Courses

\*Tutorials of 1 Credit will be conducted in case there is no practical component

## **1.2** Computation of work-load per week

	Duration of renous
1	1 Theoretical class of 1 hour duration
1	1 Theoretical class of 1 hour duration
1	1 Practical class of 2 hour duration
	1 1 1

Semester Duration: 15 weeks of direct teaching

## **1.3** List of Generic Elective subjects to be offered with Geography Honours

1. Political Science	4. Statistics
2. Economics	5. Zoology
3. Mathematics	6. Anthropology or Computer Science

Any 2 (two) GE subjects to be chosen from the above list and from each subject two courses to be taken.

Semester	Course	Course Code	Title	Credit	Marks	Remarks
	<b>C</b> = 10	GEOACOR01T	Geotectonics and Geomorphology	04	50	Compulsory
	Core	GEOACOR01P	Geotectonics and Geomorphology (Lab)	02	25	Compulsory
	Core	GEOACOR02T	Cartographic Techniques	04	50	Compulsory
I		GEOACOR02P	Cartographic Techniques (lab)	02	25	Compulsory
	GE	XXXHGEC01T		06	75	One course of a subject (Eg. A) chosen from the list of subjects given in section 1.3
	AECC	ENGSAEC01M	Communicative English	02	25	Compulsory
	Core	GEOACOR03T	Human Geography	06	75	Compulsory
11	Core	GEOACOR04T	Cartograms and Thematic Mapping	04	50	Compulsory
		GEOACOR04P	Cartograms and Thematic Mapping (Lab)	02	25	Compulsory
	GE	XXXHGEC02T		06	75	Second course of the same subject (A) taken as XXXHGEC01T
	AECC	ENVSAEC02T	Environment Studies	02	25	Compulsory
	Coro	GEOACOR05T	Climatology	04	50	
	Core	GEOACOR05P	Climatology (Lab)	02	25	
	Core	GEOACOR06T	Geography of India	06	75	
III	Care	GEOACOR07T	Statistical Methods in Geography	04	50	Compulsory
	Core	GEOACOR07P	Statistical Methods in Geography Lab	02	25	
	GE	XXXHGEC03T		06	75	One course of a subject (Eg. B) chosen from the list of subjects given in section 1.3
	SEC	GEOSSEC01M	Remote Sensing	02	25	Compulsory

# **1.4** Distribution of Courses across semesters for Geography Honours (B.Sc.)

	Core	GEOACOR08T	Regional Planning and Development	06	75	Compulsory	
	Core	GEOACOR09T	Economic Geography	06	75	Compulsory	
	Coro	GEOACOR10T	Environmental Geography	04	50	Compulsory	
IV	Core	GEOACOR10P	Environmental Geography (Lab)	02	25		
	GE	XXXAGEC04T		06	75	Second course of the same subject (B) taken as XXXHGEC03T	
	SEC	GEOSSEC02M	Advanced Spatial Statistical Techniques	02	25	Compulsory	
		GEOACOR11T	Field Work and Research Methodology	04	50		
V Core	Core	GEOACOR11P	Field Work and Research Methodology (Lab)	02	25	Compulsory	
	Coro	GEOACOR12T	Remote Sensing and GIS	04	50	Compulsory	
	Core	GEOACOR12P	Remote Sensing and GIS (Lab)	02	25	Compulsory	
DSE		GEOADSE01T	Soil and Biogeography	06	75	Compulsory	
DCE	GEOADSE02T	Settlement Geography	06	75	Students to choose		
	D3E	GEOADSE03T	Population Geography	06	75	courses (02T or 03T)	
	Core	GEOACOR13T	Evolution of Geographical Thought	06	75	Compulsory	
VI	Coro	GEOACOR14T	Disaster Management	04	50	Compulsory	
	Core	GEOACOR14P	Disaster Management (Lab)	02	25	Compulsory	
	DSE	GEOADSE04T	Hydrology and Oceanography	06	75	Compulsory	
		GEOADSE05T	Social Geography	06	75	Students to choose any one of the two	
	DSE	GEOADSE06T	Resource Geography	06	75	courses (05T or 06T)	

## **1.5** Core Subjects

Code (Theory)	Code (Practical)	Course name
GEOACOR01T	GEOACOR01P	Geotectonics and Geomorphology
GEOACOR02T	GEOACOR02P	Cartographic Techniques
GEOACOR03T		Human Geography
GEOACOR04T	GEOACOR04P	Cartograms and Thematic Mapping
GEOACOR05T	GEOACOR05P	Climatology
GEOACOR06T		Geography of India
GEOACOR07T	GEOACOR07P	Statistical Methods in Geography
GEOACOR08T		Regional Planning and Development
GEOACOR09T		Economic Geography
GEOACOR10T	GEOACOR10P	Environmental Geography
GEOACOR11T	GEOACOR11P	Field Work and Research Methodology
GEOACOR12T	GEOACOR12P	Remote Sensing and GIS
GEOACOR13T		Evolution of Geographical Thought
GEOACOR14T	GEOACOR14P	Disaster Management

## **1.6** Choices for Four Discipline Specific Electives

Code	Course name	
GEOADSE01T	Soil and Biogeography	
GEOADSE02T	Settlement Geography	
GEOADSE03T	Population Geography	
GEOADSE04T	Hydrology and Oceanography	
GEOADSE05T	Social Geography	
GEOADSE06T	Resource Geography	

# **1.7** Choices for Four Generic Electives for Honours Students of Other Disciplines

Code	Course name
GEOHGEC01T	Physical Geography
GEOHGEC02T	Human Geography
GEOHGEC03T	General Cartography
GEOAGEC04T	Environmental Geography

## **1.8** Choices for Two Skill Enhancement Courses

Code	Course name
GEOSSEC01M	Remote Sensing
GEOSSEC02M	Advanced Spatial Statistical Techniques

## 2. Core Course Syllabus

## GEOACOR01T – Geotectonics and Geomorphology 🔶

4 Credits, 50 Marks [60 classes]

Unit I: Geotectonics

- 1. Earth's tectonic and structural evolution with reference to geological time scale
- 2. Earth's interior with special reference to seismology. Isostasy: Models of Airy and Pratt
- 3. Plate Tectonics as a unified theory of global tectonics: Processes and landforms at plate margins and hotspots
- 4. Folds and Faults—origin and types

## Unit II: Geomorphology

- 5. Degradational processes: Weathering, mass wasting and resultant landforms
- 6. Development of river network and landforms on uniclinal and folded structures
- 7. Development of landforms on granites, basalts and limestones.
- 8. Coastal processes and landforms
- 9. Glacial and glacio-fluvial processes and landforms
- 10. Aeolian and fluvio-aeolian processes and landforms
- 11. Models on landscape evolution: Views of Davis, Penck and Hack

#### **Reading List**

Billings, M.P. 1971. Structural Geology, Pearson.

Frisch, W., Meschede, M., Blakey, R.C. 2011. Plate Tectonics: Continental Drift and Mountain Building. Springer.

Goudie, A.S. (Ed) 2004. Encyclopaedia of Geomorphology, vol. 1 & 2, Routledge.

Gregory, K.J., Lewin, J. 2014. The Basics of Geomorphology: Key Concepts, Sage.

Harvey, A. 2012. Introducing Geomorphology: A Guide to Landforms and Processes, Dunedin Academic Press.

Kale, V.S., Gupta, A. 2001.Introduction to Geomorphology, Orient Longman.

Kearey, P., Klepeis, K.A., Vine, F.J. 2011. Global Tectonics, 3rd ed, Wiley-India.

Knighton, A.D. 1984. Fluvial Forms and Processes, Edward Arnold.

Selby, M.J. 1986. Earth's Changing Surface, Oxford University Press.

Strahler, A. 2016. Introducing Physical Geography, 6th ed, Wiley.

Summerfield, M.J. 2003. Global Geomorphology: An Introduction to the Study of landforms, Longman.

Thornbury, W.D. 1969. Principles of Geomorphology, 2nd ed, Wiley-India / CBS.

## GEOACOR01P – Geotectonics and Geomorphology

2 Credits, 25 Marks [60 classes]

- 1. Megascopic identification of (a) *mineral samples*: Bauxite, calcite, chalcopyrite, feldspar, galena, gypsum, hematite, magnetite, mica, quartz, talc, tourmaline; and (b) *rock samples*: Granite, basalt, dolerite, laterite, limestone, shale, sandstone, conglomerate, slate, phyllite, schist, gneiss, quartzite, marble
- 2. Interpretation of geological maps with unconformity and intrusions on uniclinal and folded structures

#### **Reading List**

Farndon, J. 2012. The Illustrated Guide to Rocks & Minerals, Southwater.

McCullough, P.K. 1978. Modern Concept in Geomorphology, Oxford University Press.

Pillent, C. 2002. Smithsonian Handbooks: Rocks & Minerals, Dorling Kindersley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Sen, P.K. 1989. Geomorphological Analysis of Drainage Basin: An Introduction to Morphometric and Hydrological Parameters, University of Burdwan.

Sorrell, C.A. Rocks and Minerals: A Guide to Field Identification, St. Martin's Press.

## GEOACOR02T – Cartographic Techniques ↔

#### 4 Credit, 50 Marks [60 classes]

- 1. Maps: Classification and types. Components of a map
- 2. Concept and application of scales: Plain, comparative, diagonal and vernier
- 3. Survey of India topographical maps: Reference scheme of old and open series. Information on the margin of maps
- 4. Coordinate systems: Polar and rectangular
- 5. Concept of generating globe and UTM projection
- 6. Grids: angular and linear systems of measurement
- 7. Map projections: Classification, properties and uses

#### **Reading List**

Kennedy, M., Kopp, S. 2001. Understanding Map Projections, Esri Press.

- Kimerling, A.J., Buckley, A.R., Muehrcke, P.C., Muehrcke, J.O. 2011. Map Use: Reading, Analysis, Interpretation, 7th ed, Esri Press.
- Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Pearson II, F. 1990. Map Projections: Theory and Applications 2nd ed, CRC Press.

- Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.
- Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.
- Singh, R.L., Singh, R.P.B. 2008. Elements of Practical Geography, Kalyani Publishers.
- Vaidyanadhan, R., Subbarao, K.V. 2014.Landforms of India from Topomaps and Images, Geological Society of India.

## GEOACOR02P – Cartographic Techniques (Lab) ↔

#### 2 Credits, 25 Marks [90 classes]

- 1. Graphical construction of scales: Plain, comparative, diagonal and vernier
- 2. Construction of projections: Polar Zenithal Stereographic, Simple Conic with two standard parallels, Bonne's, Cylindrical Equal Area, and Mercator's
- 3. Delineation of drainage basin from Survey of India topographical map. Construction and interpretation of relief profiles (superimposed, projected and composite), relative relief map, slope map (Wentworth), and stream ordering (Strahler) on a drainage basin.
- 4. Correlation between physical and cultural features from Survey of India topographical maps using transect chart.

#### **Reading List**

Kennedy, M., Kopp, S. 2001. Understanding Map Projections, Esri Press.

- Kimerling, A.J., Buckley, A.R., Muehrcke, P.C., Muehrcke, J.O. 2011. Map Use: Reading, Analysis, Interpretation, 7th ed, Esri Press.
- Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.
- Pearson II, F. 1990. Map Projections: Theory and Applications 2nd ed, CRC Press.
- Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.
- Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Singh, R.L., Singh, R.P.B. 2008. Elements of Practical Geography, Kalyani Publishers.

## GEOACOR03T – Human Geography 🔶

## 6 Credits, 75 Marks [90 classes]

#### Unit I: Nature and Principles

- 1. Nature, scope and recent trends. Elements of Human Geography
- 2. Approaches to Human Geography; Resource, Locational, Landscape, Environmental
- 3. Concept and classification of race; ethnicity
- 4. Space, society and cultural regions (language and religion)

#### Unit : II: Society, Demography and Ekistics

- 5. Evolution of human societies: Hunting and food gathering, pastoral nomadism, subsistence farming and industrial society
- 6. Human adaptation to environment: Eskimo, Masai and Maori
- 7. Population growth and distribution, composition; demographic transition
- 8. Population-Resource regions (Ackerman)
- 9. Types and patterns of rural settlements
- 10. Morphology of urban settlements

#### **Reading List**

Chandna, R.C. 2016. Geography of Population: Concepts, Determinants and Patterns, Kalyani Publishers.

Fouberg, E.H., Murphy, A.B., de Blij H.J. 2015. Human Geography: People, Place, and Culture, 11th ed, Wiley.

Ghosh, S. 1998. Introduction to Settlement Geography, Sangam Books Ltd.

Gould, W.T.S. 2015. Population and Development, Routledge.

- Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.
- Knox, P.L., Marston, S.A. 2014. Human Geography: Places and Regions in Global Context, 6th ed, Pearson Education Limited.
- Knox, P.L., McCarthy, L.M. 2011. Urbanization: An Introduction to Urban Geography, 3rd ed, Pearson Educztuion Ltd.
- Mandal, R.B. 2001. Introduction to Rural Settlement, 2nd ed, Concept Publishing Company.
- Moseley, W.G., Perramond, E., Hapke, H.M., Laris, P. 2013. An Introduction to Human-Environment Geography: Local Dynamics and Global Processes, Wiley-Blackwell.
- Norton, W. 2014. Human Geography, 8th ed, Oxford University Press.
- Pickering K. and Owen A. A. (1997): An Introduction to Global Environmental Issues, 2nd edition Rutledge, London.
- Rubenstein, J.M. 2016. The Cultural Landscape: An Introduction to Human Geography, 12th ed, Pearson Education Limited.

Short, R.J. 2017. Human Geography: A Short Introduction, 2nd ed, Oxford University Press.

## GEOACOR04T – Cartograms and Thematic Mapping 🔶

## 4 Credits, 50 Marks [60 classes]

- 1. Concepts of rounding, scientific notation, logarithm and anti-logarithm, natural and log scales
- 2. Diagrammatic representation of data: Line, Bar, Isopleths
- 3. Representation of area data: Dots and spheres, proportional circles and Choropleth
- 4. Preparation and interpretation of land use land cover maps
- 5. Preparation and interpretation of socio-economic maps
- 6. Bearing: Magnetic and true, whole-circle and reduced
- 7. Basic concepts of surveying and survey equipment: Prismatic Compass, Dumpy Level, Theodolite

#### **Reading List**

Basak, N.N. 2017. Surveying and Levelling, 2nd ed, McGraw Hill Education.

Bolton. T. 2009 (reprint). Geological Maps: Their Solution and Interpretation, Cambridge University Press.

Kanetkar, T.P., Kulkatni, S.V. 1988. Surveying and Levelling, Part I, Pune VidyarthiGrihaPrakashan.

- Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.
- Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.
- Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Singh, R.L., Singh, R.P.B. 2008. Elements of Practical Geography, Kalyani Publishers.

Subramanian, R. 2012. Surveying and Levelling, 2nd ed, Oxford University Press

## GEOACOR04P – Cartograms and Thematic Mapping (Lab) $\diamond$

## 2 Credits, 25 Marks [60 classes]

- 1. Thematic maps:
  - Choropleth showing density of population
  - Dots and Spheres diagram showing distribution of rural and urban population.
  - Proportional pie-diagrams representing economic data and land use data
- 2. Traverse survey using prismatic compass

Profile survey using dumpy Level

Reading	List	

Basak, N.N. 2017. Surveying and Levelling, 2nd ed, McGraw Hill Education.

Bolton. T. 2009 (reprint). Geological Maps: Their Solution and Interpretation, Cambridge University Press.

Kanetkar, T.P., Kulkatni, S.V. 1988. Surveying and Levelling, Part I, Pune VidyarthiGrihaPrakashan.

Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Singh, R.L., Singh, R.P.B. 2008. Elements of Practical Geography, Kalyani Publishers.

Subramanian, R. 2012. Surveying and Levelling, 2nd ed, Oxford University Press

## GEOACOR05T – Climatology 4

## 4 Credits, 50 Marks [60 classes]

#### Unit I: Elements of the Atmosphere

- 1. Nature, composition and layering of the atmosphere
- 2. Insolation: controlling factors. Heat budget of the atmosphere
- 3. Temperature: horizontal and vertical distribution. Inversion of temperature: types, causes and consequences
- 4. Greenhouse effect and importance of ozone layer

Unit II: Atmospheric Phenomena and Climatic Classification

- 5. Condensation: Process and forms. Mechanism of precipitation: Bergeron-Findeisen theory, collision and coalescence. Forms of precipitation
- 6. Air mass: Typology, origin, characteristics and modification
- 7. Fronts: warm and cold; frontogenesis and frontolysis
- 8. Weather: stability and instability; barotropic and baroclinic conditions
- 9. Circulation in the atmosphere: Planetary winds, jet stream, index cycle
- 10. Tropical and mid-latitude cyclones
- 11. Monsoon circulation and mechanism with reference to India
- 12. Climatic classification after Köppen, Thornthwaite (1955) and Oliver

#### Reading List

Воокѕ

Ahrens, C.D. 2012. Essentials of Meteorology: An Invitation to the Atmosphere. 9th Ed, Cengage Learning.

Barry R. G. and Carleton A. M., 2001: Synoptic and Dynamic Climatology, Routledge, UK.

Barry, R.G, Chorley R.J. 2009. Atmosphere Weather and Climate. 9th Ed, Routledge.

Critchfield, H. J. 1983. General Climatology. Prentice Hall India Ltd (2010 Reprint).

Lal, D.S. 2012. Climatology. Sharda PustakBhawan.

Lutgens, F.K., Tarbuck, E.J. 1998. The Atmosphere : An Introduction to Meteorology, 9th Ed, Prentice-Hall Inc.

Oliver, J.E., Hidore J.J. 2002. Climatology: An Atmospheric Science, Pearson Education India

## GEOACOR05T – Climatology∻

## 2 Credits, 25 Marks [60 classes]

- 1. Interpretation of daily weather map of India (any two): Pre-Monsoon, Monsoon and Post-Monsoon
- 2. Construction and interpretation of hythergraph and climograph (G. Taylor)
- 3. Construction and interpretation of wind rose
- **4.** A Project File, comprising of one exercise from each of the following is to be prepared and submitted

#### **Reading List**

Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan.

Singh, R.L., Singh, R.P.B. 2008. Elements of Practical Geography, Kalyani Publishers.

## GEOACOR06T – Geography of India ♦

#### 6 Credits, 75 Marks [90 classes]

Unit I: Geography of India

- 1. Tectonic and stratigraphic provinces, physiographic divisions
- 2. Climate, soil and vegetation: Characteristics and classification
- 3. Population: Distribution, growth, structure and policy
- 4. Tribes of India with special reference to Gaddi, Toda, Santal and Jarwa
- 5. Agricultural regions. Green revolution and its consequences
- 6. Mineral and power resources distribution and utilisation of iron ore, coal, petroleum and natural gas
- 7. Industrial development: Automobile and information technology
- 8. Regionalisation of India: Physiographic (R.L. Singh) and economic (P. Sengupta)

Unit II: Geography of West Bengal

- 9. Physical perspectives: Physiographic divisions, forest and water resources
- 10. Resources: Agriculture, mining, and industry
- 11. Population: Growth, distribution and human development
- 12. Regional Issues: Darjeeling Hills and Sundarban

#### **Reading List**

Bandyopadhyay, S., Kar, N.S., Das, S., Sen, J. 2014. River system and water resources of West Bengal: A Review.
 In: Vaidyanadhan, R. (Ed) Rejuvenation of Surface Water Resources of India: Potential, Problems and Prospects, Geological Society of India Special Publication.

- Dhara, M.K., Basu, S.K., Bandyopadhyay, R.K., Roy, B., Pal, A.K. (Eds.) 1999. Geology and Mineral Resources of the States of India, Part-1: West Bengal. Geological Survey of India Miscellaneous Publication.
- Ghurey, G.S. 1963. The Scheduled Tribes of India, 1980 reprint, Transaction Books.
- Johnson, B.L.C. (Ed) 2001. Geographical Dictionary of India, Vision Books.
- Khullar, D.R. 2011. India: A Comprehensive Geography, Kalyani Publishers
- Mandal, H., Mukherjee, S., Datta, A. 2002. India: An Illustrated Atlas of Tribal World, Anthropological Survey of India.
- Pathak, C.R. 2003. Spatial Structure and Processes of Development in India, Regional Science Association-Kolkata.
- Sharma, T.C. 2012. Economic Geography of India, Rawat Publications.
- Singh, J. 2003. India-A Comprehensive & Systematic Geography, GyanodayaPrakashan.
- Singh, R.L. 1971. India: A Regional Geography, National Geographical Society of India.
- Spate, O.H.K., Learmonth, A.T.A. 1967. India and Pakistan: A General and Regional Geography, Methuen.

Tiwari, R.C. 2007. Geography of India, PrayagPustakBhawan.

Valdiya, K.S. 2010. The Making of India: Geodynamic Evolution, Macmillan Pubishers India Ltd.

## GEOACOR07T – Statistical Methods in Geography

## 4 Credits, 40 Marks [60 classes]

Unit I: Frequency Distribution and Sampling

- 1. Importance and significance of statistics in Geography
- 2. Discrete and continuous data, population and samples, scales of measurement (nominal, ordinal, interval and ratio),
- 3. Sources of geographical data for statistical analysis
- 4. Collection of data and formation of statistical tables
- 5. Sampling: Need, types, and significance and methods of random sampling
- 6. Theoretical distribution: frequency, cumulative frequency, normal and probability

#### Unit II: Numerical Data Analysis

- 7. Central tendency: Mean, median, mode, partition values
- 8. Measures of dispersion range: mean deviation, standard deviation, coefficient of variation
- 9. Association and correlation: Rank correlation, product moment correlation
- 10. Regression: Linear and non-linear
- 11. Time series analysis: Moving average

#### **Reading List**

- Acevedo, M.F. 2012. Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press.
- Harris, R., Jarvis, C. 2011. Statistics for Geography and Environmental Science, Prentice Hall.
- McGrew Jr., J.C., Lembo Jr., A.J., Monroe, C.B. 2014. An Introduction to Statistical Problem Solving in Geography, 3rd ed, Waveland Press.
- Pal S. K., 1998. Sstatistics for Geoscientists: Techniques and Applications, Concept Pub Co.

Rogerson, P.A. 2015. Statistical Methods for Geography: A Student's Guide, 4th ed, Sage.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan.

## GEOACOR07P – Statistical Methods in Geography (Lab)↔

## 2 Credits, 25 Marks [60 classes]

- 1. Construction of data matrix with each row representing an areal unit (districts / blocks / mouzas / towns) and corresponding columns of relevant attributes
- 2. Based on the above, a frequency table, measures of central tendency and dispersion would be computed and interpreted using histogram and frequency curve
- 3. From the data matrix a sample set (20%) would be drawn using, random, systematic and stratified methods of sampling and locate the samples on a map with a short note on methods used
- 4. Based on the sample set and using two relevant attributes, a scatter diagram and linear regression line would be plotted and residual from regression would be mapped with a short interpretation

#### **Reading List**

- Acevedo, M.F. 2012. Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press.
- Harris, R., Jarvis, C. 2011. Statistics for Geography and Environmental Science, Prentice Hall.
- McGrew Jr., J.C., Lembo Jr., A.J., Monroe, C.B. 2014. An Introduction to Statistical Problem Solving in Geography, 3rd ed, Waveland Press.
- Pal S. K., 1998. Statistics for Geoscientists: Techniques and Applications, Concept Pub Co.

Rogerson, P.A. 2015. Statistical Methods for Geography: A Student's Guide, 4th ed, Sage.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan.

## GEOACOR08T – Regional Planning and Development♦

#### 6 Credits, 75 Marks [90 classes]

#### Unit I: Regional Planning

- 1. Concept of regions: Types of regions and their delineation
- 2. Regional Planning: Types, principles, objectives, tools and techniques
- 3. Need for regional planning in India, multi- level planning in India
- 4. Metropolitan concept and urban agglomerations

#### Unit I: Regional Development

- 5. Concepts of growth and development, growth versus development
- 6. Indicators of development: Economic, social and environmental
- 7. Human development: Concept and measurement
- 8. Theories and models for regional development: Cumulative causation (Myrdal)
- 9. Theories and models for regional development: Stages of development (Rostow), growth pole model (Perroux).
- 10. Concept and causes of underdevelopment
- 11. Regional development in India: Disparity and diversity
- 12. Need and measures for balanced development in India

#### **Reading List**

Bhargava, G. 2001. Development of India's Urban, Rural, and Regional Planning in 21st Century: Policy Perspective, Gyan Publishing House.

Chand, M., Puri, V.K. 2000. Regional Planning In India, Allied Publishers Ltd.

Chandana, R.C. 2016. Regional Planning and Development, 6th ed, Kalyani Publishers.

Glasson, J. 2017. Contemporary Issues in Regional Planning, Routledge.

Gore, C. 2011. Regions in Question: Space, Development Theory, and Regional Policy, Routledge.

- Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.
- Hall, P., Tewdwr-Jones, M. 2010. Urban and Regional Planning, Routledge.

Higgins, B., Savoie, D.J. 2017. Regional Development: Theories and Their Application, Routledge.

- Kulshetra, S.K. 2012. Urban and Regional Planning in India: A Handbook for Professional Practioners, Sage Publication.
- Kumar, A., Meshram, D.S., Gowda, K. (Eds) 2016. Urban and Regional Planning Education: Learning for India, Springer.
- Misra, R.P. 1992. Regional Planning: Concepts, Techniques, Policies and Case Studies, Concept Publishing.

Ray, J. 2001. Introduction to Development & Regional Planning, Orient Blackswan.

## **GEOACOR09T** — Economic Geography

## 6 Credits, 75 Marks [90 classes]

#### Unit I: Concepts

- 1. Meaning and approaches to Economic Geography.
- 2. Concepts in Economic Geography: Goods and services, production, exchange and consumption
- 3. Concept of economic man, theories of choices
- 4. Economic distance and transport costs

Unit II: Economic Activities

- 5. Concept and classification of economic activities
- 6. Factors affecting location of economic activity with special reference to agriculture (Von Thünen), and industry (Weber).
- 7. Primary activities: Agriculture, forestry, fishing and mining
- 8. Secondary activities: Manufacturing (cotton textile, iron and steel), concept of manufacturing regions, special economic zones and technology parks
- 9. Tertiary activities: Transport, trade and services
- 10. Agricultural systems: Case studies of tea plantation in India and mixed farming in Europe
- 11. Transnational sea-routes, railways and highways with reference to India
- 12. International trade and economic blocs: WTO, GATT and BRICS: Evolution, structure and functions

#### **Reading List**

Alexander J. W., 1963: Economic Geography, Prentice-Hall Inc., Englewood Cliffs, New Jersey

Aoyama, Y., Murphy, J.T., Hanson, S. 2010.Key Concepts in Economic Geography, Sage.

- Coe N. M., Kelly P. F. and Yeung H. W., 2007: Economic Geography: A Contemporary Introduction, Wiley-Blackwell.
- Combes P., Mayer T. and Thisse J. F., 2008: Economic Geography: The Integration of Regions and Nations, Princeton University Press.
- Wheeler, J.O., Muller, P.O., Thrall, G.I., Fik, T.J. 1998. Economic Geography, 3rd ed, Wiley.

Willington D. E., 2008: Economic Geography, Husband Press.

Wood, A., Roberts, A. 2010. Economic Geography: Places, Networks and Flows, Routledge.

## GEOACOR10T—Environmental Geography <>

## 4 Credits, 50 Marks [60 classes]

#### Concepts

- 1. Geographers' approach to environmental studies
- 2. Concept of holistic environment and systems approach
- 3. Ecosystem: Concept, structure and functions
- 4. Space-time hierarchy of Environmental problems: Local, regional and global

Environmental problems and policies

- 5. Environmental pollution and degradation: Land, water and air
- 6. Urban environmental issues with special reference to waste management
- 7. Environmental policies National Environmental Policy, 2006, Earth Summits (Stockholm, Rio, Johannesburg)
- 8. Global initiatives for environmental management (special reference to Montreal Protocol, Kyoto Protocol, Paris Climate Summit)

#### **Reading List**

- Basu, R. and Bhaduri, S. (Eds) 2007. Contemporary Issues and Techniques in Geography, Progressive Publishers.
- Chandna, R.C. 2002. Environmental Geography, Kalyani Press.
- Chapman, J.L., Reiz, M.J. 1993. Ecology: Principle and Applications, Cambridge University Press.
- Cunninghum, W.P., Cunninghum, M.A. 2004. Principals of Environmental Science: Inquiry and Applications, Tata Macgraw Hill.
- Gilpin, A., 1994. Environmental Impact Assessment: Cutting Edge for the 21st Century, Cambridge University Press.
- Goudie, A. 2001. 2013. The Human Impact on the Natural Environment: Past, Present, and Future, 7th ed, Wiley-Blackwell.
- Miller, G.T. 2004. Environmental Science: Working with the Earth, Thomson Brooks.
- Odum, E.P., Barrett, G.W. 2005. Fundamentals of Ecology, Ceneage Learning.
- Raven, P.H., Hassenzahl, D.M., Hager, M.C., Gift, N.Y., Berg, L.R. 2015. Environment, 9th ed, Wiley.
- Sharma, P.D. 2011. Ecology and Environment, Rastogi Publications.
- Singh, S. 2013. Environmental Geography, PrayagPustakBhawan.

Withgott, J.H., Laposata, M. 2017. Environment: The Science behind the Stories, 6th ed, Pearson.

## GEOACOR10P—Environmental Geography <>

## 2 Credits, 25 Marks [60 classes]

- 1. Preparation of questionnaire for perception survey on environmental problems
- 2. Preparation of check-list for Environmental Impact Assessment of an urban / industrial project
- 3. Interpretation of air quality using CPCB / WBPCB data

#### Reading List

Gilpin, A., 1994. Environmental Impact Assessment: Cutting Edge for the 21st Century, Cambridge University Press.

#### WEBSITES:

BBC – Science & Environment: www.bbc.com/news/science\_and\_environment
Central Pollution Control Board: www.cpcb.nic.in
Centre for Science and Environment: www.cseindia.org
Ministry of Environment, Forest and Climate Change: www.envfor.nic.in
The Energy and Resources Institute: www.teriin.org
The World Bank – Environment: www.worldbank.org/en/topic/environment
United Nations Environment Programme: www.unenvironment.org
West Bengal Pollution Control Board: www.wbpcb.gov.in

## GEOACOR11T – Fieldwork and Research Methodology

## 4 Credits, 50 Marks [60 classes]

#### Unit I: Research Methodology

- 1. Research in Geography: Meaning, types and significance
- 2. Literature review and formulation of research design
- 3. Defining research problem, objectives and hypothesis.
- 4. Research materials and methods
- 5. Techniques of writing scientific reports: Preparing notes, references, bibliography, abstract and keywords

#### Unit II: Fieldwork

- 6. Fieldwork in Geographical studies: Role and significance. Selection of study area and objectives. Pre-field academic preparations. Ethics of fieldwork
- 7. Field techniques and tools: Observation (participant, non participant), questionnaires (open, closed, structured, non-structured). Interview
- 8. Field techniques and tools: Landscape survey using transects and quadrants, constructing a sketch, photo and video recording.
- 9. Positioning and collection of samples. Preparation of inventory from field data.
- 10. Post-field tabulation, processing and analysis of quantitative and qualitative data

#### **Reading List**

Clifford, N., Cope, M., Gillespie, T.W., French, S. (Eds) 2016. Key Methods in Geography, 3rd ed, Sage.

Gomes, B., Jones III, J.P. (Eds) 2010. Research Methods in Geography: A Critical Introduction, Wiley-Blackwell.

Lenon, B., Cleves, P. 2015. Geography Fieldwork and Skills, Harper-Collins.

- Montello , D.R, Sutton, P. 2012. An Introduction to Scientific Research Methods in Geography and Environmental Studies, 2nd ed, Sage.
- Murthy , K.LN. 2004. Research Methodology in Geography: A Text Book, Concept Publishing Co.
- Northey, N., Draper, D., Knight, D.B. 2015. Making Sense in Geography and Environmental Sciences: A Student's Guide to Research and Writing, 6th ed, Oxford University Press.
- Parsons, T., Knight, P.G. 2015. How To Do Your Dissertation in Geography and Related Disciplines, 3rd ed, Routledge.
- Phillips, R., Johns, J. 2012. Fieldwork for Human Geography, Sage.
- Riordan, D. 2013. Technical Report Writing Today, 10th ed, Wadsworth Publishing.

Thornbush, M.J., Allen, C.D., Fitzpatrick, F.A. (Eds) 2014. Geomorphological Fieldwork, Elsevier.

## **GEOACOR11P** – Fieldwork and Research Methodology (Lab)

## 2 Credits, 25 Marks [60 classes]

*Every student needs to participate in fieldwork and prepare a field report according to the following guideline, failing which he/she will not be evaluated for Core P11.* 

- 1. Each student will prepare a report based on primary data collected from field survey and secondary data collected from different sources.
- 2. Students will select either one rural area (*mouza*) or an urban area (municipal ward) for the study, with the primary objective of evaluating the relation between physical and cultural landscape.
- 3. The fieldwork should be completed within seven days.
- 4. The report should be handwritten in English on A4 size paper in candidate's own words within 5,000 words (Introductory Chapter: 1000 words; Physical Aspects: 1500 words; Socio-economic Aspects: 1500 words; Concluding Chapter: 500 words, approximately) excluding tables, photographs, maps, diagrams, references and appendices.
- 5. Maps and diagrams should not exceed 15 pages.
- 6. All sections of the report should contain relevant maps, diagrams and photographs using primary and secondary data, clearly citing sources.
- 7. A copy of the bound report, duly signed by the concerned teacher, will be submitted during examination.

## GEOACOR12T − Remote Sensing and GIS ♦

#### 4 Credits, 50 Marks [60 classes]

#### Unit I: Remote Sensing

- 1. Principles of Remote Sensing (RS): Types of RS satellites and sensors
- 2. Sensor resolutions and their applications with reference to IRS and Landsat missions
- 3. Preparation of False Colour Composites from IRS LISS-3 and Landsat TM and OLI data.
- 4. Principles of image correction and interpretation. Preparation of inventories of landuse land cover (LULC) features from satellite images.

Unit II: Geographical Information Systems and Global Navigation Satellite System

- 5. Concept of GIS and its applicability ; GIS data structures: types: spatial and non-spatial, raster and vector
- 6. Principles of preparing attribute tables and data manipulation and overlay analysis
- 7. Principles of GNSS positioning and waypoint collection
- 8. Transferring waypoints to GIS. Area and length calculations from GNSS data.

#### **Reading List**

Bhatta, B. 2011. Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others, CRC Press.

- Bhatta, B. 2011. Remote Sensing and GIS, 2nd ed, Oxford Univ. Press.
- Bolstad, P. 2016. GIS Fundamentals: A First Text on Geographic Information Systems, 5th ed, XanEdu Publishing.
- Brewer, C.A. 2015. Designing Better Maps: A Guide for GIS Users, 2nd ed, Esri Press.
- Harvey, F. 2015. A Primer of GIS: Fundamental Geographic and Cartographic Concepts, 2nd ed, The Guilford Press.
- Jensen, J.R., 2013. Remote Sensing of the Environment: An Earth Resource Perspective, Pearson Education India.
- Joseph, G. and Jegannathan, C. 2018. Fundamentals of Remote Sensing, 3rd ed, Universities Press.
- Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., 2015. Remote Sensing and Image Interpretation, 7th ed, Wiley.
- Sarkar, A. 2015. Practical Geography: A Systematic Approach. 2nd ed, Orient Black Swan Private Ltd.

## GEOACOR12P – Remote Sensing and GIS ♦

## 2 Credits, 25 Marks [60 classes]

- 1. Georeferencing of maps and images using Open Source software
- 2. Preparation of FCC and identification of features using standard FCC and other band combinations
- 3. Digitisation of features. Data attachment, overlay and preparation of annotated thematic maps (choropleth, pie chart and bar graphs).
- 4. Note: All exercises to be done using QGIS (2.10 and above)

Reading List
WEBSITES:
International Society for Photogrammetry and Remote Sensing: www.isprs.org
NASA Landsat Science: www.landsat.gsfc.nasa.gov

National Remote Sensing Centre: www.nrsc.gov.in

USGS Global Visualization Viewer: www.glovis.usgs.gov

## **GEOACOR13T – Evolution of Geographical Thought**

## 6 Credits, 75 Marks [90 classes]

#### Unit I: Nature of Pre Modern Geography

- 1. Development of Geography: Contributions of Greek and Chinesegeographers
- 2. Impact of 'Dark Age' in Geography and Arab contributions
- 3. Geography during the age of 'Discovery' and 'Exploration' (contributions of Columbus, Vasco da Gama, Magellan, Thomas Cook)
- 4. Transition from cosmography to scientific Geography (contributions of Bernard Varenius and Immanuel Kant). Dualism and Dichotomies (Ideographic vs. Nomothetic, Physical vs. Human, Regional vs. Systematic, Determinism vs. Possibilism,)

Unit II: Foundations of Modern Geography and Recent Trends

- 5. Evolution of Geographical thoughts in Germany, France, Britain and United States of America
- 6. Contributions of Humboldt and Ritter
- 7. Contributions of Richthofen, Hettner, Ratzel and Vidal deLaBlaché
- 8. Trends of geography in the post-World War-II period: Quantitative Revolution, systems approach.
- 9. Evolution of Critical Geography: Behavioural, humanistic and radical.
- 10. Changing concept of time-space in geography in the 21st Century

#### **Reading List**

Adhikari, S. 2015. Fundamentals of Geographical Thought, Orient Blackswan.

Clifford, N. Holloway S.L., Rice, S.P., Valentine, G. 2009. Key Concepts in Geography, 2nd ed, Sage.

- Couper, P. 2015. A Student's Introduction to Geographical Thought: Theories, Philosophies, Methodologies, Sage.
- Cresswell, T. 2013. Geographic Thought: A Critical Introduction, Wiley-Blackwell.
- Dikshit, R.D. 2004. Geographical Thought: A Contextual History of Ideas, Prentice Hall India.
- Holt-Jensen, A. 2011. Geography: History and Concepts: A Student's Guide, Sage.
- Husain, M. 2015. Evolution of Geographical Thought, 6th ed, Rawat Publications.
- Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.
- Pete, R. 1998. Modern Geographical Thought, Wiley-Blackwell.

## GEOACOR14T – Disaster Management♦

#### 4 Credits, 50 Marks [60 classes]

#### Unit I: Concepts

- 1. Classification of hazards and disasters.
- 2. Approaches to hazard study: Risk perception and vulnerability assessment. Hazard paradigms.
- 3. Responses to hazards: Preparedness, trauma and aftermath. Resilience and capacity building.
- 4. Hazards mapping: Data and geospatial techniques (for hazards enlisted in Unit II and Core 14P)

#### Unit II: Hazard-specific Study with focus on India

- 5. Earthquake: Factors, vulnerability, consequences and management
- 6. Landslide: Factors, vulnerability, consequences and management
- 7. Tropical Cyclone: Factors, vulnerability, consequences and management
- 8. Riverbank erosion: Factors, vulnerability, consequences and management
- 9. Radioactive fallout: Factors, vulnerability, consequences and management

#### **Reading List**

Coch, N.K. 1994. Geohazards: Natural and Human, Pearson College.

Coenraads, R. (Ed.) 2006. Natural Disasters and How We Cope, Millennium House.

Cutter, S.L. 2006. Hazards Vulnerability and Environmental Justice, Routledge

- Government of India. 1997. Vulnerability Atlas of India, Revised ed, Building Materials & Technology Promotion Council, Ministry of Urban Development.
- Hyndman, D., Hyndman, D. 2016. Natural Hazards and Disasters, 5th ed, Brooks Cole.
- Kapur, A. 2010. Vulnerable India: A Geographical Study of Disasters, Sage.
- Keller. E.A., DeVecchio, D.E. 2014. Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes, 4th ed, Routledge.

Pine, J.C. 2014. Hazards Analysis: Reducing the Impact of Disasters, 2nd ed, CRC Press.

Robbins, P., Hintz, J., Moore, S.A. 2014. Environment and Society: A Critical Introduction 2nd ed, Wiley.

Smith, K. 2013. Environmental Hazards: Assessing Risk and Reducing Disaster, 6th ed, Routledge.

Websites:

AGU landslide Blog: blogs.agu.org/landslideblog

Disaster News Network: secure.disasternews.net

India Meteorological Department Cyclone Page: www.rsmcnewdelhi.imd.gov.in/index.php?lang=en

USGS Earthquake Hazards Programme: www.earthquake.usgs.gov

## GEOACOR14P – Disaster Management 4

## 2 Credits, 25 Marks [60 classes]

An individual Project Report is to be prepared and submitted based on any one case study among the following disasters of West Bengal incorporating a preparedness plan

- 1. Thunderstorm
- 2. Landslide
- 3. Flood
- 4. Coastal / riverbank erosion
- 5. Fire
- 6. Industrial accident
- 7. Structural collapse

One case study will be done by a group of five students. Different groups may choose different case studies from any one or different types of disasters. The report should be prepared on secondary data and handwritten on A4 page in candidates' own words not exceeding 2000 words excluding references. The report should contain a proper title. The report should incorporate relevant tables, maps, diagrams and references not exceeding five pages. Photographs are not required. A copy of the stapled report in a transparent front file, duly signed by the concerned teacher, will be submitted during examination. Without the report the candidates will not be evaluated for Core P14.

# 3. Department Specific Elective Subjects Syllabus

## GEOADSE01T− Soil and Biogeography ♦

## 6 Credit, 75 Marks [90 classes]

#### Unit I: Soil Geography

- 1. Factors of soil formation. Man as an active agent of soil transformation.
- 2. Soil profile. Origin and profile characteristics of Lateritic, Podzol and Chernozem soils
- 3. Definition and significance of soil properties: Texture, structure and moisture,
- 4. Definition and significance of soil properties: pH, organic matter and NPK
- 5. Soil erosion and degradation: Factors, processes and mitigation measures
- 6. Principles of soil classification: Genetic and USDA. Concept of land capability and its classification.

#### Unit II: Biogeography

- 7. Concepts of biosphere, ecosystem, biome, ecotone, community, niche, succession and ecology
- 8. Concepts of trophic structure, food chain and food web. Energy flow in ecosystems
- 9. Geographical extent and characteristic features of: Tropical rain forest, Taiga and Grassland biomes
- 10. Bio-geochemical cycles with special reference to carbon dioxide and nitrogen
- 11. Spatial distribution of world fauna.
- 12. Measures for conservation of bio-diversity in India: Man and Biosphere Programme

#### **Reading List**

Chapman J.L., Reiz, M.J. 1993. Ecology: Principle and Applications, Cambridge University Press.

- Chiras, D.D., Reganold, J.P. 2009. Natural Resource Conservation: Management for a Sustainable Future. Pearson.
- Cox, B., Moore, P.D., Ladle, R. 2016. Biogeography: An Ecological and Evolutionary Approach, Wiley-Blackwell.

Daji, J.A., Kadam, J.R., Patil, N.D. 1996. A Textbook of Soil Science, Media Promoters and Publishers Pvt Ltd.

Dash, M.C., 2001. Fundamental of Ecology, 2nd edition, Tata McGrawHill, New Delhi

Dey, N. K., Ghosh.P. 1993. India: A Study in Soil Geography, Sribhumi Publishing Company.

Franzmeier, D.P., McFee, W.W., Graveel, J.G., Kohnke, H. 2016. Soil Science Simplified, 5th ed, Waveland Press.

Huggett, R. 1998. Fundamentals of Biogeography, Routledge, London:

Lomolino, M.V., Riddle, B.R., Whittaker, R.J. 2016. Biogeography, 5th ed, Oxford University Press.

MacDonald, G.2001. Biogeography: Introduction to Space, Time, and Life, Wiley

Morgan, R.P.C. 1995. Soil Erosion and Conservation, 2nd edition, Longman.

Santra. A. 2006. Handbook on Wild and Zoo Animals, International Book Distributing Co.

Sharma, P.D. 2011. Ecology and Environment, Rastogi Publications.

Weil, R.R. and Brady, N.C. 2016. The Nature and Properties of Soil, 15th edition, Pearson.

White, R. 2006. Principles and Practice of Soil Science: The Soil as a Natural Resource, Blackwell.

## GEOADSE02T −Settlement Geography ♦

#### 6 Credit, 75 Marks [90 classes]

#### Unit I Rural Settlement

- 1. Scope and content of Settlement Geography; rural, urban and peri-urban areas
- 2. Rural Settlement: Definition, nature and characteristics
- 3. Morphology of rural settlements: site and situation, layout-internal and external
- 4. Rural house types with reference to India, Social segregation in rural areas; Census categories of rural settlements.
- 5. Problems and policies related to rural infrastructure with reference to India

#### Unit II Urban Settlement

- 6. Urban Settlements :Census definition (Temporal) and categories in India
- 7. Urban morphology: Classical models: Burgess, Homer Hoyt, Harris and Ullman Metropolitan concept.
- 8. City-region and Conurbation, Functional classification of cities: Harris, Nelson and McKenzie
- 9. Aspects of urban places: Location, site and situation, Size and spacing of cities: the rank size rule, the law of the primate city
- 10. Urban hierarchies : Central Place Theory; August Löch's theory of market centres

#### **Reading List**

Banerjee Guha, S. (Ed.) 2004. Space, Society and Geography, Rawat Publication.

Bjelland, M.D., Montello, D.R., Fellmann, J.D., Getis, A., Getis, J. 2000. Human Geography: Landscape of Human Activity, McGraw Hill.

Carter, H. 1995. The Study of Urban Geography, 4th ed, Arnold.

Dhanagare, D.N. 2004. Themes and Perspectives in Indian Sociology, Rawat Publication.

Fern, R.L. 2002. Nature, God and Humanity, Cambridge University Press.

Fouberg, E.H., Murphy, A.B., de Blij H.J. 2015. Human Geography: People, Place, and Culture, 11th ed, Wiley

Ghosh, S. 1998. Introduction to Settlement Geography, Sangam Books Ltd.

Gottdiener, M., Budd, M. Lehtovuori, P. 2016. Key Concepts in Urban Studies, 2nd ed, Sage.

Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, Wiley.

Hudson, F.S. 1970. Geography of Settlements, Macdonald and Evans Ltd.

Hussain, M. 2007. Models in Geography, Rawat Publication.

Jordan, T., Rowntree, L. 1990. Human Mosaic, Harper Collins Publishers.

Knox, P., Pinch, S. 2000. Urban Social Geography, Pearson Education.

Mandal, R.B. 2001. Introduction to Rural Settlement, 2nd ed, Concept Publishing Company.

Mitchell, D. 2000. Cultural Geography: A Critical Introduction, Blackwell.

Singh, R.Y. 2000. Geography of Settlements, Rawat Publication.

## GEOADSE03T – Population Geography ♦

#### 75 Marks 6 Credits

#### Unit I: Population Dynamics

- 1. Development of Population Geography as a field of specialization. Relation between population geography and demography. Sources of population data, their level of reliability and problems of mapping.
- 2. Population distribution: density and growth. Classical and modern theories in population distribution and growth, Demographic transition model.
- 3. World patterns determinants of population distribution and growth. Concept of optimum population.
- 4. Population distribution, density and growth profile in India.

Unit II: Population and Development

- 5. Concepts of Age-Sex Composition; Rural and Urban Composition; Literacy and education
- 6. Measurements of fertility and mortality. Concept of cohort and life table
- 7. Population composition of India: Urbanisation and Occupational structure.
- 8. Migration: Causes and types
- 9. National and international patterns of migration with reference to India.
- 10. Population and development: population-resource regions. Concept of human development index and its components.
- 11. Population policies in developed and less developed countries. India's population policies, population and environment, implication for the future.
- 12. Contemporary Issues Ageing of Population; Declining Sex Ratio; Population and environment dichotomy, HIV/AIDS.

#### **Reading List**

Barrett, H.R. 1995. Population Geography, Oliver and Boyd.

Bartram, D. Poros, M. Monforte, P. 2014. Key Concepts in Migration, Sage.

Binde, N., Kanitkar, H. 2000. The Principle of Population Studies, Himalaya Publications.

- Chandna, R.C. 2016. Geography of Population: Concepts, Determinants and Patterns, Kalyani Publishers.
- Dyson, T. 2011. Population and Development: The Demographic Transition, Rawat Publications.
- Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.
- Hassan, M.I. 2005. Population Geography, Rawat publications.
- Hussain, M. 1994. Human Geography, Rawat publications.
- Jhingan, M.L., Bhatt, B.K., Desai, J.N. 2014. Demography, Vrinda Publications.
- Jones, H. R. 2000. Population Geography, 3rd ed, Chapman.

- Lutz, W., Warren, C.S., Scherbov, S. 2004. The End of the World Population Growth in the 21st Century, Earthscan.
- Majumdar, P.K. 2013. India's Demography: Changing Demographic Scenario in India, Rawat Publications.
- Mukherji, S. 2013. Migration in India: Links to Urbanization, Regional Disparities and Development Policies, Rawat Publications
- Newbold, K.B. 2017. Population Geography: Tools & Issues, 3rd ed, Rowman & Littlefield Publishers.
- Pacione, M. 2012. Population Geography: Progress and Prospect, Routledge.
# GEOADSE04T – Hydrology and Oceanography 4

#### 6 Credits, 75 Marks [90 classes]

#### Unit-I: Hydrology

- 1. Systems approach in hydrology. Global hydrological cycle: Its physical and biological role
- 2. Run off: controlling factors. Infiltration and evapotranspiration. Run off cycle
- 3. Drainage basin as a hydrological unit. Principles of water harvesting and watershed management
- 4. Groundwater: Occurrence and storage. Factors controlling recharge, discharge and movement

#### Unit-II: Oceanography

- 5. Major relief features of the ocean floor: characteristics and origin according to plate tectonics
- 6. Physical and chemical properties of ocean water
- 7. Water mass, T–S diagram
- 8. Ocean temperature and salinity: Distribution and determinants
- 9. Marine resources: Classification and sustainable utilisation
- 10. Sea level change: Types and causes

#### **Reading List**

Dingman, S.L. 2015. Physical Hydrology, 3rd ed, Macmillan Publishing Co.

Fitts, C.R. 2002. Groundwater Science, Elsevier.

Garrison, T. 2016. Oceanography: An Invitation to Marine Science, 9th ed, Cengage Learning.

Kearey, P., Klepeis, K.A., Vine, F.J. 2011. Global Tectonics, 3rd ed, Wiley-India.

Karanth, K.R., 1988: Ground Water: Exploration, Assessment and Development, Tata- McGraw Hill, New Delhi.

- Pinet, P.R. 2014. Invitation to Oceanography. 7th ed, Jones and Barlett Publishers.
- Pinneker, E.V. 2010. General Hydrogeology, Cambridge University Press.
- Pugh, D., Woodworth, P. 2014. Sea-Level Science: Understanding Tides, Surges, Tsunamis and Mean Sea-Level Changes, 2nd ed, Cambridge University press.

Raghunath, H.M. 2006. Hydrology: Principles, Analysis, Design, 3rd ed, New Age International Publishers.

Reddy, P.J.R. 2014. A Textbook of Hydrology, University of Science Press.

Subramanya, K. 2013. Engineering Hydrology, McGraw Hill Education.

Sverdrup, K.A., Armrest, E.V. 2010. An Introduction to the World Oceans, 10th ed, McGraw Hill.

Todd, D.K., Larry, W.M. 2004. Groundwater Hydrology, John Wiley & Sons.

Ward, A.D., Trimble, S.W., Burckhard, S.R., Lyon, J.G. 2016. Environmental Hydrology, 3rd ed, CRC Press.

#### GEOADSE05T – Social Geography ↔

#### 6 Credits, 75 Marks [90 classes]

Unit I: Society, Identity and Crisis

- 1. Social Geography: Concept, Origin, Nature and Scope
- 2. Concept of Space, Social differentiation and stratification; social processes
- 3. Social Categories: Caste, Class, Religion, Race and Gender and their Spatial distribution
- 4. Basis of Social region formation; Evolution of social-cultural regions of India
- 5. Peopling Process of India: Technology and Occupational Change; Migration.
- 6. Social groups, social behaviour and contemporary social environmental issues with special reference to India

Unit II: Social Wellbeing and Planning

- 7. Concept of Social Well-being, Quality of Life, Gender and Social Well-being
- 8. Measures of Social Well-being: Healthcare, Education, Housing, Gender Disparity
- 9. Social Geographies of Inclusion and Exclusion, Slums, Gated Communities, Communal Conflicts and Crime.
- 10. Social Planning during the Five Year Plans in India
- 11. Social Policies in India: Education and Health
- 12. Social Impact Assessment (SIA): Concept and importance

#### **Reading List**

Ahmed A., 1999. Social Geography, Rawat Publications.

Casino, V. J. D., Jr., 2009. Social Geography: A Critical Introduction, Wiley Blackwell.

Cater, J. and Jones T., 2000: Social Geography: An Introduction to Contemporary Issues, Hodder Arnold.

- Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.
- Holt, L., 2011. Geographies of Children, Youth and Families: An International Perspective, Taylor & Francis.
- Majumdar, P.K. 2013. India's Demography: Changing Demographic Scenario in India, Rawat Publications.
- Mukherji, S. 2013. Migration in India: Links to Urbanization, Regional Disparities and Development Policies, Rawat Publications
- Panelli, R., 2004. Social Geographies: From Difference to Action, Sage.
- Rachel, P., Burke, M., Fuller, D., Gough, J., Macfarlane, R. and Mowl, G. 2001. Introducing Social Geographies, Oxford University Press.
- Smith, D. M., 1994. Geography and Social Justice, Blackwell, Oxford.
- Smith, S.J., Pain, R., Marston, S. A., Jones, J. P., 2009. The SAGE Handbook of Social Geographies, Sage Publications.

Valentine, G. 2014. Social Geographies: Space and Society, Routledge.

# GEOADSE06T − Resource Geography ◆

#### 75 Marks, 6 Credits [90 classes]

Unit I: Resource and Development

- 1. Natural Resources: Concept and classification
- 2. Approaches to Resource Utilization: Utilitarian, Conservational, Community based adaptation
- 3. Significance of Resources: Backbone of Economic growth and development
- 4. Pressure on resources. Appraisal and Conservation of Natural Resources
- 5. Problems of resource depletion—global scenario (forest, water, fossil fuels).
- 6. Sustainable Resource Development

Unit II: Resource Conflict and Management

- 7. Distribution, Utilisation, Problems and Management of Mineral Resources: Bauxite and Iron Ore.
- 8. Distribution, Utilisation, Problems and Management of Energy Resources: Conventional and Non-Conventional
- 9. Contemporary Energy Crisis and Future Scenario
- 10. Limits to Growth and Sustainable Use of Resources; Concept of Resource sharing: Water

#### **Reading List**

- Chiras, D.D., Reganold, J.P. 2009. Natural Resource Conservation: Management for a Sustainable Future, 10th ed, Pearson.
- Cutter, S.N., Renwich, H.L., Renwick, W. 1991. Exploitation, Conservation, and Preservation: A Geographical Perspective on Natural Resources Use, John Wiley and Sons.
- Gadgil, M., Guha, R. 2005. The Use and Abuse of Nature: Incorporating This Fissured Land: An Ecological History of India and Ecology and Equity, Oxford University Press.
- Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.
- Holechek, J.L.C., Richard, A., Fisher, J.T., Valdez, R. 2003. Natural Resources: Ecology, Economics and Policy, Prentice Hall.
- Jones, G., Hollier, G. 1997. Resources, Society and Environmental Management, Paul Chapman.
- Klee, G. 1991. Conservation of Natural Resources, Prentice Hall.
- Mather, A.S., Chapman, K. 1995. Environmental Resources, John Wiley and Sons.
- Mitchell, B. 1997. Resource and Environmental Management, Longman Harlow.
- Owen, S., Owen, P.L. 1991. Environment, Resources and Conservation, Cambridge University Press.
- Rees, J. 1990. Natural Resources: Allocation, Economics and Policy, Routledge.

# 4. Generic Elective Subjects Syllabus for Honours Students of Other Disciplines

# GEOHGEC01T− Physical Geography ♦

## 6 Credit, 75 Marks [90 classes]

Unit I: Geotectonics and Geomorphology

- 1. Physical Geography Definition and Scope, Components of Earth System.
- 2. Internal Structure of Earth based on Seismic Evidence, Plate Tectonics and its associated Features.
- 3. Influence of rocks on topography: Limestone and Granite
- 4. Evolution of landforms under fluvial process, Normal Cycle of Erosion of Davis
- 5. Formation of erosional and depositional landforms by coastal and aeolian processes

Unit II: Climatology and Oceanography

- 6. Insolation and Heat Balance.
- 7. Horizontal and Vertical distribution of temperature and pressure
- 8. Planetary wind system, characteristics of Monsoon and Tropical Cyclone
- 9. Climatic Classification: Köppen
- 10. Hydrological Cycle, Ocean Bottom Relief Features, ocean currents.

#### **Reading List**

Conserva H. T., 2004: Illustrated Dictionary of Physical Geography, Author House, USA.

Gabler R. E., Petersen J. F. and Trapasso, L. M., 2007: Essentials of Physical Geography (8th Edition), Thompson, Brooks/Cole, USA.

Garrett N., 2000: Advanced Geography, Oxford University Press.

Goudie, A., 1984: The Nature of the Environment: An Advanced Physical Geography, Basil Blackwell Publishers, Oxford.

Hamblin, W. K., 1995: Earth's Dynamic System, Prentice Hall, N.J.

Husain M., 2002: Fundamentals of Physical Geography, Rawat Publications, Jaipur.

Monkhouse, F. J. 2009: Principles of Physical Geography, Platinum Publishers, Kolkata.

Strahler A. N. and Strahler A. H., 2008: Modern Physical Geography, John Wiley & Sons, New York.

# GEOHGEC02T – Human Geography ↔

## 6 Credit, 75 Marks [90 classes]

#### Unit I Population and Social Geography

- 1. Factors of Growth and distribution of world population. Demographic Transition Theory.
- 2. World Population Composition: Age, Gender and Literacy.
- 3. Migration: Types, causes and consequences.
- 4. Space and Society: Cultural Regions; Race; Religion and Language
- 5. Contemporary social issues: Illiteracy and Poverty

#### Unit II Economic and Settlement Geography

- 6. Sectors of the economy: primary, secondary, tertiary and quaternary
- 7. Types of agriculture: Intensive subsistence rice farming, Plantation agriculture (Tea and Coffee)
- 8. Location, problems and prospects of Indian industries Cotton textile, Petroleum refining, Locomotive
- 9. Types and Patterns of Rural Settlements
- 10. Classification of Urban Settlements; Trends and Patterns of World Urbanization

#### **Reading List**

Chandna, R.C. (2010) Population Geography, Kalyani Publisher.

Daniel, P.A. and Hopkinson, M.F. (1989) The Geography of Settlement, Oliver & Boyd, London.

Ghosh, S. (2015) Introduction to settlement geography. Orient Black Swan Private Ltd., Kolkata

Hussain, Majid (2012) Human Geography. Rawat Publications, Jaipur

Johnston R; Gregory D, Pratt G. et al. (2008) The Dictionary of Human Geography, Blackwell Publication.

Jordan-Bychkov et al. (2006) The Human Mosaic: A Thematic Introduction to Cultural Geography. W. H. Freeman and Company, New York.

Kaushik, S.D. (2010) Manav Bhugol, Rastogi Publication, Meerut.

Maurya, S.D. (2012) Manav Bhugol, Sharda Pustak Bhawan. Allahabad.

# **GEOHGEC03T** – General Cartography

#### 4 Credits, 50 Marks [60 classes]

Cartographic Techniques

- 1. Concept of map scale: Types and Application. Reading distances on a map.
- 2. Map Projections: Criteria for choice of projections. Attributes and properties of: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. Concept of UTM projection
- 3. Survey of India topographical maps: Reference scheme of old and open series. Information on the margin of maps.
- 4. Representation of Data Symbols, Dots, Choropleth, Isopleth and Flow Diagrams, Interpretation of Thematic Maps.

#### Reading List

Dent B. D., 1999: Cartography: Thematic Map Design, (Vol. 1), McGraw Hill.

Gupta K. K and Tyagi V. C., 1992: Working with Maps, Survey of India, DST, New Delhi.

Mishra R. P. and Ramesh A., 1989: Fundamentals of Cartography, Concept Publishing.

Robinson A., 1953: Elements of Cartography, John Wiley.

Sharma J. P., 2010: Prayogic Bhugol, Rastogi Publishers.

Singh R. L. and Singh R. P. B., 1999: Elements of Practical Geography, Kalyani Publishers

Singh R. L., 1998: Prayogic Bhoogol Rooprekha, Kalyani Publications.

Steers J. A., 1965: An Introduction to the Study of Map Projections, University of London.

# GEOHGEC03P − General Cartography ◆

#### 2 Credits, 25 Marks [60 classes]

Cartographic Techniques

- 1. Graphical construction of scales: Plain and comparative. [10]
- 2. Construction of projections: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. [30]
- Construction and interpretation of relief profiles from Survey of India topographical map superimposed, projected and composite, relative relief map, slope map (Wentworth), and Correlation between physical and cultural features from Survey of India topographical maps using transect chart.

# **GEOHGEC04T** – Environmental Geography $\diamond$

#### 6 Credits, 75 Marks [90 classes]

#### Concepts

- 1. Environmental Geography: Concepts and Approaches;
- 2. Human-Environment Relationship in equatorial, desert, mountain and coastal regions
- 3. Concept of holistic environment and system approach
- 4. Ecosystem: Concept, structure and functions

Environmental problems and policies

- 5. Environmental Problems and Management: Air Pollution; Water pollution; Biodiversity Loss; Solid and Liquid Waste.
- 6. Environmental problems and management: Desertification and soil erosion
- 7. Environmental Programmes and Policies: Developed Countries; Developing Countries.
- 8. New Environmental Policy of India.

#### **Reading List**

Casper J.K. (2010) Changing Ecosystems: Effects of Global Warming. Infobase Pub. New York.

- Hudson, T. (2011) Living with Earth: An Introduction to Environmental Geology, PHI Learning Private Limited, New Delhi.
- Miller, G.T. (2007) Living in the Environment: Principles, Connections, and Solutions, Brooks/ Cole Cengage Learning, Belmont.
- Singh, R.B. (1993) Environmental Geography, Heritage Publishers, New Delhi.
- UNEP (2007) Global Environment Outlook: GEO4: Environment For Development, United Nations Environment Programme. University Press, Cambridge.

Wright R. T. and Boorse, D. F. (2010) Toward a Sustainable Future, PHI Learning Pvt Ltd, New Delhi.

Singh, R.B. and Hietala, R. (Eds.) (2014) Livelihood security in Northwestern Himalaya:

Case studies from changing socio-economic environments in Himachal Pradesh, India. Advances in Geographical and Environmental Studies, Springer

# 1. Scheme for the CBCS Curriculum for Geography General (B.Sc.)

# 1.1 Credit Distribution across Courses

Course Type	Total Papers	Credits		
B.Sc. General		THEORY + PRACTICAL	THEORY + TUTORIAL*	
Core Course: 04 courses from each	12	12×4 = 48	12×5 = 60	
of the <mark>03</mark> disciplines of choice		12×2 = 24	12×1 = 12*	
Elective Courses: 02 papers from	6	6×4 = 24	6×5 = 30	
each discipline of choice		6×2 = 12	6×1 = 06*	
Ability Enhancement Courses: 02 papers of 02 credits	2	2×2 = 04	2 × 2=04	
Skill Enhancement Courses: 04 papers of 02 credits each	4	4×2 = 08	4 × 2=08	
		120	120	

\*Tutorials of 1 Credit will be conducted in case there is no practical component

# **1.2** Computation of work-load per week

Type of Course	Credit	Duration of Periods
Tutorial Class	1	1 Theoretical class of 1 hour duration
Theory (T)	1	1 Theoretical class of 1 hour duration
Practical (P)	1	1 Practical class of 2 hour duration

Semester Duration: 15 weeks of direct teaching

# **1.3** List of subjects to be offered with Geography General

1. Political Science	4. Statistics
2. Economics	5. Zoology
3. Mathematics	6. Anthropology or Computer Science

Any 2 (two) subjects to be chosen from the above list and from each subject four papers to be taken as Core Course and two papers as Elective Course as mentioned in Table 3.2.

Semester	Course	Course Code	Title	Credit	Marks	Remarks
I	Core (DSC 1A)	GEOGCOR01T	Physical Geography	06	75	From Geography
	Core (DSC 2A)	XXXGCOR01T		06	75	Subject 2 apart from Geography
	Core (DSC 3A)	XXXGCOR01T		06	75	Subject 3 apart from Geography
	AECC	ENGSAEC01M	Communicative English	02	25	Shared course
II	Core (DSC 1B)	GEOGCOR02T	Human Geography	06	75	From Geography
	Core (DSC 2B)	XXXGCOR02T		06	75	Subject 2 apart from Geography
	Core (DSC 3B)	XXXGCOR02T		06	75	Subject 3 apart from Geography
	AECC	ENVSAEC02T	Environment Studies	02	25	Shared course
III	Core (DSC 1C)	GEOGCOR03T	General Cartography	04	50	From Geography
		GEOGCOR03P	General Cartography (Lab)	02	25	
	Core (DSC 2C)	XXXGCOR03T		04	50	Subject 2 apart from Geography
	Core (DSC 3C)	XXXGCOR03T		06	75	Subject 3 apart from Geography
	SEC1	XXXSSEC01M	Remote Sensing	02	25	Shared course

# **1.4** Distribution of Courses across semesters for Geography General (B.Sc.)

IV	Core (DSC 1D)	GEOGCOR04T	Environmental Geography	06	75	From Geography
	Core (DSC 2D)	XXXGCOR04T		06	75	Subject 2 apart from Geography
	Core (DSC 3D	XXXGCOR04T		06	75	Subject 3 apart from Geography
	SEC2	XXXSSEC02M	Advanced Spatial Statistical Techniques	06	75	Shared course
		GEOGDSE01T	A. Soil and Biogeography			Any one course
	DSE1A	GEOGDSE02T	B. Regional Development			among A, B and C from Geography
		GEOGDSE03T	C. Disaster Management			
V	DSE2A	XXXGDSE01T				Subject 2 apart from Geography
	DSE3A	XXXGDSE01T				Subject 3 apart from Geography
	SEC3					Shared course
	DSE1B	GEOGDSE04P	Project Report Based on Field Work	06	75	Compulsory from Geography
VI	DSE2B	XXXGDSE01T		02	25	Subject 2 apart from Geography
	DSE3B	XXXGDSE01T		06	75	Subject 3 apart from Geography
	SEC3			06	75	Shared course

# 1.5 Core Subjects

Code (Theory)	Code (Practical)	Course Name
GEOGCOR01T		Physical Geography
GEOGCOR02T		Human Geography
GEOGCOR03T	GEOGCOR03P	General Cartography
GEOGCOR04T		Environmental Geography

# **1.6** Choices for Two Discipline Specific Electives

Code (Theory)	Course Name
GEOGDSE01T	A. Soil and Biogeography
GEOGDSE02T	B. Regional Development
GEOGDSE03T	C. Disaster Management
GEOGDSE04P	Project Report Based on Field Work

# 1.7 Choices for Two Skill Enhancement Courses

Code (Theory)	Course Name
XXXSSEC01M	Remote Sensing
XXXSSEC02M	Advanced Spatial Statistical Techniques

# 2. Core Course Syllabus

# (4 compulsory papers)

# GEOGCOR01T− Physical Geography ◆

# 6 Credit, 75 Marks [90 classes]

Unit I: Geotectonics and Geomorphology

- 6. Physical Geography Definition and Scope, Components of Earth System.
- 7. Internal Structure of Earth based on Seismic Evidence, Plate Tectonics and its associated Features.
- 8. Influence of rocks on topography: Limestone and Granite
- 9. Evolution of landforms under fluvial process, Normal Cycle of Erosion of Davis
- 10. Formation of erosional and depositional landforms by coastal and aeolian processes

Unit II: Climatology and Oceanography

11. Insolation and Heat Balance.

- 12. Horizontal and Vertical distribution of temperature and pressure
- 13. Planetary wind system, characteristics of Monsoon and Tropical Cyclone
- 14. Climatic Classification: Köppen
- 15. Hydrological Cycle, Ocean Bottom Relief Features, ocean currents.

#### **Reading List**

Conserva H. T., 2004: Illustrated Dictionary of Physical Geography, Author House, USA.

Gabler R. E., Petersen J. F. and Trapasso, L. M., 2007: Essentials of Physical Geography (8th Edition), Thompson, Brooks/Cole, USA.

Garrett N., 2000: Advanced Geography, Oxford University Press.

Goudie, A., 1984: The Nature of the Environment: An Advanced Physical Geography, Basil Blackwell Publishers, Oxford.

Hamblin, W. K., 1995: Earth's Dynamic System, Prentice Hall, N.J.

Husain M., 2002: Fundamentals of Physical Geography, Rawat Publications, Jaipur.

Monkhouse, F. J. 2009: Principles of Physical Geography, Platinum Publishers, Kolkata.

Strahler A. N. and Strahler A. H., 2008: Modern Physical Geography, John Wiley & Sons, New York.

# GEOGCOR02T – Human Geography ↔

## 6 Credit, 75 Marks [90 classes]

Unit I Population and Social Geography

- 1. Factors of Growth and distribution of world population. Demographic Transition Theory.
- 2. World Population Composition: Age, Gender and Literacy.
- 11. Migration: Types, causes and consequences.
- 12. Space and Society: Cultural Regions; Race; Religion and Language
- 13. Contemporary social issues: Illiteracy and Poverty

#### Unit II Economic and Settlement Geography

- 14. Sectors of the economy: primary, secondary, tertiary and quaternary
- 15. Types of agriculture: Intensive subsistence rice farming, Plantation agriculture (Tea and Coffee)
- 16. Location, problems and prospects of Indian industries Cotton textile, Petroleum refining, Locomotive
- 17. Types and Patterns of Rural Settlements
- 18. Classification of Urban Settlements; Trends and Patterns of World Urbanization

#### **Reading List**

Chandna, R.C. (2010) Population Geography, Kalyani Publisher.

Daniel, P.A. and Hopkinson, M.F. (1989) The Geography of Settlement, Oliver & Boyd, London.

Ghosh, S. (2015) Introduction to settlement geography. Orient Black Swan Private Ltd., Kolkata

Hussain, Majid (2012) Manav Bhugol. Rawat Publications, Jaipur

Johnston R; Gregory D, Pratt G. et al. (2008) The Dictionary of Human Geography, Blackwell Publication.

Jordan-Bychkov et al. (2006) The Human Mosaic: A Thematic Introduction to Cultural Geography. W. H. Freeman and Company, New York.

Kaushik, S.D. (2010) Manav Bhugol, Rastogi Publication, Meerut.

Maurya, S.D. (2012) Manav Bhugol, Sharda Pustak Bhawan. Allahabad.

# GEOGCOR03T – General Cartography ↔

#### 4 Credits, 50 Marks [60 classes]

Cartographic Techniques

- 4. Concept of map scale: Types and Application. Reading distances on a map.
- 5. Map Projections: Criteria for choice of projections. Attributes and properties of: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. Concept of UTM projection
- 6. Survey of India topographical maps: Reference scheme of old and open series. Information on the margin of maps.
- 5. Representation of Data Symbols, Dots, Choropleth, Isopleth and Flow Diagrams, Interpretation of Thematic Maps.

#### Reading List

Dent B. D., 1999: Cartography: Thematic Map Design, (Vol. 1), McGraw Hill.

Gupta K. K and Tyagi V. C., 1992: Working with Maps, Survey of India, DST, New Delhi.

Mishra R. P. and Ramesh A., 1989: *Fundamentals of Cartography*, Concept Publishing.

Robinson A., 1953: *Elements of Cartography*, John Wiley.

Singh R. L. and Singh R. P. B., 1999: Elements of Practical Geography, Kalyani Publishers

Steers J. A., 1965: An Introduction to the Study of Map Projections, University of London.

# GEOGCOR03P – General Cartography 🔶

#### 2 Credits, 25 Marks [60 classes]

Cartographic Techniques

- 4. Graphical construction of scales: Plain and comparative. [10]
- 5. Construction of projections: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. [30]
- Construction and interpretation of relief profiles from Survey of India topographical map superimposed, projected and composite, relative relief map, slope map (Wentworth), and Correlation between physical and cultural features from Survey of India topographical maps using transect chart.

# GEOGCOR04T – Environmental Geography ↔

#### 6 Credits, 75 Marks [90 classes]

#### Concepts

- 9. Environmental Geography: Concepts and Approaches
- 10. Human-Environment Relationship in equatorial, desert, mountain and coastal regions
- 11. Concept of holistic environment and system approach
- 12. Ecosystem: Concept, structure and functions

Environmental problems and policies

- 13. Environmental Problems and Management: Air Pollution; Water pollution Biodiversity Loss; Solid and Liquid Waste.
- 14. Environmental problems and management: Desertification and soil erosion
- 15. Environmental Programmes and Policies: Developed Countries; Developing Countries.
- 16. New Environmental Policy of India.

**Reading List** 

- Casper J.K. (2010) Changing Ecosystems: Effects of Global Warming. Infobase Pub. New York.
- Hudson, T. (2011) Living with Earth: An Introduction to Environmental Geology, PHI Learning Private Limited, New Delhi.
- Miller, G.T. (2007) Living in the Environment: Principles, Connections, and Solutions, Brooks/ Cole Cengage Learning, Belmont.
- Singh, R.B. (1993) Environmental Geography, Heritage Publishers, New Delhi.
- UNEP (2007) Global Environment Outlook: GEO4: Environment For Development, United Nations Environment Programme. University Press, Cambridge.

Wright R. T. and Boorse, D. F. (2010) Toward a Sustainable Future, PHI Learning Pvt Ltd, New Delhi.

Singh, R.B. and Hietala, R. (Eds.) (2014) Livelihood security in Northwestern Himalaya:

Case studies from changing socio-economic environments in Himachal Pradesh, India. Advances in Geographical and Environmental Studies, Springer

# **3. Discipline Specific Elective**

# (2 Compulsory papers)

# **GEOGDSE01T** – Soil and Biogeography

# 6 Credits, 75 Marks [90 classes]

Unit I: Soil Geography

1. Factors of soil formation.

- 2. Soil profile. Origin and profile characteristics of Lateritic and Chernozem soils
- 3. Definition and significance of soil properties: Texture, structure and moisture, pH and organic matter
- 4. Principles of soil classification: Genetic and USDA. Concept of land capability and its classification.

Unit II: Biogeography

- 5. Concepts of biosphere, ecosystem, biome, ecotone, community, niche and succession.
- 6. Concepts of food chain and food web. Energy flow in ecosystems
- 7. Geographical extent and characteristic features of: Tropical rain forest and Grassland biomes
- 8. Bio-geochemical cycles with special reference to carbon dioxide and nitrogen.

#### Reading List

Biswas, T.D. and Mukherjee, S.K. 1997: Textbook of Soil Science, TataMcGraw Hill,

Brady, N.C. and Weil, R.R. 1996. The Nature and Properties of Soil, 11th edition, Longman, London :

Chapman J.L. and Reiss, M.J. 1993. Ecology: Principle and Applications, Cambridge University Press, Cambridge:

Dash, M.C., 2001. Fundamental of Ecology, 2nd edition, Tata McGrawHill, New Delhi

Huggett, R. 1998. Fundamentals of Biogeography, Routledge, London:

Kormondy, E.J. 1996. Concept of Ecology, 4th edition, Prentice- Hall, India, New Delhi

Myers, A. A. and Giller, P.S. (editors) 1988. Analytical Biogeography: an Integrated Approach to the Study of Animal and Plant Distribution. Chapman and Hall, London

## **GEOGDSE02T – Regional Development**

## 6 Credits, 75 Marks [90 classes]

#### Concepts of Regions and Regional Planning

- 1. Definition of Region. Types and Need of Regional planning:
- 2. Choice of a Region for Planning: Characteristics of an Ideal Planning Region; Delineation of Planning Region
- 3. Regionalization of India for Planning (Agro Ecological Zones)
- 4. Strategies/Models for Regional Planning: Growth Pole Model of Perroux; Growth Centre Model in Indian Context.
- 5. Problem Regions and Regional Planning: Backward Regions and Special Area Development Plans in India.

#### **Regional Development**

- 6. Changing concept of development and underdevelopment;
- 7. Indicators of development: Economic, social and environmental. Concept of human development
- 8. Development and regional disparities in India since Independence: Disparities in agricultural development and industrial development
- 9. Development and regional disparities in India since independence : Disparities in human resource development in terms of education and health

#### **Reading List**

- Bhargava, G. 2001. Development of India's Urban, Rural, and Regional Planning in 21st Century: Policy Perspective, Gyan Publishing House.
- Bhatt, L.S. 1976 Micro Level Planning in India. KB Publication, Delhi
- Chand, M., Puri, V.K. 2000. Regional Planning In India, Allied Publishers Ltd.
- Chandana, R.C. 2016. Regional Planning and Development, 6th ed, Kalyani Publishers.
- Deshpande C. D., 1992: India: A Regional Interpretation, ICSSR, New Delhi.
- Glasson, J. 2017. Contemporary Issues in Regional Planning, Routledge.
- Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography.
- Hall, P., Tewdwr-Jones, M. 2010. Urban and Regional Planning, Routledge.
- Higgins, B., Savoie, D.J. 2017. Regional Development: Theories and Their Application, Routledge.
- Kulshetra, S.K. 2012. Urban and Regional Planning in India: A Handbook for Professional Practioners, Sage Pub.
- Kumar, A., Meshram, D.S., Gowda, K. (Eds) 2016. Urban and Regional Planning Education: Learning for India, Springer.
- Misra, R.P. 1992. Regional Planning: Concepts, Techniques, Policies and Case Studies, Concept Publishing.
- Rapley, J. 2007. Understanding Development: Theory and Practice in the Third World, Lynne Rienner.
- Rapley, John (2007) Understanding Development: Theory and Practice in the 3rd World. Lynne Raza, M., Ed. (1988). Regional Development. Contributions to Indian Geography. New Delhi,
- Ray, J. 2001. Introduction to Development & Regional Planning, Orient Black swan.
- Raza, M. (Ed.) 1988. Regional Development: Contributions to Indian Geography, Heritage Publishers.

## **GEOGDSE03T** – Disaster Management

#### 6 Credits, 75 Marks [90 classes]

#### Unit I: Concepts

- 1. Hazards, risk, vulnerability and disasters: definition and concepts.
- 2. Approaches to hazard study: risk perception and vulnerability assessment. Hazard paradigms.
- 3. Response and mitigation to disasters: mitigation and preparedness, NDMA and NIDM; indigenous knowledge and community-based disaster management; do's and don'ts during disasters.

#### Unit II: Hazard-specific Study with focus on India

- 4. Disasters in india: (a) causes, impact, distribution and mapping: flood, drought and cyclone
- 5. Disasters in india: (b) causes, impact, distribution and mapping: earthquake, tsunami and landslide
- 6. Human induced disasters: causes, impact, distribution and mapping: radioactive fallout.

#### **Reading List**

Government of India. (1997) Vulnerability Atlas of India. New Delhi, Building Materials & Technology Promotion Council, Ministry of Urban Development, Government of India.

Kapur, A. (2010) Vulnerable India: A Geographical Study of Disasters, Sage Publication, New Delhi.

Modh, S. (2010) Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.

Singh, R.B. (2005) Risk Assessment and Vulnerability Analysis, IGNOU, New Delhi. Chapter 1, 2 and 3

Singh, R. B. (ed.), (2006) Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi.

Sinha, A. (2001). Disaster Management: Lessons Drawn and Strategies for Future, New United Press, New Delhi.

Stoltman, J.P. et al. (2004) International Perspectives on Natural Disasters, Kluwer Academic Publications. Dordrecht.

Singh Jagbir (2007) "Disaster Management Future Challenges and Oppurtunities", 2007. Publisher- I.K. International Pvt. Ltd. S-25, Green Park Extension, Uphaar Cinema Market, New Delhi, India (www.ikbooks.com).

# **GEOGDSE04P – Project Report based on Field Work**

## 6 Credits, 75 Marks

Project work is compulsory for completing B.Sc Course in Geography. Project Work is intended to provide an opportunity to the candidate to field test the learning.

The Project report should be based on field work on some specified topics as suggested by the Department.

Each student will prepare an individual report based on primary and secondary data collected during field work.

The duration of the field work should not exceed 10 days.

The word count of the report should be about **8000** excluding figures, tables, photographs, maps, references and appendices.

The report should include an introduction, literature review, project aims and objectives, methodology, results and discussion and references.

It should not exceed 20 to 25 pages (A4 pages) including maps, diagrams, and photographs etc.

One copy of the report on A 4 size paper should be submitted prior to examination.

# 4. Skill Enhancement Course Syllabus

(For both Honours and General courses)

# **GEOSSEC01M – Remote Sensing**

## 2 Credits, 25 Marks [30 classes]

- 1. Principles of Remote Sensing (RS): Classification of RS satellites and sensors
- 2. Sensor resolutions and their applications with reference to IRS and Landsat missions, image referencing schemes and data acquisition.
- 3. Preparation of False Colour Composites from IRS LISS-3 and Landsat TM and OLI data. Principles of image rectification and enhancement.
- 4. Principles of image interpretation and feature extraction. Preparation of inventories of land use land cover features from satellite images.

#### A project file consisting of four exercises on the above themes is to be submitted

Reading List

- Bhatta, B. 2011. Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others, CRC Press.
- Jensen, J.R., 2013. Remote Sensing of the Environment: An Earth Resource Perspective, Pearson Education India.
- Joseph, G. and Jegannathan, C. 2018. Fundamentals of Remote Sensing, 3rd ed, Universities Press.
- Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., 2015. Remote Sensing and Image Interpretation, 7th ed, Wiley.

WEBSITES:

International Society for Photogrammetry and Remote Sensing: www.isprs.org

NASA Landsat Science: www.landsat.gsfc.nasa.gov

National Remote Sensing Centre: www.nrsc.gov.in

USGS Global Visualization Viewer: www.glovis.usgs.gov

# GEOSSEC02M – Advanced Spatial Statistical Techniques 🔶

## 2 Credits, 25 Marks [30 classes]

- 1. Probability theory, probability density functions with respect to Normal, Binomial and Poisson distributions and their geographical applications.
- 2. Sampling: Sampling plans for spatial and non-spatial data, sampling distributions. Sampling estimates for large and small samples tests involving means and proportions.
- 3. Correlation and Regression Analysis: Rank order correlation and product moment correlation; linear regression, residuals from regression, and simple curvilinear regression. Introduction to multi-variate analysis.
- 4. Time Series Analysis: Time Series processes; Smoothing time series; Time series components.

Any statistical Software Package (e.g., SPSS, MS Excel, R, etc.) may be used for practice. A project file consisting of four exercises on the above themes is to be submitted.

#### **Reading List**

- Acevedo, M.F. 2012. Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press.
- Harris, R., Jarvis, C. 2011. Statistics for Geography and Environmental Science, Prentice Hall.
- McGrew Jr., J.C., Lembo Jr., A.J., Monroe, C.B. 2014. An Introduction to Statistical Problem Solving in Geography, 3rd ed, Waveland Press.

Pal S. K., 1998. Statistics for Geoscientists: Techniques and Applications, Concept Pub Co.

Rogerson, P.A. 2015. Statistical Methods for Geography: A Student's Guide, 4th ed, Sage.

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