

## **COURSE LEARNING OUTCOMES FOR PHYSICS SYLLABUS**

### **For Under Graduate Syllabus**

### **Vidyasagar University**

### **PART – I (Honours) /1<sup>st</sup> Semester**

#### **Course - Calculus**

#### **C<sub>1</sub> - Recapitulation:**

CO<sub>1</sub> - 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). –Theoretical idea and Problem solve

CO<sub>2</sub> - First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients, Wronskian and general solution, Statement of existence and Uniqueness Theorem for Initial Value Problems, Particular Integral -Theoretical idea and Problem solve

CO<sub>3</sub> - Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials, Integrating factor, with simple illustration, Constrained Maximization using Lagrange Multipliers, - Theoretical idea and Problem solve

#### **C<sub>2</sub> - Vector Calculus:**

CO<sub>1</sub> - 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.- Theoretical idea and Problem solve

CO<sub>2</sub> - Vector Differentiation: Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector field  $\nabla$  and Laplacian operators. Vector identities - Theoretical idea and Problem solve

CO<sub>3</sub> - 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).- Theoretical idea and Problem solve

#### **C<sub>3</sub> - Orthogonal Curvilinear Coordinates:**

CO<sub>1</sub> - Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.- Theoretical idea and Problem solve

#### **C<sub>4</sub>- Introduction to probability:**

CO<sub>1</sub> - Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.- Theoretical idea and Problem solve

#### **C<sub>5</sub>- DiracDelta function and its properties**

CO<sub>1</sub> - Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.- Theoretical idea and Problem solve

### **Course: Mathematical Physics**

#### **C<sub>1</sub>- Introduction and Overview**

CO<sub>1</sub> - Computer architecture and organization, memory and Input/output devices

#### **C<sub>2</sub>- Basics of scientific computing**

CO<sub>1</sub> - 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- Theoretical idea and Problem solve

#### **C<sub>3</sub>- Errors and error Analysis**

CO<sub>1</sub> - Truncation and round off errors, Absolute and relative errors, Floating point computations.- Theoretical idea and Problem solve

#### **C<sub>4</sub>- Introduction to plotting graphs with Gnuplot**

CO<sub>1</sub> - Basic 2D and 3D graph plotting - plotting functions and datafiles, fitting data using gnuplot's fit function, polar and parametric plots, modifying the appearance of graphs, Surface and contour plots, exporting plots.- Theoretical idea and Problem solve

#### **C<sub>5</sub>- Introduction to programming in python:**

CO<sub>1</sub>- Introduction to programming, constants, variables and data types, dynamical typing, operators and expressions, modules, I/O statements, iterables, compound statements, indentation in python, the if-elif-else block, for and while loops, nested compound statements, lists, tuples, dictionaries and strings, basic ideas of object oriented programming.-Theoretical idea and Problem solve

## C<sub>6</sub> - Programs

CO<sub>1</sub> -Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search

CO<sub>2</sub> -**Random number generation**

CO<sub>3</sub> -Area of circle, area of square, volume of sphere, value of pi ( $\pi$ )

CO<sub>4</sub> -**Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods**

CO<sub>5</sub> -Solution of linear and quadratic equation, solving  $\alpha = \tan\alpha$ ,  $\mu = \mu \left\{ \frac{\sin\alpha}{\alpha} \right\}^2$ , in optics

CO<sub>6</sub> -**Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation**

CO<sub>7</sub> -Evaluation of trigonometric functions e.g.  $\sin \theta$ ,  $\cos \theta$ ,  $\tan \theta$ , etc.

CO<sub>8</sub> -**Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method**

CO<sub>9</sub> -Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop

CO<sub>10</sub> -**Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods**

First order differential equation

- ▶ CO<sub>11</sub> -Radioactive decay
- ▶ CO<sub>12</sub> --Current in RC, LC circuits with DC source
- ▶ CO<sub>13</sub> -Newton's law of cooling
- ▶ CO<sub>14</sub> -Classical equations of motion

Attempt following problems using RK 4 order method

CO<sub>15</sub> -Solve the coupled differential equations□

$$\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dx} = -x$$

CO<sub>16</sub> -For four initial conditions  $x(0) = 0$ ,  $y(0) = -1, -2, -3, -4$ .

CO<sub>17</sub> -Plot  $x$  vs  $y$  for each of the four initial conditions on the same screen for  $0 \leq t \leq 15$

CO<sub>18</sub> -The differential equation describing the motion of a pendulum is  $\frac{d^2(\theta)}{dt^2} = -\sin(\theta)$ . The pendulum is released from rest at an angular displacement  $\alpha$ , i. e.  $\theta(0) = \alpha$ , and  $\theta'(0) = 0$ . Solve the equation for  $\alpha = 0.1, 0.5$  and  $1.0$  and plot  $\theta$  as a function of time in the range  $0 \leq t \leq 8$ . Also plot the analytic solution valid for small  $\theta$  ( $\sin(\theta) \approx \theta$ )

## **Course - Mechanics**

### **C<sub>1</sub> - Fundamentals of Dynamics**

CO<sub>1</sub> -Reference frames. Inertial frames; Review of Newton's Laws of Motion.

CO<sub>2</sub> -Galilean transformations; Galilean invariance.

CO<sub>3</sub> -Momentum of variable- mass system: motion of rocket.

CO<sub>4</sub> -Motion of a projectile in Uniform gravitational field

CO<sub>5</sub> -Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

### **C<sub>2</sub> - Work and Energy**

CO<sub>1</sub> -Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. -Theory, calculation and problem solve

CO<sub>2</sub> -Qualitative study of one dimensional motion from potential energy curves. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. -Theory, calculation and problem solve

CO<sub>3</sub> - Work done by non-conservative forces. Law of conservation of Energy.- Theory, calculation and problem solve

### **C<sub>3</sub> - Collisions**

CO<sub>1</sub> -Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. -Theory, calculation and problem solve

### **C<sub>4</sub> - Rotational Dynamics**

CO<sub>1</sub> -Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. -Theory, calculation and problem solve

CO<sub>2</sub> -Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation.- Theory, calculation and problem solve

CO<sub>3</sub> -Motion involving both translation and rotation.- Theory, calculation and problem solve

### **C<sub>5</sub>-Elasticity**

CO<sub>1</sub> -Relation between Elastic constants. Twisting torque on a Cylinder or Wire.- Theory, calculation and problem solve

### **C<sub>6</sub>-Fluid Motion**

CO<sub>1</sub> -Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.- Theory, calculation and problem solve

### **C<sub>7</sub>-Gravitation and Central Force Motion**

CO<sub>1</sub> -Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.- Theory, calculation and problem solve

CO<sub>2</sub> -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. - Theory, calculation and problem solve

CO<sub>3</sub> -Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). - Theory, calculation and problem solve

### **C<sub>8</sub>-Oscillations**

CO<sub>1</sub> -SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution.- Theory, calculation and problem solve

CO<sub>2</sub> - Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations:- Theory, calculation and problem solve

CO<sub>3</sub> -Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.- Theory, calculation and problem solve

### **C<sub>9</sub>-Non-Inertial Systems:**

CO<sub>1</sub> -Non-inertial frames and fictitious forces. Uniformly rotating frame. - Theory, calculation and problem solve

CO<sub>2</sub> -Laws of Physics in rotating coordinate systems. Centrifugal force. - Theory, calculation and problem solve

CO<sub>3</sub> -Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.- Theory, calculation and problem solve

### **C<sub>10</sub>-Special Theory of Relativity**

CO<sub>1</sub> -Michelson-Morley Experiment and its outcome. - Theory, calculation and problem

solve

CO<sub>2</sub> -Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation.- Theory, calculation and problem solve

CO<sub>3</sub> -Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. - Theory, calculation and problem solve

CO<sub>4</sub> -Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.-Theory, calculation and problem solve

### **C<sub>10</sub>- Practical**

CO<sub>1</sub> -Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.-Practical idea

CO<sub>2</sub> -To study the random error in observations. -Practical idea

CO<sub>3</sub> -To determine the height of a building using a Sextant. -Practical idea

CO<sub>4</sub> -To study the Motion of Spring and calculate, (a) Spring constant, (b) g and (c) Modulus of rigidity. -Practical idea

CO<sub>5</sub> -To determine the Moment of Inertia of a Flywheel. -Practical idea

CO<sub>6</sub> -To determine g and velocity for a freely falling body using Digital Timing Technique-Practical idea

CO<sub>7</sub> -To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). -Practical idea

CO<sub>8</sub> -To determine the Young's Modulus of a Wire by Optical Lever Method. -Practical idea

CO<sub>9</sub> -To determine the Modulus of Rigidity of a Wire by Maxwell's needle. -Practical idea

CO<sub>10</sub> -To determine the elastic Constants of a wire by Searle's method. -Practical idea

CO<sub>11</sub> -To determine the value of g using Bar Pendulum. -Practical idea

CO<sub>12</sub> -To determine the value of g using Kater's Pendulum. -Practical idea

## **PART – II (Honours)**

**Students who complete this course will be able to:**

### **Course: Mathematical Methods II**

#### **C<sub>1</sub>: Matrices:**

CO<sub>1</sub> - Definitions of row & column matrices ( vectors ), transpose of a matrix, real, square, symmetric & skew-symmetric, hermitian & skew-hermitian, singular & non-singular matrices.

CO<sub>2</sub> - Apply their knowledge for calculation of inverse, submatrices, rank, orthogonal, unitary, normal, SO & SU with examples e.g. matrix for active or passive rotation of a vector.

CO<sub>3</sub> – Calculation of eigen values and eigen vectors, similarity transformation, diagonalisation of matrix, unitary transformation, orthonormality of eigen vectors for normal matrices.

CO<sub>4</sub> – Theory of completeness theorem, spectral decomposition methods and solution of problem.

#### **C<sub>2</sub>: Probability & Statistics:**

CO<sub>1</sub> - Basic idea on introduction, definitions of probability, fundamental laws of probability

CO<sub>2</sub> – Theory and problems on combinations and permutations

CO<sub>3</sub> – Theory and problems on statistical distributions, second moments and standard deviation, discrete probability distributions, the binomial, Poisson and normal distributions.

#### **C<sub>3</sub>: Hermite Polynomial:**

CO<sub>1</sub> - Introduction and the solution of Hermite differential equation about origin by Power series

CO<sub>2</sub> – Conversion into Sturm-Liouville equation to find the weight function

CO<sub>3</sub> – Theory and problems on generating function, orthonormality, Rodrigue's formula.

CO<sub>4</sub> – Prove of different recurrence relations

#### **C<sub>4</sub>: Fourier Analysis:**

CO<sub>1</sub> – Problems on Fourier series of some typical wave forms e.g. square wave pulses, triangular waveform, waveforms of the output of a half-wave and a full-wave rectifiers, sawtooth – Half-range expansions

CO<sub>2</sub> – Basic idea, theory and problems on Parseval's identity, Complex form of Fourier series, Fourier expansion, Fourier integral, Fourier transforms pair, Fourier transforms of simple functions occurring in physical applications.

#### **C<sub>5</sub>: Tensors:**

CO<sub>1</sub> – Basic idea, theory and problems on space of n-dimensions, summation convention, contravariant and covariant vectors, invariants, contravariant, covariant and mixed tensors, the Kronecker delta, symmetric and skew-symmetric tensors,

CO<sub>2</sub> – Basic idea, theory and problems on algebra of tensors, quotient law, Metric tensor and some simple examples of it related to Special Theory of Relativity.

#### **C<sub>6</sub>: Complex Variables:**

CO<sub>1</sub> – Functions of a complex variable, analytic functions, Cauchy-Riemann relations, Harmonic Functions, Single and Multivalued functions,

CO<sub>2</sub> – Statements of Taylor and Laurent series, Solutions of these series

CO<sub>3</sub> – Definition and calculation of singularities and zeroes, Cauchy's integral theorem (no proof is required) for simply connected regions, Cauchy's integral formulae, Solutions of problems

CO<sub>4</sub> – Poles, Residue at a pole of order 'n', Cauchy's residue theorem (statement only), Calculation, solution of problems

CO<sub>5</sub> – Preliminary idea of Contour integration, Evaluation of real integrals with the help of residue theorem (simple examples restricted to improper integrals of rational functions), solutions of problems

#### **Course: Current Electricity and Magnetism II**

##### **C<sub>1</sub>: Electromagnetic induction**

CO<sub>1</sub> – Electromagnetic induction, Faraday's laws, Lenz's law, motional e.m.f. – simple problems; differential form of Faraday's laws-Theory and Problems

CO<sub>2</sub> – vector and scalar potentials in time varying electromagnetic field; calculation of coefficients

CO<sub>3</sub> – Self and mutual induction in simple cases, inductances in series and parallel; Theory and Problems

CO<sub>4</sub> – Elementary theory of transformers

CO<sub>5</sub> – Elementary idea on construction and principle of dead-beat and ballistic galvanometers – Theory and Problems

##### **C<sub>2</sub>: D.C & A. C circuits**

CO<sub>1</sub> – Theory and Problems on Potential difference and electromotive force

CO<sub>2</sub> – Electric current, continuity equation; metallic conduction and Ohm's law, analysis of Resistive network,

CO<sub>3</sub> – Kirchhoff's laws in analysis of multi-loop circuits- Theory and Problems

CO<sub>4</sub> – Superposition principle, current and voltage sources, Thevenin's and Norton's theorems (statements and explanations) and reduction of two terminal, Problems and solutions

CO<sub>5</sub> – Networks, maximum power transfer theorem and matching of network; T and  $\pi$  networks analysis and solution of problem

CO<sub>6</sub> – Wheatstone bridge principle and calculation of galvanometer current by Thevenin's Theorem in an unbalanced Wheatstone bridge connected to ideal voltage source- Theory and Problems

CO<sub>7</sub> – Calendar and Griffith bridge; Potentiometer principle.



CO<sub>8</sub> -Circuit elements, passive and active, linear and nonlinear, thermistor, LDR- Theory and Problems

CO<sub>9</sub> - Growth and decay of current in LR, CR and LCR circuits- Theory and Problems

CO<sub>10</sub> - Frequency, amplitude, phase, r.m.s. and peak-to-peak value of A.C. voltage and current; reactance, complex impedance - Theory and Problems

CO<sub>11</sub> - LR, CR, LCR series and parallel circuits, Phasor diagrams, resonance, Q factor, power dissipation- Theory and Problems

CO<sub>12</sub> - A. C. bridge (Anderson's).

### **Course: Electromagnetic Theory**

#### **C<sub>1</sub>: Fundamentals of electromagnetic theory**

CO<sub>1</sub> - Generalisation of Ampere's Law, Displacement Current, Maxwell's Field Equations,

CO<sub>2</sub> - Wave equation for electromagnetic (EM) field and its solution

CO<sub>3</sub> - Plane wave and spherical wave solutions, transverse nature of field,

CO<sub>4</sub>- Relation between E and B; energy density of field, Poynting vector and Poynting theorem- Theory deduction and Problems

#### **C<sub>2</sub>: EM Waves in an isotropic dielectric**

CO<sub>1</sub> -Wave equations and solutions

CO<sub>2</sub> -Deduction of Reflection and refraction at plane boundary, reflection and transmission coefficients, CO<sub>3</sub> -Fresnel's formula, change of phase on reflection

CO<sub>4</sub> - Deduction of Polarization on reflection and Brewster's law, total internal reflection.

#### **C<sub>3</sub>: EM Waves in conducting medium**

CO<sub>1</sub> -Wave equation in conducting medium and solutions

CO<sub>2</sub> -Reflection and transmission at metallic surface - skin effect and skin depth -Deduction and problems solution

CO<sub>3</sub> - Propagation of E-M waves between parallel and conducting plates - wave guides (rectangular only).

#### **C<sub>4</sub>: Dispersion**

CO<sub>1</sub> -Equation of motion of an electron in a radiation field-Deduction and problems solution

CO<sub>2</sub> -Lorentz theory of dispersion - normal and anomalous-Deduction and problems solution

CO<sub>3</sub> -Sellmeier's and Cauchy's formulae-Deduction and problems solution

### **Course: Quantum Mechanics**

#### **C<sub>1</sub>: Old quantum theory**

CO<sub>1</sub> -Origin of the quantum theory - difficulties with the classical theory, Rayleigh-Jean's law and Wien's law for black body radiation, Planck's formula for black body radiation, short review of the line spectra, -theory deduction and problem solution

CO<sub>2</sub> -Photoelectric effect, Compton effect-theory deduction and problem solution

CO<sub>3</sub> -Bohr atom and quantization of energy levels-theory deduction and problem solution

#### **C<sub>2</sub>: Basic Quantum Mechanics**

CO<sub>1</sub> -De Broglie hypothesis, electron double-slit experiment-proof

CO<sub>2</sub> -Davisson-Germer experiment-proof

CO<sub>3</sub> -Heisenberg's uncertainty principle (statement) with illustrations-proof and problem solution

CO<sub>4</sub> -concept of wave packet (qualitative), physical concept of wave function as describing the dynamical state of a single particle, group & phase velocities, classical velocity of a particle and the group velocity of the wave representing the particle- proof and problem solution

CO<sub>5</sub> -complementary principle, principle of superposition-proof

Schrodinger equation, probabilistic interpretation, normalization, orthonormality and orthogonality-proof

CO<sub>6</sub> -equation of continuity, probability current density, boundary conditions on the wave functions, time dependent and time independent Schrodinger equation as an operator equation

CO<sub>7</sub> -operators, observables & measurements-proof and problem solution

CO<sub>8</sub> -Simple applications of Quantum mechanics - one-dimensional infinite potential well, its extension in 2D and 3D (derivation not required) and concept of degeneracy- proof and problem solution

## **Course: Relativity**

### **C<sub>1</sub>: Introduction**

CO<sub>1</sub> –Concept of Newtonian relativity, Galilean transformation and invariance of Newton's law of motion, non-invariance of Maxwell's equations,

CO<sub>2</sub> -Michelson-Morley experiment and explanation of null result-deduction

### **C<sub>2</sub>Special Theory of Relativity**

CO<sub>1</sub> -Concept of inertial frame, Postulates of special theory, simultaneity-deduction and problem solution

CO<sub>2</sub> -Lorentz transformation, length contraction, time dilation and velocity addition theorem-deduction and problem solution

CO<sub>3</sub> -Doppler Effect in light-deduction and problem solution

CO<sub>4</sub> -Variation of mass with velocity, energy momentum relation, mass energy equivalence-deduction and problem solution

CO<sub>5</sub> -Four vectors (coordinate and momentum only), Invariance of an interval time like, space like and light like intervals, light cone, causality.

## **Paper IV**

### **Course: Mechanics II**

#### **C<sub>1</sub>: Mechanics of Ideal Fluids**

CO<sub>1</sub> -Definition of fluid, liquid and gas, ideal and non ideal fluids; local, substantial and commoving rate of change

CO<sub>2</sub> –definition and deduction of equation of continuity;

CO<sub>3</sub> -stream lines, stream tubes vorticity vector, vortex lines, vortex tubes-general idea

CO<sub>4</sub> -Euler equation; Bernoulli's equation, deduction, simple applications and explanation of everyday experience

#### **C<sub>2</sub>: Lagrangian formulation**

CO<sub>1</sub>-Degrees of freedom; constraints, holonomic, non-holonomic, scleronomous and rheonomous constraints; generalised coordinates-general idea and problem solution

CO<sub>2</sub>-virtual displacement and virtual work, principle of virtual work; D' Alembert's principle; Lagrange's equation for holonomic systems (from D' Alembert's principle) – for

conservative systems and for systems with velocity dependent potentials-deduction and problem solution

CO<sub>3</sub>-application of Lagrange's equation in simple cases-Solution

### C<sub>3</sub>: **Small oscillations**

CO<sub>1</sub>-Deduction of theory of small oscillations (up to calculation of eigen frequencies and relative amplitudes),

CO<sub>2</sub>-simple applications: spring mass systems, diatomic molecules, linear vibration of symmetric linear tri-atomic molecules-deduction and problem solution

### C<sub>4</sub>: **Hamiltonian Formulation**

CO<sub>1</sub>-Generalised momentum, cyclic coordinates and its relation with conservation principles, symmetries and the law of conservation (Homogeneity and isotropy of space and homogeneity of time), definition of Hamiltonian, Hamilton's equation,

CO<sub>2</sub>-derivation of Hamilton's equation by Legendre transformation; kinetic energy in terms of generalised velocities and generalised coordinates, Hamiltonian and total energy for systems with scleronomous and rheonomous constraints, application of Hamiltonian Formulation to simple cases.

CO<sub>3</sub>-Variational principle, Euler-Lagrange equation; Hamilton's principle, derivation of Lagrange's equation from Hamilton's principle, application to brachistochrone problem-deduction and problem solution

CO<sub>4</sub>-Contact transformation and canonical transformation, generating function, conditions for transformation to be canonical, simple problems

CO<sub>5</sub>-Fundamental Poisson brackets, fundamental properties of Poisson bracket, equations of motion in Poisson bracket form, Poisson bracket and integrals of motion, Poisson bracket of angular momentum components, Poisson bracket and canonical transformation-proof and problem solution

## **Course: Atomic, Molecular & Laser Physics**

### C<sub>1</sub>: **Atomic models**

CO<sub>1</sub> -Derivation of Bohr model, ionization and excitation potentials, correction due to finite mass of nucleus, limitations of Bohr model, Sommerfeld's model (no derivation), limitations of Sommerfeld's model-solution of problem

### C<sub>2</sub>: **Electron magnetic moments and vector atom model**

CO<sub>1</sub> -Derivation of Orbital angular momentum and orbital magnetic moment of electron: Classical expression, gyromagnetic ratio and solution of problems

CO<sub>2</sub> -Derivation of Orbital angular momentum quantum number, quantum mechanical expression of orbital angular momentum and orbital magnetic moment of electron, Larmor precession-derivation and solution

CO<sub>3</sub> -Electron Spin & space quantization of magnetic moments: Stern-Gerlach experiment, electron spin, spin angular momentum quantum number, spin magnetic moment, -derivation and solution

CO<sub>4</sub> -space quantization of spin and orbital magnetic moment - orbital and spin magnetic moment quantum numbers-derivation and solution

CO<sub>5</sub> -Vector atom model: Total angular momentum, total angular momentum quantum number, vector atom model

### C<sub>3</sub>: **Spectra of single electron atom (Hydrogen)**

CO<sub>1</sub> -Four quantum numbers, Degeneracy, Selection rules for transition in Hydrogen atom, Fine structure, Removal of degeneracy by spin orbit interaction. Lamb shift, Lamb-Rutherford experiment-derivation and solution

#### **C<sub>4</sub>: Many-electron atom**

CO<sub>1</sub> –Pauli Exclusion Principle, shell structure, maximum number of electrons in a shell and a sub shell, -derivation and solution

CO<sub>2</sub> –Electronic configuration, L-S coupling; Multiplicity of state, Spectroscopic term symbol of atomic states of many electron atoms, Selection rules, J-J coupling. Hund's rule-derivation and solution

#### **C<sub>5</sub>: Spectra of alkali atoms:**

CO<sub>1</sub> –Hydrogen-like nature of monovalent atoms, Screening effect, doublet structure of alkali spectra-derivation and solution

#### **C<sub>6</sub>: Spectra of Helium and alkali earth atoms:**

CO<sub>1</sub> –Energy levels and transitions of Helium and alkali earth atoms, singlet and triplet states-derivation and solution

#### **C<sub>7</sub>: Effect of magnetic field on atomic spectra:**

CO<sub>1</sub> –Effect of magnetic field on energy levels, Lande g factor, Normal & Anomalous Zeeman effect, Paschen-Back effect-derivation and solution

#### **C<sub>8</sub>: X-ray Spectra:**

CO<sub>1</sub> –Basic idea of Continuous & Characteristic X-ray,

CO<sub>2</sub> –Basic idea and derivation-Duane & Hunt limit, Moseley's law, Doublet fine structure, H-like character of X-Ray states, X-Ray absorption spectra

#### **C<sub>9</sub>: Molecular Spectra:**

CO<sub>1</sub> –Basic ideas about molecular spectra, Diatomic molecules – rotational and vibrational energy levels – rotation and vibration spectra,

CO<sub>2</sub> –Raman effect (Preliminary idea)

#### **C<sub>9</sub>: Laser Physics:**

CO<sub>1</sub> –Population inversion, Einstein's A & B co-efficient, feedback of energy on a resonator, 3-level & 4-level systems, He-Neon and Semiconductor laser-derivation and solution

### **Course: Electronics II**

#### **C<sub>1</sub>: Field effect transistors (FET)**

CO<sub>1</sub> –Classification of various types of FETs, construction of junction FET, drain characteristics,

CO<sub>2</sub> –biasing, operating region, pinch-off voltage. JFET amplifier: CS, CD amplifier.

CO<sub>3</sub> –MOSFET: construction of enhancement and depletion type, principle of operation and characteristics.

CO<sub>4</sub> –Elementary ideas of CMOS and NMOS.

#### **C<sub>2</sub>:Operational Amplifier (OPAMP)**

CO<sub>1</sub> –Introduction to differential amplifier, Characteristics of ideal and real OPAMP, concept of virtual ground,

CO<sub>2</sub> –applications of OPAMP as inverting amplifier, non-inverting amplifier, Mathematical operation - addition, subtraction, integration and differentiation, solution of differential equations and linear algebraic equations

#### **C<sub>3</sub>: Feedback in Amplifier**

CO<sub>1</sub> –Voltage and current gain, principle of feedback, positive and negative feedback, advantages of negative feedback

#### **C<sub>4</sub>:Multistage amplifier**

CO<sub>1</sub> –Classification of amplifier, Principle of Multistage amplifier, R-C coupled BJT amplifier (two stage only):

CO<sub>2</sub> –Analysis in low, mid, and high frequency range, gain and band width and Bode plot,

CO<sub>3</sub> –Analysis of single tuned voltage amplifier, Requirement of power amplifiers, Class B push-pull amplifier-derivation and solution

### **C<sub>5</sub>: Oscillators**

CO<sub>1</sub> –Barkhausen criteria, Hartley, Colpitts, Wien Bridge, Phase shift and Crystal oscillators, -basic idea, derivation and solution

CO<sub>2</sub> –relaxation oscillators - Astable, monostable (with transistor, IC555, OPAMP) and bistable multivibrators- basic idea, derivation and solution

### **C<sub>6</sub>: Combinational logic**

CO<sub>1</sub> –Half adder, full adder, digital comparator, decoder, encoder (ROM),

CO<sub>2</sub> –digital to analog conversion, analog to digital conversion, multiplexer

### **C<sub>7</sub>: Sequential logic**

CO<sub>1</sub> –Flip - Flops - RS, D, JK, JKMS, edge triggering and locked operation,

CO<sub>2</sub> –shift registers, ripple counter (binary and decade)

### **C<sub>8</sub>: Electronic measuring instruments**

CO<sub>1</sub> –knowledge about CRO – Block diagram of CRO, Deflection and focusing systems, time base circuit, measurement of voltage, frequency and phase with a CRO;

CO<sub>2</sub> –Knowledge about Electronic voltmeter and Digital multimeter

## **Course: Nuclear Physics I**

### **C<sub>1</sub>: Bulk properties of nuclei**

CO<sub>1</sub> –Idea and derivation of Nuclear charge, mass, binding energy, mass defect, packing fraction, binding fraction, size.

CO<sub>2</sub> -Spin, magnetic dipole moment, electric quadrupole moment, isospin- definition and deduction

CO<sub>3</sub> -Isotopes, Isobars & isotones, mass spectrometer (Bainbridge) and its uses

### **C<sub>2</sub>: Nuclear models:**

CO<sub>1</sub> –Theory of Neutron- proton hypothesis, Nature of forces between nucleons, Nuclear stability & nuclear binding.

CO<sub>2</sub> –Liquid drop model (descriptive) and Bethe-Weizsacker mass formula – application of mass formula to stability consideration, mass parabola, -Theory and Problem

CO<sub>3</sub> –Nuclear shell model (qualitative discussions), Single particle states in nuclei, Application of extreme single particle shell model (qualitative discussion with emphasis on phenomenology with examples), Theory and Problem

CO<sub>4</sub> –Theory of nuclear forces

### **C<sub>3</sub>: Radioactivity:**

CO<sub>1</sub> –Survival equation, Half-life, Mean-life,

CO<sub>2</sub> –Transient and secular equilibrium,

CO<sub>3</sub> –radioactive dating

### **C<sub>4</sub>: $\alpha$ -decay:**

CO<sub>1</sub> –Alpha particle spectra – velocity and disintegration energy of  $\alpha$ -particles. Range of  $\alpha$ -particles, Geiger-Nuttal law – Gamow's explanation,

CO<sub>2</sub> –Fine structure of the  $\alpha$ -ray spectra

### **C<sub>4</sub>: $\beta$ -decay:**

CO<sub>1</sub> –Detection of the  $\beta$ -energy, Nature of  $\beta$ -ray spectra, the neutrino, energy levels & decay schemes, positron emission & electron capture, selection rules, beta absorption & range of beta particles, Kurie plot, Sergent diagram

### **C<sub>5</sub>: Gamma decay:**

CO<sub>1</sub> –Detection of the gamma ray energy, spectra & nuclear energy levels

CO<sub>2</sub> –Gamma absorption in matter – photoelectric process, Compton scattering, e<sup>-</sup> - e<sup>+</sup> pair production (qualitative discussions)

CO<sub>3</sub> – Selection rule for gamma decay, Positronium atom and pair annihilation, Radiative transitions in nuclei - multipolarity of transition and selection rules (no derivations).

CO<sub>4</sub> –Internal conversions, Auger transition and Bremstralung radiation (qualitative discussions)

**Course: Non-electrical Practical**

**C<sub>1</sub>: Study of flexure of a bar**

CO<sub>1</sub> – Practical idea, calculation of young modulus

C<sub>2</sub>: Study of flow of liquid through capillary tube (radius to be measured by microscope directly)

CO<sub>1</sub> – Practical idea, calculation of viscosity

C<sub>3</sub>: Focal length of a concave lens by combination method

CO<sub>1</sub> – Practical idea, calculation of focal length

C<sub>4</sub>: Determination of wavelength by Newton's ring experiment

CO<sub>1</sub> – Practical idea, calculation of Interference

C<sub>5</sub>: Calibration of spectrometer and determination of unknown wavelength

CO<sub>1</sub> – Practical idea about spectrometer and its application

C<sub>6</sub>: Dispersive power of a prism

CO<sub>1</sub> – Practical idea, calculation of dispersive power

C<sub>7</sub>: Single slit experiment

CO<sub>1</sub> – Practical idea, calculation of diffraction

C<sub>8</sub>: To study interference & diffraction in case of a wire by using LASER

CO<sub>1</sub> – Practical idea, calculation of Laser Diffraction

C<sub>9</sub>: Calibration of polarimeter and study of optical rotation of solution

CO<sub>1</sub> – Practical idea, calculation of Polarization

C<sub>10</sub>: Determination of thermal conductivity of a bad conductor by Lee's and Chorlton's method

CO<sub>1</sub> – Practical idea, calculation of thermal conductivity

11. Deflection Magnetometer experiment to determine earth horizontal Magnetic field

CO<sub>1</sub> – Practical idea, calculation of magnetic field

**Course : Electrical and Electronics Practical**

C<sub>1</sub>: Measurement of resistance of voltmeter and ammeter by half deflection method and their conversion (range and meter) with calibration

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>:. Measurement of temperature coefficient of resistance by Carey Foster Bridge

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>:. Verification of Thevenin and Norton Theorems

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>:. Calibration of a thermocouple and find thermoelectric power

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>:Study of the thermistor characteristics

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>: Platinum resistance thermometer

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>:Study of variation of mutual inductance of a coaxial coil

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>: Study of magnetic flux using a search coil

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>:Study of the impedance of a capacitor of varying frequency to measure capacitance

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>:Study of response curve of LCR series resonance

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>: Study of regulation characteristics of a bridge rectifier (i) without using a filter and (ii) using a filter

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>: Study of the reverse and regulation characteristics of a Zener diode

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>: To draw the characteristics of a transistor in CE mode

CO<sub>1</sub> – Practical idea, calculation

C<sub>1</sub>: Construction of OR, AND, NOT and NAND gates with basic components and verification of truth tables

CO<sub>1</sub> – Practical idea, calculation

### **Part – III (Honours)**

#### **Course: Quantum Mechanics II**

##### **C<sub>1</sub>: Operator formulation**

CO<sub>1</sub> – Basic postulates of quantum mechanics, linear operators, Derivation, calculation and problem solving.

CO<sub>2</sub> . Hermitian operators, Hermitian adjoints, eigen values and eigen functions, Momentum, energy and angular momentum operators. - Derivation, calculation and problem solving.

CO<sub>3</sub> . Commuting and non-commuting operators, commutation relations between operators, expectation values, time evolution of expectation values, compatible observables and simultaneous measurements, Ehrenfest theorem. Derivation, calculation and problem solving.

##### **C<sub>2</sub> - Simple application to quantum mechanics**

CO<sub>1</sub> - Step potential, Penetration through one-dimensional rectangular potential barrier, Reflection and transmission coefficients – explanation of alpha decay. Derivation, calculation and problem solving.

CO<sub>2</sub> - Linear harmonic oscillator: energy eigen values and eigen function from Hermite Differential equation. Derivation, calculation and problem solving.

CO<sub>3</sub> - Energy eigen values and eigen functions using raising and lowering operators, zero point energy, parity of wave function, comparison with classical theory. Derivation, calculation and problem solving.

##### **C<sub>3</sub> - Angular momentum and spin**

CO<sub>1</sub> - Orbital angular momentum operators and their commutation relations, L<sub>+</sub> & L<sub>-</sub> as Ladder operators, Derivation, calculation and problem solving.

CO<sub>2</sub> – Eigen values of L<sup>2</sup> and L<sub>z</sub>, Angular momentum operators in spherical polar coordinates, evaluation of eigenfunctions, Derivation, calculation and problem solving.

CO<sub>3</sub> - Schrodinger equation of hydrogen atom, Reduction of two body problem into single body, separation of variables in spherical polar coordinates, spherical Harmonics, wavefunction and energy eigenvalues, degeneracy, parity of spherical Harmonics. Derivation, calculation and problem solving.

CO<sub>4</sub> - Pauli spin matrices and their commutation relation, eigenvalues and eigenvector of spin operators (only spin  $\frac{1}{2}$  particle). Representation of general spin state of spin  $\frac{1}{2}$  particle. Derivation, calculation and problem solving.

## **Course: Nuclear Physics II**

### **C<sub>1</sub> - Nuclear reactions**

CO<sub>1</sub> - Conservation principles in nuclear reactions. Qvalues and thresholds, nuclear reaction cross-sections, Derivation, calculation and problem solving.

CO<sub>2</sub> – Relativistic reactions and their characteristics. Derivation, calculation and problem solving.

CO<sub>3</sub> - Bohr's postulate of compound nuclear reaction, Ghoshal's experiment. Derivation, calculation and problem solving.

### **C<sub>2</sub> - Nuclear fission and fusion**

CO<sub>1</sub> - Discovery and characteristics, explanation in terms of liquid drop model, fission products and energy release. Derivation, calculation and problem solving.

CO<sub>2</sub> - Prompt and delayed neutrons, spontaneous and induced fission, condition for the spontaneous fission, transuranic elements. Derivation, calculation and problem solving.

CO<sub>3</sub> - Chain reaction, four-factor formula and basic principle of nuclear reactors. Nuclear fusion: energetic in terms of liquid drop model. Basic principles of Atom bomb and Hbomb. Derivation, calculation and problem solving.

### **C<sub>3</sub> - Cosmic ray**

CO<sub>1</sub> - Nature and origin of primary and secondary rays, latitude and altitude variations, hard & soft components, muon, pion, mesons & hyprons, Mean life of muon & pion. Derivation, calculation and problem solving.

CO<sub>2</sub> - Extensive air shower, solar modulation of primary ray, effect of Earth's magnetic fields. East-West Effect, Van Allen radiation belt, Aurora Borealis. Derivation, calculation and problem solving.

### **C<sub>4</sub> - Elementary particles**



CO<sub>1</sub> - Natural units, four basic interactions in nature and their relative strengths, examples of different types of interactions. Derivation, calculation and problem solving.

CO<sub>2</sub> - Quantum numbers – mass, charge, spin, isotopic spin, intrinsic parity, Baryon number, Lepton number, Strangeness, hypercharge. Derivation, calculation and problem solving.

CO<sub>3</sub> - Gell-Mann Nisijima formula, Charge conjugation, Time reversal, Symmetries and Conservation laws. Derivation, calculation and problem solving.

CO<sub>4</sub> - Classifications of elementary particles – Leptons, Quarks and Mediators. Derivation, calculation and problem solving.

CO<sub>5</sub> - Standard Model (qualitatively). Hadrons: Baryons and Mesons. Antiparticles, Neutrinos, Strange Particles. Derivation, calculation and problem solving.

CO<sub>6</sub> - Elementary ideas about quark structure of hadrons – Weight diagrams, The Quark structure of hadrons octet and decuplet families. Derivation, calculation and problem solving.

### **C<sub>5</sub> - Particle Accelerator and Detector**

CO<sub>1</sub> - Cyclotron – basic theory, GM counter. Derivation, calculation and problem solving.

CO<sub>2</sub> - Accelerators and Neutrino observatory in India (basic idea). Derivation, calculation and problem solving.

### **Course: Statistical Mechanics**

#### **C<sub>1</sub> - Probability Distribution**

CO<sub>1</sub> - *Random Walk and Binomial Distribution*: The simple random walk problem in one dimension. Derivation, calculation and problem solving.

CO<sub>2</sub> - General discussion of mean values, Calculation of mean values for the random walk problem. Derivation, calculation and problem solving.

CO<sub>3</sub> - Probability distribution for large N, Gaussian probability distributions, General discussion of the random walk. Derivation, calculation and problem solving.

#### **C<sub>2</sub> - Microstates and macrostates**

CO<sub>1</sub> - Concept of phase space; microstates and macrostates, statistical weight of a macrostate. Derivation, calculation and problem solving.

CO<sub>2</sub> - Classical description in terms of phase space and quantum description in terms of wave functions. Calculation of phase volumes. Derivation, calculation and problem solving.

CO<sub>3</sub> - Hypothesis of equal a priori probability for microstates of an isolated system in equilibrium. Derivation, calculation and problem solving.

CO<sub>4</sub> - Interactions between two systems – thermal, mechanical and diffusive; statistical definition of temperature, pressure, entropy and chemical potential. Derivation, calculation and problem solving.

CO<sub>5</sub> - Partition function of a system in thermal equilibrium with a heat bath; concept of ensembles. Derivation, calculation and problem solving.

### **C<sub>3</sub> - Classical statistical mechanics**

CO<sub>1</sub> - Maxwell-Boltzmann distribution law (derivation as the most probable distribution) and its applications. Derivation, calculation and problem solving.

CO<sub>2</sub> - Calculation of thermodynamic quantities for ideal gases using partition function. Derivation, calculation and problem solving.

### **C<sub>4</sub> - Motivations for quantum statistics**

CO<sub>1</sub> - Gibbs' paradox; identical particles and symmetry requirement; indistinguishability of small particles. Derivation, calculation and problem solving.

CO<sub>2</sub> - Derivation of BE & FD statistics as the most probable distributions (microcanonical ensemble). Derivation, calculation and problem solving.

CO<sub>3</sub> - Classical limit of quantum statistics and its region of validity, reduction to Maxwell distribution, comparison between photon, phonon, electron and the ideal gas. Derivation, calculation and problem solving.

### **C<sub>5</sub> - Application of quantum statistical mechanics**

CO<sub>1</sub> - Bose Einstein statistics: Application to radiation – Planck's law, Rayleigh Jeans and Wien laws as limiting cases, Stefan's law. Derivation, calculation and problem solving.

CO<sub>2</sub> - Bose-Einstein condensation; liquid Helium and its phase transition (qualitative discussion); third law of thermodynamics. Derivation, calculation and problem solving.

CO<sub>3</sub> - Fermi-Dirac statistics: Fermi distribution at zero and non-zero temperatures. Fermi energy and its expression in terms of particle density. Derivation, calculation and problem solving.

CO<sub>4</sub> - Degenerate and non-degenerate Fermi gas. Electron specific heat of metals at low temperature. Thermionic emission. Saha equation for thermal ionization and its application to astrophysics. Derivation, calculation and problem solving.

## **Course: Solid State Physics**

### **C<sub>1</sub> - Crystal Structure**

CO<sub>1</sub> - Crystalline and amorphous solids, translational symmetry. Derivation, calculation and problem solving.

CO<sub>2</sub> - Elementary ideas about crystal structure, lattice and bases, unit cell, reciprocal lattice, fundamental types of lattices, Miller indices, lattice planes, simple cubic, f.c.c. and b.c.c. lattices. Derivation, calculation and problem solving.

CO<sub>3</sub> - Laue and Bragg equations, Determination of crystal structure with X-rays. Derivation, calculation and problem solving.

## **C<sub>2</sub> - Structure of solids**

CO<sub>1</sub> - Different type of binding: ionic, covalent, metallic and van-der-Waals and hydrogen. Derivation, calculation and problem solving.

CO<sub>2</sub> - Free electron theory of metals - free electron model, Fermi energy and momentum, density of states, Wiedemann - Franz law, Hall effect in metals. Derivation, calculation and problem solving.

CO<sub>3</sub> - Band theory of solids: Bloch Theorem, Physical origin of energy gap, Kronig-Penny Model and its consequence, effective mass, conductor, semiconductors and insulators. Derivation, calculation and problem solving.

CO<sub>4</sub> - Semiconductor: carrier distribution, drift current, mobility and conductivity in intrinsic semiconductor. Derivation, calculation and problem solving.

## **C<sub>3</sub> - Lattice vibrations**

CO<sub>1</sub> - Elastic and atomic force constants; Dynamics of a chain of similar atoms. Derivation, calculation and problem solving.

CO<sub>2</sub> - Introduction to phonon (Qualitative), Einstein's and Debye's theories of specific heats of solids. Derivation, calculation and problem solving.

## **C<sub>4</sub> - Dielectric properties of materials**

CO<sub>1</sub> - Electronic, ionic and dipolar polarisability, local field, Clausius - Mosotti relation, orientational polarisation. Derivation, calculation and problem solving.

## **C<sub>5</sub> - Magnetic Properties of Materials**

CO<sub>1</sub> - Dia-, para-, and ferro-magnetic properties of solids. Derivation, calculation and problem solving.

CO<sub>2</sub> - Langevin's theory of diamagnetism, Quantum theory of paramagnetism. Derivation, calculation and problem solving.

CO<sub>3</sub> - Curie's law, Spontaneous magnetisation and its temperature dependence, Curie-Weiss law of ferromagnetism, Curie temperature domain structure, explanation of Hysteresis. Derivation, calculation and problem solving.

### **C<sub>6</sub> – Superconductivity**

CO<sub>1</sub> - Introduction, critical temperature, Meissner effect, critical field, Type I and Type II superconductors. Derivation, calculation and problem solving.

### **Course: Electronics Practical**

#### **C<sub>1</sub> - Analog Electronics Experiments**

CO<sub>1</sub> - Construct a regulated power supply on a bread board (a) using a power transistor as pass element and, (b) a second transistor as feedback amplifier (c) a zener diode as a reference voltage source and to study its operational characteristics. Practical knowledge and direct verification

CO<sub>2</sub> - Study the effects of negative feedback on frequency response of a RC coupled amplifier. Practical knowledge and direct verification

CO<sub>3</sub> - To construct and study the frequency response of voltage amplifier using a transistor in CE mode & to find its band width- Practical knowledge and direct verification

CO<sub>4</sub> - To design a circuit and test the following related to OPAMP - (a) Offset parameters (b) Inverting and non-inverting amplifier (c) Integrator (d) Differentiator & differential amplifier (e) Adder & Subtractor. Practical knowledge and direct verification

CO<sub>5</sub> - Design and construction of a phase shift oscillator. Practical knowledge and direct verification

CO<sub>6</sub> - To construct Wien bridge oscillator on a bread board using OPAMP and to study the waveform of the oscillator and frequency determination using CRO. Practical knowledge and direct verification

#### **C<sub>2</sub> - Digital Electronics Experiments**

CO<sub>1</sub> - Verify various Boolean expressions using IC gates. Practical knowledge and direct verification

CO<sub>2</sub> - NAND & NOR Gates circuits using IC. Practical knowledge and direct verification

CO<sub>3</sub> - Multiplexer & Demultiplexer using IC. Practical knowledge and direct verification

CO<sub>4</sub> - Half adder & full adder circuits using IC. Practical knowledge and direct verification

CO<sub>5</sub> - Design and verify the following flip flop operations (i) RS (ii) Clocked JK (iii) D. Derivation, calculation and problem solving.

CO<sub>6</sub> - Study of Modulo- 3, Modulo - 5, Modulo - 7 binary counters. Practical knowledge and direct verification

CO<sub>7</sub> - Construction of AND, OR, NOT Gates using diodes, transistors and verification of Truth table. Practical knowledge and direct verification

CO<sub>8</sub> - Multivibrators using transistors & IC555. Practical knowledge and direct verification

### **C<sub>3</sub> - Non-electronic experiments**

CO<sub>1</sub> - Study of Resolving power of a grating. Practical knowledge and direct verification

CO<sub>2</sub> - Biprism experiment. Practical knowledge and direct verification

CO<sub>3</sub> - 3. B - H loop. Practical knowledge and direct verification

CO<sub>4</sub> - Anderson bridge. Practical knowledge and direct verification

CO<sub>5</sub> - Study of Fourier spectrum of – (a) Square; (b) triangular; C) half sinusoidal wave form; (by CRO). Practical knowledge and direct verification

CO<sub>6</sub> - To determine the Stefan's constant. Practical knowledge and direct verification

CO<sub>7</sub> - Spectrum of hydrogen & Rydberg constant. Practical knowledge and direct verification

CO<sub>8</sub> - Magnetic susceptibility of FeCl<sub>3</sub> solution. Practical knowledge and direct verification

CO<sub>9</sub> - Hall probe in magnetic field measurement. Practical knowledge and direct verification

CO<sub>10</sub> - To determine Planck's constant. Practical knowledge and direct verification

CO<sub>11</sub> - To study the intensity distribution of grating pattern by Laser & LDR. Practical knowledge and direct verification

CO<sub>12</sub> - Use of P-N junction for measurement of bandgap energy. Practical knowledge and direct verification

### **Course: Program writing with algorithm and showing result**

Apart from executing the computer programmes prescribed in the syllabus, students should be encouraged to execute other problems of Physics particularly associated with practical with the help of computer, using available software packages (e.g. graph plotting etc.).

### **C<sub>1</sub> - Computer Language (FORTRAN or C)**

CO<sub>1</sub> - Constants and variables. Assignment and arithmetic expressions. Logical expressions and control statements, loops, array, input and output statements (with I, F and E formats), function subprogram, subroutine.

CO<sub>2</sub> - Sorting.

CO<sub>3</sub> -Read N numbers, find their mean, median, mode

CO<sub>4</sub> - Find whether a number is prime

CO<sub>5</sub> - Factorize a number

CO<sub>6</sub> - Sum of different types of series term by term with a specified accuracy

CO<sub>6</sub>- Matrix operations (addition, subtraction, multiplication, transpose, trace)

CO<sub>7</sub> - Finding zeroes of a given function by the method of bisection and Newton-Raphson

CO<sub>8</sub> - Integration by trapezoidal and Simpson's rule.

### **C<sub>2</sub> - Project**

CO<sub>1</sub> - This work should be an experimental one with special reference to the techniques into practical classes. This may be application oriented or some simple law / experimental verification.

## **B. Sc. Botany CBCS Semester - I**

### **Theory**

#### **Course I: Microbiology**

CO1: Introduction to microbial world including Microbial nutrition, growth and metabolism.

CO2: Economic importance of viruses with reference to vaccine production,

CO3: Role in research, medicine and diagnostics, as causal organisms of plant diseases.

CO4: Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

CO5: Viruses - Discovery, physiochemical and biological characteristics; classification (Baltimore),

CO6: General structure with special reference to viroids and prions; replication (general account),

CO7: DNA virus(T-phage), lytic and lysogenic cycle; RNA virus (TMV).

CO8: Discovery and general characteristics of Bacteria

CO9: Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts);

#### **Course II: Phycology**

CO1: Cell structure; Nutritional types;

CO2: Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

CO3: General characteristics; Ecology and distribution; range of thallus organization of algae.

CO4: Cell structure and components; cell wall, pigment system, reserve food.

CO5: Flagella; methods of reproduction;

CO6: Classification; criteria, system of Fritsch and evolutionary classification of Lee (only upto groups);

CO7:Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P.Iyengar).

CO8: Role of algae in the environment, agriculture, biotechnology and industry.

#### **CO9: Cyanophyta**

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc*

**CO10: Xanthophyta**

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Vaucheria*.

**CO11: Chlorophyta** General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction.

CO 12: Morphology and life-cycles of *Chlamydomonas*, *Volvox*,

CO13: Morphology and life-cycles of *Oedogonium*, *Coleochaete*.

**CO14: Charophyta** General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction.

CO15: Morphology and life-cycles of *Chara*.

CO16: Evolutionary significance of *Prochloron*.)

**CO17: Phaeophyta** Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus*.

**CO17: Rhodophyta**

Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Polysiphonia*.

## **Practical**

### **CourseI: Microbiology**

CO1: Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.

CO2: Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.

CO3: Gram staining.

CO4: Endospore staining with malachite green using the (endospores taken from soil bacteria).

### **CourseII: Phycology**

CO1: Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs),

CO2: *Volvox*, *Oedogonium* through electron micrographs, temporary preparations and permanent slides.

CO3: *Coleochaete*, *Chara* through electron micrographs, temporary preparations and permanent slides.

CO4: *Vaucheria*, *Ectocarpus* through electron micrographs, temporary preparations and permanent slides.

CO5: *Fucus* and *Polysiphonia*, *Prochloron* through electron micrographs, temporary preparations and permanent slides.

## **B. Sc. Botany (Honours) Part -I**

### **PAPER-I**

#### **Course-I Microbiology:**

CO 1: Origin of life, History, Definition and Distribution of microorganisms.

CO 2: Classification of microorganisms and importance.

CO 3: Idea about prokaryotic and eukaryotic microorganisms including five and three kingdom concepts.

CO 4: Nature of viruses, Types (Plant, Animal and Bacteriophage).

CO 5: Structure of T4 and TMV.

CO 6: Lytic and Lysogenic cycle with reference to T4 and Lambda phage.

CO 7: Interferon, Structure of AIDS causing virus-HIV and importances.

CO 8: Bacteria: Systematic position, Characters need for identification, Types (on the basis of cell shape), Ultrastructure (Flagella, Pili, Endospore, Capsule and Slime Layer, Cell Wall of Gram Positive and Gram Negative Bacteria),

CO 9: Cell membrane (structure and function in brief), Concept of genome and plasmid, Special organelles (Mesosome, Magnetosome) and reserve materials.

CO 10: Bacterial growth-definition, growth curve, Generation time, Cultural condition - physical (temperature, pH), Nutritional requirements.

CO 11: Recombination-transformation (*Streptococcus pneumoniae*), transduction (generalised), conjugation (F and Hfr mediated), Idea of soil microorganisms,



CO 12: Role of microbes in biogeochemical cycle (Nitrogen cycle). Actinomycetes, Archaeobacteria, Myxomycetes (Diagnostic features only).

### **Course-II ALGAE:**

CO1: A general account: Habit and habitat, thallus organization, mode of reproduction, origin and evolution of sex in algae.

CO2: Criteria of classification, Classification of algae Lee (1989) with class characters. Life cycle patterns in algae.

CO3: Salient features of Cyanophyta and chromatic adaptation, Bacterial features of Cyanophyta, Ultrastructure of cell including heterocyst and its role in nitrogen fixation and study of type genus *Anabaena*.

CO4: Salient features of Chlorophyta and study of the type genus *Chlamydomonas*,

CO5: Study of the type genus *Oedogonium* and *Chara* and importance.

CO6: Salient features of Bacillariophyta, vegetative structure, reproduction of centric and pinnate diatoms.

CO7: Salient features of Xanthophyta and study of the type genus *Vaucheria*.

CO8: Salient features of Phaeophyta and study of the type genus *Ectocarpus*, *Laminaria*

CO9: Salient features of Rhodophyta and study of the type genus *Polysiphonia*.

### **Course-III. LICHEN:**

CO1: Definition & types, Reproduction.

CO2: Economic and Ecological importance.

### **Course-IV. FUNGI:**

CO1: General Characters - Habit and habitat. Hyphal forms, Nutrition, Reproduction,

CO2: Classification (Ainsworth-1973) upto subdivisions with characters and examples.

CO3: Evolution of sex in fungi.

CO4: Life Histories –Phycomycotina, Types - *Synchytrium*, *Rhizopus*;

CO5: Ascomycotina, Types -*Penicillium*, *Ascobolus*, *Claviceps*;

CO6: Basidiomycotina Types - *Agaricus*, *Polyporus*;

CO7: Deuteromycotina - A general account Types - *Alternaria*.

### **Course-V. PLANT PATHOLOGY:**

CO1: Classification of plant diseases. Terms and definitions: Causal complex, primary and secondary inocula, disease cycle, pathogenecity, susceptibility, resistance and immunity,

CO2: sign and symptom, necrosis, hyperplasia and hypoplasia, disease syndrome, Koch's postulates, quarantine.

CO3: Host - parasite interaction: mechanism of infection, role of enzymes and toxins in pathogenesis,

CO4: defence mechanism, with special emphasis on phytoalexins.

CO5: Physical, chemical and Biological Control of plant diseases. Knowledge of the following diseases: symptoms, causal organism, etiology of pathogen,

CO6: disease cycle & control measure of (i) Late Blight of potato, (ii) Tungro Virus disease of rice.

CO7: disease cycle & control measure of (iii) Black stem rust of wheat, (iv) Tikka disease of ground nut,

CO8: disease cycle & control measure of (v) Blight of betel.

## **Course-VI. MORPHOLOGY**

CO1: **Inflorescence:** Types and evolution.

CO2: **Flowers:** Types, corolla aestivation, cohesion and adhesion of stamens, different types of ovule,

CO3: Placentation - types and evolution, floral formula and floral diagram.

CO4: **Pollination:** Types and contrivances.

CO5: **Fruits:** Types and dispersal.

## **PAPER-II (Theory)**

### **Course-I. BRYOLOGY**

CO1: Classification of Bryophytes (Proskauer, 1957) upto class characters. Mischler, 1994-outline only.

CO2: Origin of Bryophytes with reference to different theories.

CO3: Life history (including Gametophytic structure, Reproduction, Development and structure of sporophyte, Spore dispersal) of *Riccia*, *Marchantia*.

CO4: Life history (including Gametophytic structure, Reproduction, Development and structure of sporophyte, Spore dispersal) of *Anthoceros*, *Sphagnum* and *Funaria*.

CO5: Phylogenetic relationship and evolutionary tendencies in Bryophytes (among the studied genera).

CO6: Ecological and economic importance of Bryophytes with reference to soil erosion, pollution monitoring and control,

CO7: geo-botanical prospecting, animal feed, horticulture and antibiotics.

### **Course-II. PTERIDOLOGY**

CO1: Origin and Classification of Pteridophytes (Sporne, 1975) with class characters and example, Telome concept.

CO2: Life history (including Sporophytic nature, Reproduction and structure of gametophyte) of *Psilotum*, *Lycopodium*.

CO3: Life history (including Sporophytic nature, Reproduction and structure of gametophyte) of *Selaginella*, *Equisetum*, *Marsilea*.

CO4: Characteristic features and geographic distribution and evolutionary significance of *Rhynia*, *Lepidodendron*.

CO5: Characteristic features and geographic distribution and evolutionary significance of *Lepidocarpon*, *Calamities*.

CO6: Progymnosperm- diagnostic features and significance.

CO7: Heterospory and attainment of seed habit in Pteridophytes.

CO8: Economic importance (food, medicine and agriculture) of Pteridophytes.

### **Course – III. GYMNOSPERM**

CO1: Classification of Gymnosperm (Stewart and Rothwell, 1993) with class characters and example.

CO2: Establishment of heterospory and seed habit.

CO3: General characters of the order and structural features of *Cycadofilicales* (*Lygenopteris*).

CO4: General characters of the order and structural features of *Glossopteridales* (*Glossopteris*) and *Benettitales* (*Williamsonia seawardiana*).

CO5: Life history of *Cycas*.

CO6: Life history of *Pinus*.

CO7: Life history of *Ginkgo* and *Gnetum*.

CO8: Economic importance of Gymnosperms with reference to wood, resin, essential oil and drugs.

#### **Course-IV. PALAEOBOTANY**

CO1: Definition, process of fossilisation, fossil types- trace fossil, chemical fossil, Petrification and Compression.

CO2: Index fossil. Radio Carbon dating. Nomenclature, Economical and ecological importance.

CO3: Geological time scale and major events of plant life through geological time, Dominant plant groups through ages.

#### **Course-V. PALYNOLOGY**

CO1: Definition of Palynology, different branches of Palynology, importance of study.

CO2: NPC classification of Spores, Pollen morphology with special reference to polarity, size.

CO3: Spores shape, symmetry aperture and sculpture.

#### **Course-VI. EMBRYOLOGY**

CO1: Development of male and female gametophyte of Angiosperms.

CO2: Development and structure of endosperm - nuclear, hellobial and cellular types.

CO3: Development of a typical dicot embryo and Monocot embryo.

### **B. Sc. Botany (Honours) Part -II**

#### **Paper- III (Theory)**

##### **Course-I. TAXONOMY OF ANGIOSPERMS**

CO1: Taxonomy and Systematics, aims and objectives, phases of Taxonomy.

CO2: The concept of primitive and advanced characters, Monophyly and Polyphyly, Parallelism and Convergence,

CO3: ideas about Alpha & Beta taxonomy, units of classification and taxonomic keys (indented and bracketed).

CO4: Botanical Nomenclature: Elementary Knowledge of ICBN (ICN) Principles, the type methods,

CO5: rules of Priority, effective and valid publications, citation of author's name, rejection of names.

CO6: Major systems of Plant classification like Betham and Hooker,

CO7: Arthur Cronquist (1988), Idea of APG I, II, III (2009).

CO8: Herbarium: Collection of specimens, preparation, preservation and maintenance of herbarium. Important herbaria in India; roles of herbarium; CO9: Botanic gardens: Roles and some important gardens in India. Digital Herbarium.

CO10: Modern evidences in Taxonomy: Anatomy, Cytology, Palynology, Chemotaxonomy.

CO10: Modern evidences in Taxonomy: Numerical taxonomy (Definition, purpose and use only).

CO11: Diagnostic features and systematic position (Bentham & Hooker, Cronquist) including all economic plants of Dicot. families :-

CO11: Magnoliaceae, Nymphaeaceae,

CO12: Brassicaceae, Malvaceae,

CO13: Fabaceae (ss), Caesalpiniaceae,  
CO14: Mimosaceae, Rutaceae,  
CO15: Anacardiaceae, Euphorbiaceae,  
CO16: Apiaceae, Asclepiadaceae, Apocynaceae,  
CO17: Solanaceae, Verbenaceae,  
CO18: Lamiaceae, Scrophulariaceae.  
CO19: Acanthaceae, Rubiaceae.  
CO20: Cucurbitaceae, Asteraceae.  
CO21: **Monocot families:** Alismataceae, Liliaceae.  
CO22: Zingiberaceae, Arecaceae, Poaceae.  
CO23: Cyperaceae, Orchidaceae.  
CO24: Origin of Angiosperm: Basic idea.

### **Course-II. ECOLOGY, PLANT GEOGRAPHY, BIODIVERSITY.**

CO1. Modern Concepts of Ecology: Shallow and Deep Ecology (Basic ideas only).  
CO2. Ecological factors: their impact on plant life, Different types of plant adaptations (Mesophyte, Xerophyte).  
CO3. Ecological factors: their impact on plant life, Different types of plant adaptations (Halophyte, Hydrophyte).  
CO4. Concepts of Ecosystem, Ecotone, Edge effect.  
CO5. Concepts of population and its characteristics, Ecological niche and habitat, principle of competitive exclusion, r- and K-strategies.  
CO6. Biogeochemical cycles: Basic ideas of different biogeochemical cycles and their importance (C, N).  
CO6. Biogeochemical cycles: Basic ideas of different biogeochemical cycles and their importance (S, P).  
CO7: Community Ecology: History and definition, Characteristics of community, community composition, methods of study of the community structure.  
CO8: Pollution: Air, water and soil, effects of pollutants on organisms.  
CO9: An elementary knowledge of Green House effect and Global Warming, Acid precipitation, Ozone depletion.  
CO10: . Deforestation-its causes and consequences, Chipko movement, Joint Forest Management.  
CO11: Concept of Social Forestry.  
CO12: Biomonitoring: the state of environmental pollution.  
CO13: Natural Resources and Waste Management (including phytoremediation), Reclamation of wasteland.  
CO14: Basic ideas of Ecotoxicology, Environmental Impact Assessment (EIA) and Biopesticides.  
CO15: Biodiversity: Definition, importance, degeneration and conservation.

## **DEPARTMENT OF CHEMISTRY**

### **SEMESTER -1 CBCS SYSTEM**

#### **Core-1:T1 - : ORGANIC CHEMISTRY-I**

#### **Basics of Organic Chemistry**

## Bonding and Physical Properties

### *Valence Bond Theory:*

- CO1 concept of hybridisation, shapes of molecules,
- CO2 resonance (including hyperconjugation);
- CO3 calculation of formal charges and double bond equivalent (DBE);
- CO4 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:*

- CO5 inductive effect, field effect,
- CO6 mesomeric effect, resonance energy;
- CO7 bond polarization and bond polarizability;
- CO8 electromeric effect; steric effect, steric inhibition of resonance.

### *MO theory:*

- CO9 qualitative idea about molecular orbitals,
- CO10 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)
- CO11 cyclic p orbital system (neutral systems: [4], [6]-annulenes; charged systems: 3-,4-,5-membered ring systems);
- CO12 Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring);
- CO13 concept of antiaromaticity and homoaromaticity; non-aromatic molecules; CO14 Frost diagram; elementary idea about  $\alpha$  and  $\beta$ ; measurement of delocalization energies in terms of  $\beta$  for buta-1,3-diene,
- CO15 cyclobutadiene, hexa-1,3,5-triene and benzene.

### *Physical properties:*

- CO16 influence of hybridization on bond properties:
- CO17 bond dissociation energy (BDE) and bond energy;
- CO18 bond distances, bond angles; concept of bond angle strain (Baeyer's strain theory);
- CO19 melting point/boiling point and solubility of common organic compounds in terms of covalent & non-covalent intermolecular forces;
- CO20 polarity of molecules and dipole moments;
- CO21 relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation,
- CO22 heat of combustion and heat of formation.

## General Treatment of Reaction Mechanism I

- CO23 *Mechanistic classification:* ionic, radical and pericyclic (definition and example);
- CO24 reaction type: addition, elimination and substitution reactions (definition and example);
- CO25 nature of bond cleavage and bond formation: homolytic and heterolytic bond fission,
- CO26 homogenic and heterogenic bond formation;
- CO27 curly arrow rules in representation of mechanistic steps; reagent type: electrophiles and nucleophiles (elementary idea);
- CO28 electrophilicity and nucleophilicity in terms of FMO approach.

### *Reactive intermediates:*

- CO29 carbocations (carbenium and carbonium ions), carbanions, carbon radicals, CO30 carbenes: generation and stability,
- CO31 structure using orbital picture and electrophilic/nucleophilic behavior of reactive intermediates (elementary idea).

## Stereochemistry I

CO32

*Bonding geometries of carbon compounds and representation of molecules: tetrahedral nature of carbon and concept of asymmetry; Fischer,*

CO33 sawhorse,

CO34 flying-wedge and Newman projection formulae and their inter translations.

CO35 *Concept of chirality and symmetry: symmetry elements and point groups ( $C_{\infty}$ ,  $C_{nh}$ ,  $C_{nv}$ ,  $C_n$ ,  $D_{ah}$ ,  $D_{nh}$ ,  $D_{nd}$ ,  $D_n$ ,  $S_n$  ( $C_s$ ,  $C_i$ );*

CO36 molecular chirality and centre of chirality;

CO37 asymmetric and dissymmetric molecules;

CO38 enantiomers and diastereomers; concept of epimers;

CO39 concept of stereogenicity, chirotopicity and pseudoasymmetry;

CO40 chiral centres and number of stereoisomerism: systems involving 1/2/3-chiral centre(s) (AA, AB, ABA and ABC types).

CO41 *Relative and absolute configuration: D/L and R/S descriptors; erythro/threo and meso nomenclature of compounds;*

CO42 *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.*

CO43 *Optical activity of chiral compounds: optical rotation,*

CO44 specific rotation and molar rotation; racemic compounds,

CO43 racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates);

CO44 resolution of acids, bases and alcohols via diastereomeric salt formation; CO45 optical purity and enantiomeric excess; invertomerism of chiral trialkylamines.

## Core-1:P1 - CHEMISTRY LAB- I

CO1 **Separation**, based upon solubility, by using common laboratory reagents like water (cold, hot),

CO2 dil. HCl, dil. NaOH, dil.

CO3 NaHCO<sub>3</sub>, etc., of components of a binary solid mixture; purification of the separated components by crystallization and determination of its melting point.

CO4 The composition of the mixture may be of the following types: Benzoic acid/*p*-Toluidine;

CO5 *p*-Nitrobenzoic acid/*p*-Aminobenzoic acid;

CO6 *p*-Nitrotoluene/*p*-Anisidine; etc.

**Determination of boiling point** of common organic liquid compounds

CO7 ethanol, cyclohexane, chloroform, ethyl methyl ketone,

CO8 cyclohexanone, acetylacetone, anisole,

CO9 crotonaldehyde, mesityl oxide,

**Identification of a Pure Organic Compound**

CO10 *Solid compounds*: oxalic acid, tartaric acid,

CO11 citric acid, succinic acid, resorcinol,

CO12 urea, glucose, cane sugar,

CO13 benzoic acid and salicylic acid

*Liquid Compounds*:

CO14 formic acid, acetic acid,

CO15 methyl alcohol, ethyl alcohol,

CO16 acetone, aniline, dimethylaniline,

CO17 benzaldehyde, chloroform and nitrobenzene

## **Core- 2: T2 - : PHYSICAL CHEMISTRY-I**

### **Kinetic Theory and Gaseous state**

- CO1 Kinetic Theory of gases: Concept of pressure and temperature;
- CO2 Collision of gas molecules; Collision diameter;
- CO3 Collision number and mean free path;
- CO4 Frequency of binary collisions (similar and different molecules);
- CO5 Wall collision and rate of effusion
- CO6 Maxwell's distribution of speed and energy:
- CO7 Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions;
- CO8 Kinetic energy distribution in one, two and three dimensions,
- CO9 calculations of average, root mean square and most probable values in each case;
- CO10 Calculation of number of molecules having energy  $\geq \epsilon$ , Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases
- CO11 Real gas and virial equation:
- CO12 Deviation of gases from ideal behavior; compressibility factor;
- CO13 Boyle temperature; Andrew's and Amagat's plots;
- CO14 van der Waals equation and its features; its derivation and application in explaining real gas behaviour,
- CO15 other equations of state (Berthelot, Dietrici);
- CO16 Existence of critical state, Critical constants in terms of van der Waals constants;
- CO17 Law of corresponding states; virial equation of state; van der Waals equation expressed in virial form and significance of second virial coefficient;
- CO18 Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea)

### **Chemical Thermodynamics**

- CO19 Zeroth and 1<sup>st</sup> law of Thermodynamics: Intensive and extensive variables; state and path functions;
  - CO20 isolated, closed and open systems;
  - CO21 zeroth law of thermodynamics;
  - CO22 Concept of heat, work, internal energy and statement of first law;
  - CO23 enthalpy,  $H$ ; relation between heat capacities,
  - CO24 calculations of  $q$ ,  $w$ ,  $U$  and  $H$  for reversible,
  - CO25 irreversible and free expansion of gases (ideal and van der Waals)
  - CO26 under isothermal and adiabatic conditions;
  - CO27 Joule's experiment and its consequence.
  - CO28 Thermochemistry: Standard states;
  - CO29 Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications;
  - CO30 Laws of thermochemistry; bond energy,
  - CO31 bond dissociation energy and resonance energy from thermochemical data, CO32 Kirchhoff's equations and effect of pressure on enthalpy of reactions;
  - CO33 Adiabatic flame temperature; explosion temperature
- 
- CO32 Second Law: Need for a Second law;
  - CO33 statement of the second law of thermodynamics;
  - CO34 Concept of heat reservoirs and heat engines;
  - CO35 Carnot cycle; Physical concept of Entropy;

- CO36 Carnot engine and refrigerator; Kelvin – Planck and Clausius statements and equivalence of the two statements with entropic formulation;  
 CO37 Carnot's theorem; Values of  $\int dQ/T$  and Clausius inequality;  
 CO38 Entropy change of systems and surroundings for various processes and transformations;  
 CO39 Entropy and unavailable work; Auxiliary state functions (G and A) and their variation with T, P and V.  
 CO40 Criteria for spontaneity and equilibrium.

- CO41 Thermodynamic relations: Maxwell's relations;  
 CO42 Gibbs- Helmholtz equation,  
 CO43 Joule-Thomson experiment and its consequences; inversion temperature; Joule-Thomson coefficient for a van der Waals gas; General heat capacity relations

**c) Chemical kinetics**

CO44

- Rate law, order and molecularity: Introduction of rate law,  
 CO45 Extent of reaction; rate constants, order;  
 CO46 Forms of rates of First, second and nth order reactions;  
 CO47 Pseudo first order reactions (example using acid catalyzed hydrolysis of methyl acetate);  
 CO48 Determination of order of a reaction by half-life and differential method; CO49 Opposing reactions, consecutive reactions and parallel reactions (with explanation of kinetic and thermodynamic control of products; all steps first order)  
 CO50 Role of T and theories of reaction rate: Temperature dependence of rate constant;  
 CO51 Arrhenius equation, energy of activation;  
 CO52 Rate-determining step and steady-state approximation – explanation with suitable examples;  
 CO53 Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)  
 CO54 Homogeneous catalysis: Homogeneous catalysis with reference to acid-base catalysis;  
 CO55 Primary kinetic salt effect; Enzyme catalysis;  
 CO56 Michaelis-Menten equation, Lineweaver-Burk plot,  
 CO57 turn-over number  
 CO58 Autocatalysis; periodic reactions

**Core- 2: P2 - : CHEMISTRY LAB-II**

- CO1 Determination of pH of unknown solution (buffer), by color matching method  
 CO2 Determination of heat of neutralization of a strong acid by a strong base  
 CO3 Study of kinetics of acid-catalyzed hydrolysis of methyl acetate  
 CO5 Study of kinetics of decomposition of H<sub>2</sub>O<sub>2</sub>  
 CO6 Determination of heat of solution of oxalic acid from solubility measurement

**2nd Year**

**Part II**

**Paper –III**

**Group A (Organic Chemistry)**

**Unit I:**

**Elimination reactions**

- CO1 Alkyl halides and alcohols, 1,2-(β) elimination: E1, E2 and E1Cb mechanism.



CO2 Orientation in E2 elimination (Saytzeff and Hofmann)- effect of substrate structure, base and leaving group, stereochemistry of E2 elimination-stereospecific and stereoselective reactions.

CO3 Substitution Vs elimination: E1/SN1 and E2/SN2. Syn elimination (Ei).

CO4 Mechanism and stereochemistry of pyrolysis of esters and xanthates,  $\alpha$ -elimination.

### **Addition reactions**

CO5 Addition to Carbon- Carbon multiple bond:

CO6 electrophilic and free radical mechanism, stability of alkenes-heat of hydrogenation and heat of combustion.

CO7 Mechanism of the following reactions: Halogenation, hydrohalogenation

CO8 hydration of alkene (including oxymercuration-demercuration, hydroboration-oxidation), epoxy-dation, hydroxylation, ozonolysis (involving 1, 3-dipolar mechanism),

CO9 hydration of alkyne, stereochemistry of bromination,

CO10 hydroxylation and carbene addition.

CO11 Electrophilic addition to allene and butadiene.

CO12 Dissolving metal reduction of alkynes and benzenoid aromatics (Birch).

CO13 Dynamic stereochemistry: Conformations and reactivity in cyclohexane system: E2 elimination, nucleophilic substitution (SN1, SN2, NGP),

CO14 rearrangement (pinacol-pinacolone and related rearrangements, Favorski rearrangement).

CO15 Oxidation of cyclohexanol, esterification, saponification and lactonization.

## **Unit II:**

### **Carbonyl Chemistry**

CO15 Nucleophilic addition to carbonyl group- Aldehydes and ketones:

CO16 Addition to HCN, NaHSO<sub>3</sub>, water, alcohol, thioalcohol (Umpolung), derivatives of ammonia, ylides (Wittig reaction),

CO17 nucleophilic addition to  $\alpha,\beta$  - unsaturated carbonyl compounds (general principles).

CO18 Quinones, reactions of p-benzoquinone. Hydride addition (LiAlH<sub>4</sub>, NaBH<sub>4</sub> reduction), MPV reduction, Wolff-Kishner, dissolving metal (Clemenson reduction, Bouveault-Blanc reduction).

CO19 Acidity of  $\alpha$ -H: reaction via enols and enolate ion (carbanions),

CO20 aldol condensation, Knoevenagel reaction, Claisen ester condensation, Perkin reactions,

CO21 Darzen's reaction, halogenations of ketones,

CO22  $\alpha$ -halogenation of acids (HVZ reaction).

CO23 Nucleophilic substitution at the acyl carbon- carboxylic acids and their derivatives:

CO24 Esterification and hydrolysis (BAC 2, AAC 2, AAC 1, AAI 1 mechanism, non kinetic use of isotope labels), amides (formation and hydrolysis).

CO25 Carbonyl compounds without  $\alpha$ -H; Cannizaro reaction, Tischenko reaction, benzoin condensation.

CO26 Stereoselectivity and asymmetric synthesis-

CO27 enantioselectivity/ diastereo-selectivity; asymmetric synthesis involving achiral and chiral reagent; chiral substrate and achiral reagent (Cram's rule and Felkin-Anh model).

## **Unit III:**

### **Aromatic Substitution**

CO28 Electrophilic aromatic substitution:- Mechanism orientation and reactivity (including free energy profiles) of halogenations, nitration, sulfonation,

CO29 Friedel-Craft reactions, chloromethylation, formylation (Gatterman-Koch, Gatterman, Reimer- Tiemann and Vilsmeier-Haack).

CO30 Kolbe-Schmidt reaction, Houben-Hoesch reaction.

CO31 IPSO substitution.

CO32 Synthesis of naphthalene, anthracene and their derivatives;

CO33 Pthenenthrene (Bardhan- Sengupta synthesis),

CO34 orientation and reactivity in polynuclear hydrocarbons (naphthalene and anthracene).

CO35 Nucleophilic aromatic substitution: Addition-elimination mechanism, reactivity and orientation in activated aromatic substitutions.

CO36 Elimination- Addition, mechanism, benzyne intermediate. SN1 mechanism.

CO37 Chemoselectivity: different reactivity of –NH<sub>2</sub> and –OH in aromatic system.

### **Chemistry of nitrogen containing compounds:**

CO38 Aliphatic and aromatic amines (preparation, separation and identification of primary, secondary and tertiary amines), alkylation including Hoffmann's exhaustive methylation,

CO39 reactions of aliphatic and aromatic amines with nitrous acid, carbyl amine reaction, Mannich reaction,

CO40 Eschweiler Clarke reaction, enamines, diazomethane, diazoacetic ester, aromatic nitrocompounds, aromatic diazonium salts, nitriles and isonitriles, Ritter reaction.

### **Unit IV:**

#### **Organometallics:**

CO41 Preparation of Grignard reagent and organolithium.

CO42 Reactions: addition of Grignard and organolithium to carbonyl compounds, substitution on – COX, conjugate addition by Gilman cuprates, Reformatsky reaction.

#### **Molecular rearrangements:**

CO43 Intramolecular Vs intermolecular rearrangements. Crossover experiment. 1,2-shift:

CO44 Migration to electron deficient carbon; Wagner-Meerwein, pinacol-pinacolone, diene-phenone,

CO45 Wolff rearrangement in Arndt- Eistert synthesis, Benzil-benzilic acid rearrangement.

CO46 Migration to electron deficient nitrogen: Beckmann, Schmidt (carbonyl compound), Hofmann, Lossen, Curtius, Schmidt (carboxylic acid).

CO47 Migration to electron deficient oxygen: Baeyer-Villiger, Dakin, Hydroperoxide rearrangement.

CO48 Aromatic rearrangements; Migration from oxygen to ring carbon:

CO49 Fries, Claisen rearrangement Migration from nitrogen to ring carbon: Hofmann-Mertius, Fischer- Hepp, N-azo to C-azo,

CO50 Bamberger, Orton, Benzidine-Semidine rearrangement.

## **Group B (Inorganic Chemistry)**

### **Unit – I:**

#### **Radioactivity & nuclear chemistry**

CO1 Radioactive decay, half life and average life of radio elements, units of radioactivity,

CO2 natural radioactive disintegration series, radioactive equilibrium, group displacement law, isotope, isotone, isobars and nuclear isomerism.

- CO3 Application of isotope in medicine, agriculture, reactor mechanism (isotope as tracer), age of minerals, age of earth, radio carbon dating, nuclear particles, nuclear forces, nuclear models (elementary idea), nuclear stability, nuclear binding energy, nuclear reactions,  
CO3 magic numbers, mass defect, proton-neutron ratio, packing fraction, transmutation of elements, fission, fusion and spallation reaction.  
CO4 Nuclear energy, hazards of nuclear radiations.

### **Unit – II:**

#### **Redox chemistry: (10 L)**

- CO5 Oxidation and reduction, oxidation numbers, balancing of redox reaction by oxidation number and ion electron method.  
CO6 Standard redox potential, Sign conventions. Nernst equation, influence of complex formation, precipitation and change of pH on redox potential,  
CO7 formal potential, feasibility of a redox titration, redox potential at the equivalence point, redox indicators,  
CO8 redox potential diagram (Latimer, Frost and Pourbaix diagrams) of common elements and their applications.  
CO9 Dis-proportionation and com-proportionation reactions (Typical examples). CO10 Redox titration using  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$ .

### **Unit– III:**

#### **(a) Chemical bonding - II:**

- CO11 Types of bonding. Overlap of atomic orbitals. VB and MO concepts,  
CO12 LCAO method. Bonding of homo- and hetero-nuclear diatomic molecules ( $\text{H}_2$ ,  $\text{H}_2^+$ ,  $\text{H}_2^-$ ,  $\text{He}_2^+$ ,  $\text{B}_2$ ,  $\text{C}_2$ ,  $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{NO}$ ,  $\text{CO}$ ,  $\text{CN}^-$ ,  $\text{HF}$ ),  
CO13 bond order, bond length. Metallic bonding: Qualitative idea of band theory, conducting, semiconducting and insulating properties with examples from main group elements.  
CO14 Close-packing: hcp (ABAB.... type), ccp (ABCABC.....type); holes: cubic, tetrahedral and octahedral; radius ratio principle and different polyhedra; structures of MX ( $\text{NaCl}$ ,  $\text{CsCl}$  and  $\text{ZnS}$ ),  $\text{MX}_2$  ( $\text{CaF}_2$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ) /  $\text{M}_2\text{X}$  ( $\text{Na}_2\text{O}$ ),  $\text{MX}_3$  ( $\text{AlF}_3$ ).  
CO15 Structure of simple silicates, metallic structure, alloy structure.

#### **(b) Chemistry of coordination compounds - I:**

- CO16 Double salts and complex salts, detection of complexes in solution, ligands, ambidentate and polydentate ligands,  
CO17 coordination number, Werner's coordination theory. IUPAC nomenclature. Factors affecting the stability of complexes in solution.  
CO18 Overall and stepwise formation constants, determination of stability constants by Job's method, perfect and imperfect complexes,  
CO19 chelate complexes, flexidentate behavior of ligand,  
CO20 inner-metalic complexes, their properties and applications in analytical chemistry.  
CO21 Complexones, masking and demasking interactions, metallochrome indicators,  
CO22 titration of metal ions and their mixtures with EDTA, hardness of water and its determination.

### **Unit – IV:**

#### **Study of elements and their compounds.**

- CO23 Comparative study of p-block elements: Group trends in electronic configuration,

CO24 modification of pure elements, common oxidation states, inert pair effect, CO25 catenation and catalytic properties (if any), and their important compounds in respect of the following groups of elements: Group-14 (C, Si, Ge, Sn, Pb)

CO26 Group-15 (N, P, As, Sb, Bi)

CO27 Group-16 (O, S, Se, Te)

CO28 Group-17 (F, Cl, Br, I)

CO29 Group-18 (He, Ne, Ar, Kr, Xe)

#### **Paper-IV**

#### **Physical Chemistry**

##### **Unit – I**

##### **Thermodynamics-II**

CO1 Clapeyron equation, Clausius–Clapeyron equation, Trouton’s rule.

CO2 Open systems, activity, fugacity,

CO3 activity coefficients, partial molar quantities, chemical potential, CO4 thermodynamics of mixing ( $\Delta_{mix}G$ ,  $\Delta_{mix}S$ ,  $\Delta_{mix}H$ ),

CO5 Gibbs–Duhem equation. 5L

##### **Colligative properties:**

CO6 Ideal solutions, thermodynamic properties of binary solution,

CO7 colligative properties. Raoult’s laws.

CO8 Colligative properties (relative lowering of vapour pressure, elevation of boiling point, depression of freezing point,

CO9 van’t Hoff’s law for osmotic pressure) statement,

CO10 derivation (using chemical potential), application, critical comment on limitation.

CO11 Abnormal colligative properties, van’t Hoff’s factor, deviation from ideality (negative, positive).

CO12 Duhem–Margules relation, Konowaloff’s rule,

CO13 non-ideal and ideally dilute solutions

##### **Unit – II**

CO14 **Chemical equilibrium:** Extent of reaction, law of mass action, thermodynamic equilibrium constant,  $K_p$ ,  $K_c$  and  $K_f$  and relationship between them,

CO15 effect of temperature, pressure and addition of inert gas on equilibrium and equilibrium constant,

CO16 Le Chatelier principle, van’t Hoff isotherm and equation.

CO17 Examples of equilibria in homogenous and heterogeneous systems.

##### **Ionic Equilibrium:**

CO18 Debye-Huckel limiting law (no derivation),

CO19 solubility and solubility product, ionic product of water,

CO20  $pH$ , Henderson equation, concept of buffer solution,

CO21 buffer capacity, hydrolysis,

CO22 indicators (acidbase, adsorption, redox, metal ion).

##### **Unit - III**

##### **Quantum mechanics–1:**

CO23 Drawback of classical mechanics, stability of atom,

CO24 black body radiation, photoelectric effect; Compton effect, waveparticle duality,

CO25 de Broglie hypothesis, Heisenberg’s uncertainty principle. Concept of operators, different types of operators,

CO26 properties and interpretation of wavefunctions (normalization, orthogonality, probability distribution)

- CO27 eigen function, eigen values. Commutation of operators, commutators, theorem,  
CO28 postulates of quantum mechanics, time-dependent, time-independent Schrodinger equation,  
CO29 stationary state, stationary state wavefunction, applications,  
CO30 free particle, boundary condition.

#### **Unit - IV**

##### **Electrolytic conduction:**

- CO31 Conductance, conductivity, molar and equivalent conductivities, limiting molar conductivity, measurement, variation with dilution,  
CO32 Ostwald's dilution law, ionic mobility, Kohlrausch law, asymmetry effect, electrophoretic effect, temperature dependence of ion conductivity.  
CO33 Stoke's law, Hittorf's rule, conductivity of ions in aqueous and non-aqueous solvent,  
CO34 Debye-Huckell-Onsagar equation (no derivation), Debye-Falkenhagen effect and Wien effect, application of conductance measurement,  
CO35 conductometric titration, Transport number, abnormal transport number, solvation of ions,  
CO36 measurement of transport numbers (moving boundary method) 8L

##### **Electromotive Force:**

- CO37 Electrochemical cell, reversible and irreversible, EMF and electrical work, CO38 measurement of EMF, temperature co-efficient of EMF,  
CO39 standard cell, different type of electrodes, electrodepotential,  
CO40 Nernst's equation, standard electrode potential,  
CO41 reference electrode, (hydrogen, quinhydrone, glass, calomel), chemical and concentration cells,  
CO42 liquid junction potential, salt bridge,  
CO43 applications of potentiometric measurement.

#### **Paper-V**

##### **Group A (Organic Chemistry Practical)**

- (A) Identification of a solid unknown organic compound  
CO1 Detection of elements (N,S and Cl) in a given solid sample  
CO2 Determination of melting point of the organic sample  
CO3 Detection of the following functional groups in organic samples  
Carbonyl- keto, aldehyde,  
CO4 carboxylic acid, phenolic hydroxyl,  
CO5 unsaturation, aromatic (nitro, amino), amido  
CO6 Preparation of a suitable derivative of the supplied organic sample and determine the Melting point of derivative

##### **Group B (Inorganic Chemistry Practical)**

##### **Inorganic Qualitative Analysis:**

- (A) Qualitative analysis of inorganic sample containing not more than four radicals (Basic and acid) selected from the list given below

##### **Basic radicals:**

- CO1 Cu(II), Sb(III), Bi(III),  
CO2 Fe(II/III), Cr(III),  
CO3 Al(III), Zn(II), Mn(II),

- CO4 Co(II), Ni(II), Ca(II),  
CO5 Ba(II), Sr(II), Mg(II),  
CO6 Na(I), K(I), NH<sub>4</sub><sup>+</sup>.

**Acid radicals:**

- CO7 Cl<sup>-</sup>, F<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>,  
CO8 [Fe(CN)<sub>6</sub>]<sup>3-</sup>, [Fe(CN)<sub>6</sub>]<sup>4-</sup>,  
CO9 SO<sub>3</sub><sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, S<sup>2-</sup>,  
CO10 PO<sub>4</sub><sup>3-</sup>, CrO<sub>4</sub><sup>2-</sup>, BO<sub>3</sub><sup>3-</sup>,  
CO11 H<sub>3</sub>BO<sub>3</sub>, NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>,  
CO12 Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>, SCN<sup>-</sup>.

**Less common ion (Special test only):**

- CO13 Ti(III/IV), Zr(IV),  
CO14 V(IV/V), Mo(VI).

**Insoluble compound:**

- CO15 Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>,  
CO16 Cr<sub>2</sub>O<sub>3</sub>, SnO<sub>2</sub>,  
CO18 SrSO<sub>4</sub>, BaSO<sub>4</sub>, CaF<sub>2</sub>.

**Group C (Physical Chemistry Practical)**

- CO1 Determination of pH of an unknown solution by colour matching method.  
CO2 Determination of surface tension of a liquid by stalagmometer.  
CO3 Determination of viscosity of a liquid by Ostwald's method.  
CO4 Determination of distribution co-efficients: I<sub>2</sub> in water-organic solvent (CCl<sub>4</sub>/CHCl<sub>3</sub>)  
CO5 Adsorption isotherm study of acetic acid on charcoal.  
CO6 Study of the kinetics of acid catalyzed hydrolysis of methyl acetate.  
CO7 Study of the decomposition kinetics of hydrogen peroxide (FeCl<sub>3</sub> catalysed).  
CO8 Solubility product study (by titration) of (i) Silver acetate and (ii) strontium oxalate (iii) KHTa in the presence and absence of common ions (any one of the three).

**Part III**

**Paper –VI**

**Unit I:**

**Spectroscopy**

- CO1 UV: Electronic transitions ( $\sigma \rightarrow \sigma^*$ ,  $n \rightarrow \sigma^*$ ,  $\pi \rightarrow \pi^*$ ,  $n \rightarrow \pi^*$ ), absorption maximum and absorption intensity considering conjugative effect, steric effect,  
CO2 solvent effect, red shift (bathochromic shift), blue shift (hypsochromic shift),  
CO3 hyperchromic effect, hypochromic effect (typical examples).  
CO4 Woodward rule with reference to conjugate dienes, trienes and  $\alpha, \beta$ - unsaturated carbonyls including cyclic systems.  
CO5 IR: Stretching and bending vibrations, Hooke's law,  
CO6 characteristics stretching frequencies of O-H, N-H, C-H, C-D, C=C, C=N, C=O functions,  
CO7 factors affecting stretching frequencies (H-bonding, mass effect, electronic factors, bond multiplicity, ring size).  
CO8 <sup>1</sup>H NMR: Nuclear spin, NMR-active nuclei, principle of proton magnetic resonance,  
CO9 chemically equivalent and non-equivalent protons, chemical shift, upfield and downfield shifts, shielding/deshielding of protons (systems involving C=C, C=O, benzene) NMR peak area (integration).

CO10 First order coupling, (splitting of the signals; ordinary ethanol, bromoethane, dibromoethanes),

CO11 coupling constants, relative peak positions of different kinds of protons of substituted benzenes (toluene, nitrobenzene, halobenzenes, dinitrobenzenes, chloronitrobenzenes).

## **Unit II:**

### **Synthesis**

CO12 General synthetic strategy: Disconnection approach- Target molecule,

CO13 retrosynthetic analysis, function group interconversion (FGI),

CO14 disconnection, synthon, electrophilic and nucleophilic synthons, synthetic equivalent, latent polarity.

CO15 Ring synthesis: Methodologies: C-C disconnection involving carbanion chemistry (Ethyl acetoacetate, diethyl malonate).

CO16 carbonyl condensation – two group disconnection:  $\alpha,\beta$ - unsaturated carbonyl compounds,

CO17 1,3- dicarbonyl compounds, 1,5- dicarbonyl compounds, Robinson annelation.

CO18 Large ring synthesis: high dilution technique,

CO19 Aldol condensation (use of trimethyl silyl chloride).

## **Unit III**

### **Carbohydrate Chemistry**

CO20 Monosaccharides- classification, configuration of D-glucose and D-fructose and their ring structures, mutarotation, anomeric effect.

CO21 Reactions: Osazone formation, bromine-water oxidation,

CO22 epimerization, stepping-up (Killani method) and stepping-down (Ruff & Wohl's degradation method) of aldose.

CO23 Disaccharides – glycosidic linkages,

CO24 structure of sucrose, inversion of sucrose.

### **Amino acids, peptides and nucleic acids**

CO25 Amino acids: Synthesis of  $\alpha$ -amino acids (Gabriel, Strecker, azolactone, acetamidomalonic ester methodologies), isoelectronic point, ninhydrin reaction.

CO26 Peptides: peptide linkage, peptide synthesis including Merrifield resin, CO27 C-terminal, N-terminal and their determination (Edmann, Sanger and dansyl chloride).

CO28 Nucleic acids: structure of nucleosides and nucleotides, pyrimidine and purine bases (structure and nomenclature only),

CO29 elementary idea of RNA and DNA; Watson-Crick model, complementary base-pairing in DNA.

## **Unit IV**

### **Heterocyclic Compounds**

CO30 Reactivity, orientation and important reactions of furan, pyrrole, thiophene, pyridine, indole. Synthesis (including retrosynthetic approach)

CO31 Furan: Paal-Knoor synthesis, Feist-Benary synthesis

Pyrrole: Knoor synthesis, Hantzsch synthesis Thiophene:

CO32 Hinsberg synthesis Pyridine: Hantzsch synthesis Indole: Fischer,

CO33 Madelung, Reissert synthesis Quinoline: Skatrup,

CO34 Friedlander synthesis

CO35 Isoquinoline: Bischler-Napieralski synthesis

### **Pericyclic reaction**

- CO36 Definition and classification of pericyclic reactions,  
CO37 thermal and photochemical electrocyclic reactions of neutral species involving 4 and 6 electrons- FMO approach.  
CO38 Cycloaddition reactions [2+2] and [4+2],  
CO39 Diels- Alder reaction-FMO approach.

## **Group B (Inorganic Chemistry),**

### **Unit – I:**

#### **Chemistry of coordination compounds - II**

- CO1 **Stability of Coordination Complexes:** Thermodynamic and kinetic stability of complexes,  
CO2 substitution reactions in square planar complexes,  
CO3 trans effect, and labile and inert complexes.

CO4 **Types of Isomerism in Coordination Compounds:** Types of isomerism in coordination compounds :

CO5 Constitutional, geometrical and optical isomerism in respect of coordination numbers 4 and 6.

CO6 Determination of configuration of cis-, trans-isomers by chemical methods.

CO7 Resolution of optical isomers.

#### **CO8 Nature of bonding in coordination compounds (including colour**

**and spectra):** Nature of coordinate linkage, EAN rule, electro-neutrality principle, CO9 VB theory, its limitations. Crystal field and Ligand field theory, d-orbital splitting in octahedral, tetrahedral and square planar fields,

CO10 crystal field stabilization energy in weak and strong field complexes, pairing energy,

CO11 explanation of magnetic behavior and spectral features including charge transfer spectra of transition metal complexes,

CO12 selection rules for electronic spectral transitions, qualitative Orgel diagram for 3d1 – 3d9 systems,

CO13 spectrochemical series, Jahn-Teller distortion.

CO14 Metal - Ligands bonding (MO concept - elementary idea) sigma & pi-bonding in octahedral complexes (qualitative approach) and stabilization of unusual oxidation states due to complex formation.

### **Unit – II:**

#### **Magneto chemistry:**

CO15 Diamagnetic and paramagnetic susceptibility, Curie equation (without derivation),

CO16 magnetic moment and its determination by Guoy method,

CO17 L-S coupling, term symbol, orbital and spin moment (qualitative treatment), quenching of magnetic moment, super-exchange, anti-ferromagnetic interaction (elementary idea with examples only),

CO18 application of spin only values of magnetic moments to determine valency and stereochemistry of coordination compounds (based on VBT and CFT).

#### **Chemistry of d-block elements**

CO19 Comparative study of the metals of first transition series with reference to electronic configuration, atomic and ionic radii,

CO20 ionization potential oxidation states, aqueous and redox chemistry, complex chemistry,



- CO21 magnetic properties, metallic nature and catalytic properties.  
CO22 Trends in physical and chemical properties in passing from 3d through 4d to 5d block elements.  
CO23 Extraction and purification scheme (omitting technical details) and technical uses of the following metals: Ti, V, Cr, Mn, Co, Ni, Pt, Ag, Au, Cd, Hg and U.

### **Unit– III:**

#### **Organometallic compounds:**

- CO24 Definition, acid ligands, hapticity (s) of ligands, 18-electron rule, application of 18-electron rule to carbonyl, nitrosyl, cyanide and hydrido complexes.  
CO25 Preparation, Properties and bonding of carbonyl, nitrosyl and cyanide complexes, metal carbonylates, carbonyl hydrides,  
CO26 metal olefin, alkynes and cyclopentadienyl complexes, Ziese's salt (preparation, structure and bonding),  
CO27 Ferrocene (preparation, Structure, bonding and reactions). Metal-metal bonded compounds and metal clusters (simple examples).  
CO28 Simple examples of fluxional molecules, coordinative unsaturation, oxidative addition and insertion reactions,  
CO29 homogeneous catalysis by organometallic compounds: hydrogenation, hydroformylation and polymerization of alkenes (Ziegler Natta Catalyst).

#### **Chemistry of f-block elements:**

- CO30 f-block elements: electronic configuration, ionization energies,  
CO31 oxidation states, variation in atomic and ionic (3+) radii,  
CO32 magnetic and spectral properties of lanthanides, comparison between lanthanide and actinides,  
CO33 separation of lanthanides (by ion-exchange method).

### **Unit – IV:**

#### **Bioinorganic chemistry:**

- CO34 Essentials and trace elements of life, basic reactions in the biological systems and the role of metal ions specially Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Fe<sup>3+/2+</sup>, Cu<sup>2+</sup> & Zn<sup>2+</sup>. CO35 Transport across biological membrane-Na<sup>+</sup> ion pump, ionophores.  
CO36 Bio-function of hemoglobin and myoglobin, cytochromes and ferridoxins, CO37 photosynthesis: photo system I and II, Carbonate-bicarbonate buffering system and carbonic anhydrase.  
CO38 Biological nitrogen fixation. Toxic metal ions and their effects, chelation Therapy,  
CO39 metal dependent diseases and Pt and Au complexes as drugs (examples only).

#### **Instrumental analysis.**

- CO40 Basic Principles, Instrumentations and simple applications of conductometry, potentiometry, polarography,  
CO41 UV-Visible and IR spectrophotometry.  
CO42 Analysis of water (BOD, COD, DO, TDS), air & soil samples.  
CO43 Principles for determination of BOD, COD, DO, TDS in water samples. CO44 Detection and estimation of As, Hg, Cd, Pb in water sample.

### **Paper-VII**

## Physical Chemistry

### Unit - I

#### Quantum mechanics–2:

- CO1 Particle in one dimensional box, wavefunction,
- CO2 normalized wavefunction, probability of finding of particle, expectation values ( $\langle x \rangle$ ,  $\langle x^2 \rangle$ ,  $\langle px \rangle$ ,  $\langle px^2 \rangle$  etc.),
- CO3 uncertainty, particle in one dimensional box,
- CO4 degeneracy,
- CO5 tunneling effect.
- CO6 Simple harmonic oscillator, Schrodinger equation, energy (no derivation) wavefunction (no derivation),
- CO7 probability density, expectation values,
- CO8 uncertainty. Rigid rotator,
- CO9 Schrodinger equation, energy (no derivation) wavefunction (no derivation).

#### Hydrogen atom:

- CO10 Hydrogen-like system, Schrodinger equation in polar coordinates,
- CO11 radial solution, radial wavefunction, real hydrogen-like wavefunction, probability density,
- CO12 probability of finding of electron, radial distribution function,
- CO13 quantum numbers, energy expression (no derivation), degeneracy,
- CO14 concept of orbitals (s,p,d) and shapes.

### Unit - II

#### Photochemistry:

- CO15 Thermal versus photochemical reactions, Grotthüs-Draper law, Lambert-Beer's law,
- CO16 Einstein's law of photochemical equivalence, quantum yield,
- CO17 actinometer, effect of adsorption of light, phosphorescence, fluorescence, CO18 photochemical reactions (decomposition of HI and combination of H<sub>2</sub> and Br<sub>2</sub>),
- CO19 photo-stationary state, Jablonksy diagram.

#### Molecular geometry:

- CO20 Polarization, dipole moment, permittivity, relative permittivity, Debye-Langevin equation (No derivation),
- CO21 Clausius-Massoti equation (No derivation), application towards explanation of structure.
- CO22 Spectroscopy, microwave and I.R spectra energy expressions (no derivation) selection rule applications,
- CO23 potential energy diagram, Franck- Condon principle,
- CO24 Raman spectra, comparison with fluorescence.

### Unit - III

#### Crystalline state:

- CO25 Laws of Crystallography, unit cell, lattice, different crystalline systems with characteristics,
- CO26 Bragg's equation, application towards structure of NaCl and KCl.
- CO27 Specific heats of solid elements, Dulong-Petit's law, limitations,
- CO28 Einstein's equation, success and limitations,
- CO29 Debye's T<sup>3</sup> law (no derivation).

### Thermodynamics–III

- CO30 Third law of thermodynamics, Nernst heat theorem,  
 CO31 Lewis-Randall statement Plank statement. Macrostates and microstates, Ensemble,  
 CO32 mathematical probability versus thermodynamic probability, thermodynamic probability and the concept of entropy,  
 CO33 Partition function and representation of the thermodynamic functions;  
 CO34 Boltzmann distribution, non-degenerate and degenerate cases.

#### **Unit - IV**

##### **Phase Equilibrium:**

- CO35 Phase, phase stability, first-order phase transition, transition temperature, phase boundary,  
 CO36 slope of phase boundary, vapour pressure, critical point, boiling point and melting point (normal and standard).  
 CO37 Henry's law, Nernst's distribution law, solvent extraction, phase, component, degree of freedom,  
 CO38 phase rule, derivation from thermodynamics.  
 CO39 One component system, (water, CO<sub>2</sub> and sulphur), triple point.  
 CO40 Two component system liquid-liquid and solid-liquid systems (phenol-water, triethylamine-water, nicotine-water) isopleths, tie-line, lever rule,  
 CO41 critical solution temperature, simple eutectic compound with congruent and incongruent melting points,  
 CO42 peritectic line.

#### **Paper-VIII**

##### **Group A**

##### **(Organic Chemistry Practical)**

##### Organic preparation

- CO1 m-dinitrobenzene, Aspirin,  
 CO2 Methyl orange, p-bromo acetanilide,  
 CO3 p-bromo aniline from p-bromo acetanilide,  
 CO4 phthalimide from phthalic anhydride,  
 CO5 benzanilide, anthranilic acid from phthalimide,  
 CO6 benzoic acid from benzil, benzil from benzoin,  
 CO7 benzoic acid by oxidation of benzene derivative (ph-CHO/ph-CH<sub>2</sub>OH/ph-CH<sub>3</sub>).

##### Spectroscopic analysis of organic compounds:

Assignment of labelled peaks in the <sup>1</sup>H NMR spectrum of the known organic compounds explaining the relative  $\delta$  values and splitting pattern and also assignment of labelled peaks in the IR spectrum of the same compound.

- CO8 p-nitro aniline, p-nitro benzaldehyde,  
 CO9 p-bromo acetanilide, p-amino benzoic acid,  
 CO10 p-methyl  $\alpha$ -bromo acetophenone, o-hydroxy acetophenone,  
 CO11 o-hydroxy benzaldehyde, salicylamide, vanillin,  
 CO12 cinamic acid, benzal acetone, diethyl maleate,  
 CO13 diethyl fumarate,  
 CO14 glucose, fructose.

##### **Group B (Inorganic Chemistry Practical)**

##### **A. Quantitative analysis:**

Acidimetry and alkalimetry.

- CO1 Titration of  $\text{Na}_2\text{CO}_3 + \text{NaHCO}_3$  mixture vs  $\text{HCl}$  using phenolphthalein and methyl orange indicators.
- CO2 Titration of  $\text{HCl} + \text{CH}_3\text{COOH}$  mixture vs  $\text{NaOH}$  using two different indicators to find the composition.
- CO3 Volumetric analysis with potassium permanganate and potassium dichromate solutions.
- CO4 Iodometry and complexometry
- CO5 Estimation of mixtures of  $\text{Fe(III)-Ca(II)}$ ,  $\text{Fe(III)-Cu(II)}$ ,  $\text{Fe(III)-Cr(VI)}$ ,  $\text{Fe(III)-Mn(II)}$ ,  $\text{Ca(II)-Mg(II)}$ ,  $\text{Cu(II)-Zn(II)}$ .
- CO6 Gravimetric estimation of chloride, sulphate and nickel as dimethyl glyoxime complex.
- CO7 Determination of total hardness of water by EDTA titration.
- CO8 Estimation of available chlorine in bleaching
- CO9 powder Estimation of available oxygen in pyrolusite.

**B. Preparation of inorganic compounds:**

- CO10 Ammonium manganous sulphate,  $(\text{NH}_4)_2\text{SO}_4, \text{MnSO}_4 \cdot 6\text{H}_2\text{O}$
- CO11 Ammonium ferrous sulphate hexa hydrate (Mohr's salt),  $(\text{NH}_4)_2\text{SO}_4, \text{FeSO}_4 \cdot 6\text{H}_2\text{O}$
- CO12 Ammonium ferric sulphate (Ferric alum),  $(\text{NH}_4)_2\text{SO}_4, \text{Fe}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$  or  $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$
- CO13 Potash alum,  $\text{K}_2\text{SO}_4, \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
- CO14 Tetra ammine carbonato cobalt(II) nitrate hemi hydrates,  $[\text{Co}(\text{NH}_3)_4(\text{CO}_3)](\text{NO}_3) \cdot \frac{1}{2}\text{H}_2\text{O}$ .
- CO15 Bis-acetylacetonato copper(II),  $[\text{Cu}(\text{acac})_2]$

**Group C (Physical Chemistry Practical)**

- CO1 Conductometric titration of  $\text{HCl}$  vs  $\text{NaOH}$ ; acetic acid & oxalic acid vs  $\text{NaOH}$ ; mixed acid ( $\text{HCl} + \text{CH}_3\text{COOH}$ ) vs  $\text{NaOH}$ .
- CO2 Determination of ionization constant of weak electrolyte and its conductance at infinite dilution using conductometer (verification of Ostwald dilution law).
- CO3 Determination of solubility and solubility product of  $\text{AgCl}$  by EMF measurement.
- CO4 Potentiometric estimation of Mohr salt solution with standard  $\text{K}_2\text{Cr}_2\text{O}_7$  and the determination of formal potential of  $\text{Fe}^{3+}/\text{Fe}^{2+}$  system.
- CO5 Determination of  $pK_a$  values of weak monobasic acid and  $pK_2$  of dibasic acid using  $pH$ -meter.
- CO6 Verification of the Lambert-Beer's law and determination of the concentration of a solution.
- CO7 Determination of  $pK_{in}$  of Bromochresol green using colorimeter.
- CO8 Determination of optical rotation of cane sugar by polarimeter.
- CO9 Determination of critical solution temperature of phenol-water system and effect of impurities on CST.

## **Bengali Honors**

### **COURSE – History of Bengali Literature (from 10<sup>th</sup> century to 20<sup>th</sup> century).**

CO1: Give an outline of ancient Bengali literature in reference with socio-political, religious, and cultural aspect.

CO2: Give an outline of early medieval Bengali literature in reference with socio-political, religious, and cultural aspect.

CO3: Give an outline of medieval Bengali literature in reference with socio-political, religious, and cultural aspect.

CO4: Give an outline of 19<sup>th</sup> century Bengali literature in reference with socio-political, religious, and cultural aspect.

CO5: Give an outline of 20<sup>th</sup> century Bengali literature in reference with socio-political, religious, and cultural aspect.

### **COURSE – History of Sanskrit literature.**

CO1: Discuss the impact of Kalidas's work in Bengali literature.

CO2: Discuss the life & work of varabi.

CO3: Discuss the life & work of Banbhata.

CO4: Discuss the life & work of Bhababhuti.

### **COURSE – History of English literature.**

CO1: Discuss the impact of Shekespeare's work in Bengali literature.

CO2: Discuss the dramas of Shekespeare.

CO3: Discuss about a romantic poets and their impact in 19<sup>th</sup> century Bengali literature.

CO4: Discuss about the works of William Wordsworth.

CO5: Discuss about the works of P.B.Shelley.

CO6: Discuss about the works of John Keats.

CO7: Discuss about the works of T.S.Eliot and his influence on 20<sup>th</sup> century Bengali poems.

CO8: Discuss about the plays of George Bernard Shaw.

### **COURSE – Linguistics**

CO1: Discuss on original development of Bengali language.

CO2: Discuss on Bengali phonetics with suitable examples.

CO3: Discuss on Bengali semantics with suitable examples.

CO4: Discuss on Bengali morphology with suitable examples.

CO5: Discuss on Bengali dialects with explanation of their phonetical & morphological features.

CO6: Discuss on Bengali syntax with suitable examples.

CO7: Give an outline of history of Bengali grammar.

### **COURSE – Literary types.**

CO1: Explain the features of an epic with reference to Bengali literature.

CO2: Explain lyric with reference to Bengali literature.

CO3: Explain Elegy with reference to Bengali literature.

CO4: Explain tragedy with reference to Bengali literature.

CO5: Classify comedy with its reference to Bengali literature.

CO6: Discuss on one act play with reference to Bengali literature.

CO7: Discuss on Ode with reference to Bengali literature.

CO8: Explain absurd drama and its influence on Bengali literature.

### **COURSE – Bengali Meters.**

CO1: Discuss about the basic components of Bengali meters with suitable examples.

- CO2: Discuss about different structures of Bengali meters.  
CO3: Compare among different structures of Bengali meters.  
CO4: Identify different meters and do the scansion of the given examples.

**COURSE – Bengali figure of speeches.**

- CO1: Discuss about different types of Bengali figure of speeches.  
CO2: Compare between Upama&Rupakalankar.  
CO3: Identify the difference between Birodh& Bisham.  
CO4: Discuss about Anuprass-alankar with suitable example.  
CO5: Identify different figure of speeches in the given examples.

**COURSE – Baishnab Padabali**

- CO1: Discuss about the theories of BaishnabPadabali.  
CO2: Compare between Prac-chaitanya and Para-chaitanyabaishnabpadabali.  
CO3: Critique on Vidyapatipadabali.  
CO4: Critique on Chandidas'spadabali.  
CO5: Critique on Govindadas'spadabali  
CO6: Critique on jnanadas'spadabali.

**COURSE – Viranganakavya by Madhusudan Dutt.**

- CO1: Discuss about the significant of the title of the text.  
CO2: Explain Virangana in the light of 19<sup>th</sup> century renaissance.  
CO3: Discuss about the rythem of Viranganakavya.  
CO4: Explain Virangana as a epistle .  
CO5: Explain the female characters of Virangana.

**COURSE – SANCHYATA -Collection of poems by Rabindranath Tagore**

- CO1: Give a critique on NirjharerSwapnabhanga .  
CO2: Give a critique on Ananta prem.  
CO3: Give a critique on Sonar Tori poem.  
CO4: Give a critique on 8<sup>TH</sup> Number poem(Balaka).  
CO5: Give a critique on Simay Prakash.  
CO6: Discuss about the Topobhonga poem.  
CO7: Explain the Swapna poem.  
CO8: Explain the Sadharon Maya poem.  
CO9: Give a critique on Ami poem.  
CO10: Give a critique on Oikotan .  
CO11: Give a critique on TomarSristirPoth Poem.

**COURSE – SANCHITA – Collection of poems by Kazi Nazrul Islam**

- CO1: Give a critique on Bidrohi poem.  
CO2: Give a critique on Sammobadi poem.  
CO3: Give a critique on Amar Koifiot poem.  
CO4: Discuss about the Dariddra poem.  
CO5: Explain the Batyaonpasegubaktarur sari poem.

**COURSE – Collection of Modern Bengali poem Edited by BuddhadevBasu**

- CO1: Give a critique on Aatbachar ager akdin poem.  
CO2: Give a critique on BarababurKachaNibedan poem.  
CO3: Give a critique on Utpakhi poem.  
CO4: Give a critique on Ghorosowar poem.  
CO5: Give a critique on Abani Bari Acho poem.  
CO6: Give a critique on Mukh Dhaka Jai Bigghapone poem.  
CO7: Give a critique on MalatibalaBalika Vidyalaya poem.

**COURSE – Bengali Novels – Give a critique on Bengali Novels**

- CO1: Discuss about the structure of novel Rajsingha.

- CO2: Discuss about the style of novel Rajsingha.
- CO3: Explain the character of novel Rajsingha.
- CO4: Discuss about the structure of novel Chokher Bali.
- CO5: Explain the style of novel Chokher Bali.
- CO6: Explain the character of novel Chokher Bali.
- CO7: Explain the psychological thought behind the plot of novel Chokher Bali.
- CO8: Discuss about the style of novel Srikanta.
- CO9: Discuss about the Structure of novel Srikanta.
- CO10: Discuss about the character of novel Srikanta.
- CO11: Explain the auto-biographical novel of Srikanta.
- CO12: Explain the scientific novel of Dana.
- CO13: Discuss about the structure of novel Dana.
- CO14: Explain the style of novel Dana.
- CO15: Discuss about the character of novel Dana.

### **COURSE – Bengali Short stories – Give a critique on Bengali Short Stories**

- CO1: Discuss about the romantic thought of short story Meghomollar.
- CO2: Discuss about the character of short story Chikitshasankat.
- CO3: Explain the substance of short story ChaturthaPanipatherjuddha.
- CO4: Explain the character of short story Stanadyany.
- CO5: Discuss about the style of short story Motilal padry.
- CO6: Discuss about the structure of short story Attwaja.

### **COURSE – Bengali Drama – Analysis the critique on Bengali Dramas**

- CO1: Discuss about the structure of drama Falguni.
- CO2: Discuss about the character of drama Falguni.
- CO3: Explain the symbolism drama of Falguni.
- CO4: Explain the dialogue of drama Fulguni.
- CO5: Discuss about the song of drama Falguni.
- CO6: Discuss about the structure of drama Krishnakumari.
- CO7: Discuss about the character of drama Krishnakumari.
- CO8: Explain the Trajic thought of drama Krishnakumari.
- CO9: Discuss about the dialogue of drama Sita.
- CO10: Explain the character of drama sita.
- CO11: Discuss about the historical drama of GoirikPataka.
- CO12: Discuss about the character of drama GoirikPataka.
- CO13: Explain the Dialogue of drama GoirikPataka.

### **COURSE – Bengali one act play**

- CO1: Give a critique on Rajpuri.
- CO2: Give a critique on Chutyananda.
- CO3: Give a critique on Saressreep.
- CO4: Give a critique on EkpaslaBristi.
- CO5: Give a critique on Aswathama.

### **COURSE – Essays by Bankim Chandra Chattopaddhya**

- CO1: Give the critique on gGitikabbo.
- CO2: Give the critique on Anukaran.
- CO3: Explain the comparison of Sakuntala Miranda o Desdimona.
- CO4: Explain the Bharatbarserswadhinota o paradhinota.
- CO5: Analysis the essay of Babu.

### **COURSE – Chhinnopatra- Collection of letters by Rabindranath Tagore**

- CO1: Give a critique on 16 number letter.
- CO2: Give the critique on 30 number letter.

- CO3: Give the critique on 49 number letter.  
CO4: Analysis the 80 number letter.  
CO5: Discuss about the 92 number letter.  
CO6: Explain the style of Chhinnopotra.  
CO7: Compare between chinnopotra and ammiels journals.

**COURSE – Essaya 20 TH Century**

- CO1: Give a critique on PitamohaRamjoyTarkabhusan.  
CO2: Discuss about the Apabiggan.  
CO3: Discuss about the Sukhna Dukkha.  
CO4: Discuss about the jatiyojibongothonasahittersthan.  
CO5: Discuss about the DukkhantoParinoti o SanskritoSahittyo.

**COURSE –Essays 20 th century**

- CO1: Critique on Adhunik jug o Rabindranath.  
CO2: Critique on MonerDutiBhasa.  
CO3: Critique on Sahityo Samassa.  
CO4: Discuss on Bharotiyo Sanskriter Gorar Kotha.  
CO5: Discuss on Banglar Nabajagoran o Vidyasagar.

**COURSE – Essays – Collected by Pramatha Chowdhury**

- CO1: Discuss on Bartaman Banga Sahitya.  
CO2: Discuss on Bharatchandra.  
CO3: Discuss on Boipora.  
CO4: Explain the essay of Sadhubhasa o Cholitobhasa.  
CO5: Explain with examples the writing style of Pramatha Chowdhury.

**COURSE – Sahitto (Essays) – Collected by Rabindranath Tagore**

- CO1: Discuss on Sahitter Samogry.  
CO2: Explain the essay of Sahitter Tatparya.  
CO3: Discuss on Sahitter Bicharak.  
CO4: Discuss on Soundaryabodh.  
CO5: Discuss on Oitihasic Upannas.  
CO6: Explain the authentic views of Rabindranath.  
CO7: Critique on Sahityo.

**COURSE – Kabbojingshasha – Atul Chandra Gupta**

- CO1: Explain the classical Sanskrit.  
CO2: Discuss on western aesthetics.  
CO3: Compare between Sanskrit aesthetics and western aesthetics.

**COURSE – Essays – Collected by Abanindranath Tagore**

- CO1: Discuss about the essay of Dristi o sristi.  
CO2: Discuss about the silpo o bhasa.  
CO3: Discuss about the essay of Soundaryer Sandhan.  
CO4: Explain the essay of Antar bahir.  
CO5: Discuss about the Asundar.  
CO6: Discuss about the Arup na Rup.  
CO7: Give a critique on Bageswari Shilpo Prabandhabali.

**COURSE – literary Movement**

- CO1: Discuss about the movement of Sur-realism.  
CO2: Discuss about the Symbolism.  
CO3: Discuss about the Narratology.  
CO4: Discuss about the Structuralism.  
CO5: Discuss about the Faminism.  
CO6: Explain the Psycho-analysis.



### **COURSE – Creative writing**

CO1: Explain their connection with Bengali literature.

CO2: Students have to write essays on various topics of Bengali literature.

### **COURSE – Special paper choice of four clusters are offered**

CO1: Discuss about the Folk Culture.

CO2: Discuss about the various type of Folk – culture.

CO3: Compare between the Modern culture and Folk culture.

CO4: Discuss about the Folk superstition.

### **COURSE – Folk literature**

CO1: Compare between literature and folk literature.

CO2: Explain the various type of folk literature.

CO3: Discuss about the folk language.

CO4: Discuss about the Nursery poem.

CO5: Discuss about the Riddle.

CO6: Discuss about the Ballad.

CO7: Discuss about the Folk Drama.

CO6: Discuss about the Folk Song.

### **COURSE – Folk literature (Essays) –Collected by Rabindranath Tagore**

CO1: Discuss about the Chalabulano Chara.

CO2: Discuss about the Grammosahitto.

### **COURSE – Banglar Brata – Collected by Abanindranath tagore**

CO1: Discuss about the Sejuti Brata.

CO2: Discuss about the various type of brata.

### **COURSE – Mymensingha Gitika**

CO1: Discuss about the Chandrabati Pala.

CO2: Discuss about the character of chandrabati pala.

CO3: Discuss about the structure of chandrabati pala.

Students get special knowledge on their selected special paper.

## **COURSE OUTCOME – BENGALI M.A**

### **COURSE-Linguistics**

Co1: Discuss about Old Indo Aryan Language.

Co2:Discuss in details about Middle Indo Aryan Language

Co3:Discuss in details about New Indo Aryan Language

### **COURSE-History Of Bengali People( Ancient and Mediavel Bengal)**

Co 1 Explain the history ,culture,religious belief of Bengali people

Co 2:Discuss about Sufism and its impact on Bengali literature

Co 3:Discuss on shakta cult in reference with eighteenth century Bengal

Co 4:Discuss on Baul cult and its impact on Bengali poetry

Co 5:Discuss onNathSahitya,Arakan Rajsabhar sahitya,Mongal sahitya,Shakta Padabali,Kabi gaan

### **COURSE-Charyapadabali**

Co 1:Discuss about Charyapadas in reference with socio -cultural aspect of ancient bengal

Co 2:Assess the literary values of Charya padas

Co 3:Discuss about padakartas (poets) of charyapadas

### **COURSE-Srikrishnakirtan Kabya**

Co 1:Discuss about Srikrishnakirtan Kabya in reference with its socio -cultural aspect

Co 2:Critique on Bansi khanda of Srikrishna kirtan Kabya

Co 3: Critique on Radha biraha of Srikrishna kirtan Kabya

**COURSE-Vaishnava Padabali**

Co 1: Assess the literary values of Vaishnava Padabali

Co 2: Evaluate the importance of Vaishnava poets in perspective of medieval Bengal

**COURSE-Srichaitanya charitamrita**

Co 1: Explain the main features of Gauriya Vaishnava darshan

Co 2: Discuss in details about Adilila 4<sup>th</sup> part of Srichaitanya charitamrita

Co 3: Discuss in details about Madhyalila 8<sup>th</sup> part of Srichaitanya charitamrita

**COURSE-Bengali essays in nineteenth and twentieth century Bengal**

Co1: Discuss the importance of Fort William College oriented writers in development of 19<sup>th</sup> century Bengali verse

Co 2: Assess the importance of Rammohan Roy in development of nineteenth century Bengali essays

Co 3: Assess the importance of Vidyasagar in development of Bengali essays

Co 4: Assess the importance of Pramatha Chowdhury in development of Bengali essays in late nineteenth century

Co 5: Evaluate the essays of Annadasankar Roy in perspective of twentieth century Bengali literature

**COURSE-Selected essays**

Co 1: Explain the essay Banglar itihās

Co 2: Assess the essay Monpassant, Chekhov, Rabindranath

Co 3: Evaluate the concept of “shiksha” and “sanskriti” of suniti Kumar Chattopadhyay in the light of essay siksha osanskriti-

**COURSE-Kamalakanter daftar-by Bankimchandra**

Co 1: Explain the text of Kamalakanter Daftar

Co 2: Assess the literary importance of Kamalakanter Daftar

Co 3: Analyse the style of Bankimchandra in Kamalakanter Daftar

**COURSE-Sakuntala-by Vidyasagar**

Co 1: Compare the text “sakuntala” of Vidyasagar with Kalidasa ‘s Abhigyanam sakuntalam’

Co 2: Analyse the style of Vidyasagar in the text “Sakuntala”

Co 3: Explain the literary value of the text “Sakuntala”

**COURSE-Socio-Linguistics**

CO 1: Explain Bengali phonetics with suitable examples.

CO2: Explain Bengali morphology with suitable examples.

CO3: Discuss in details about Bengali syntax.

CO4: Discuss on scope of socio-linguistics of Bengali language.

**COURSE – Meghnadbadh Kavya by Madhusudan Dutt**

CO1: Analyse the text Meghnadbadh Kavya in the light of nineteenth century Bengal Renaissance.

CO2: Assess the literary value of Meghnadbadh Kavya

CO3: Explain the poetic style of Madhusudan Dutt in Meghnadbadh Kavya.

CO4: Assess Meghnadbadh Kavya as a tragedy epic.

**COURSE – Babarer Prarthona by Shankha Ghosh.**

CO1: Assess the text Babarer Prarthona in the perspective of socio-political condition of 1960’s Bengal.

CO2: Explain the poems of Babarer Prarthona in the light of classical Sanskrit mythology.

CO3: Assess the poetic style of Shankha Ghosh in Babarer Prarthona.

**COURSE – Banalata Sen By Jibanananda Das.**

CO1: Discuss the book Banalata Sen in the light of sur-realism.

- CO2: Discuss about the poetic imageries of the book Banalata Sen.  
CO3: Assess the poetic style of Jibananda in Banalata Sen.  
CO4: Discuss Banalata Sen in perspective of 21<sup>st</sup> century Bengali literary movement.

**COURSE –Chitra By Rabindranath Tagore.**

- CO1: Discuss about the romanticism lies in the writings of the book Chitra.  
CO2: Discuss about the philosophic thought of Rabindranath in Chitra.  
CO3: Assess the poetic value of the poems of Chitra.

**COURSE – Rakta Karabi By Rabindranath Tagore.**

- CO1: Discuss Rakta Karabi as a symbolic drama.  
CO2: Discuss the philosophic thought of Rabindranath in Rakta karabi.  
CO3: Analyse the character of Raja, Busu, Nandini, Ranjan in the light of symbolic drama.  
CO4: Assess the importance of the songs used in drama Rakta Karabi.  
CO5: Explain the significance of the title of this drama.  
CO6: Explain the structure of the drama Rakta Karabi.

**COURSE – Chaturanga By Rabindra Tagore.**

- CO1: Assess the importance of Chaturanga in course of Bengali novel.  
CO2: Explain the structure of the novel Chaturanga.  
CO3: Discuss the philosophic thought of Rabindranath revealed in Chaturanga.  
CO4: Analyse the characters of Sachis, Sribilas, Damini in Chaturanga.  
CO5: Analyse the title of the novel.  
CO6: Assess Chaturanga in the perspective of early 20<sup>th</sup> century Bengal.

**COURSE – Short stories by Rabindranath Tagore.**

- CO1: Analyse the story Post Master.  
CO2: Analyse the super natural element of the story Kshudhito Pashan.  
CO3: Explain the romanticism of the story Aak Ratri.  
CO4: Expalin the intellectualism revealed in the story Laboratory.  
CO5: Discuss Kabuliwala as a short story.

**COURSE – Fictions of 19<sup>th</sup> & 20<sup>th</sup> century Bengali literature.**

- CO1: Evaluate the importance of Swarnakumari Devi in 19<sup>th</sup> century Bengali fictions.  
CO2: Evaluate the works of Tarashankar Bandyopadhyay  
CO3: Discuss about novels of Manik Bandyopadhyay.  
CO4: Discuss about writings of Satinath Bhaduri.  
CO5: Evaluate the short stories of Narendranath Mitra  
CO6: Evaluate the short stories of Subodh Ghosh and compare his works with Manik Bandyopadhyay.  
CO7: Discuss about writing of Mahasweta Devi.  
CO8: Discuss about short stories of Samaresh Bose.

**COURSE – Krishnakanter Will by Bankimchandra Chattopadhyay.**

- CO1: Discuss about the structure of novel, Krishnakanter Will.  
CO2: Analyse the character of Rohini in Krishnakanter Will.  
CO3: Analyse the character of Gobindolal in Krishnakanter Will.  
CO4: Analyse the character of Bhramar in Krishnakanter Will.  
CO5: Analyse the title of the novel Krishnakanter Will.  
CO6: Critique on Krishnakanter Will in the aspect of socio-cultural life of 19<sup>th</sup> century Bengali.

**COURSE –Novel Aranyak by Bibhutibhushan Bandyopadhyay**

- CO1: Critique on treatment of nature in novel Aranyak.  
CO2: Analyse the character of Satyacharan as an alter ego of novelist.  
CO3: Assess the male characters of the novel Aranyak.  
CO4: Assess the female characters of the novel Aranyak.

CO5: Discuss about the structure of novel Aranyak.

**COURSE – Selected short stories of 20<sup>th</sup> century.**

CO1: Critique on short story Tarini Majhi

CO2: Discuss the crisis of the story, 'stove'.

CO3: Critique on short story Banajyotsna.

CO4: Assess the story Budhni as a short story.

CO5: Discuss the story Sana Baurir Kathakata.

**COURSE –History of Bengali drama of 19<sup>th</sup> & 20<sup>th</sup> century.**

CO1: Discuss about life & work of Ramnarayan Tarkaratna.

CO2: Discuss about dramas & farces of Dinabandhu Mitra.

CO3: Assess the importances of Jyotirindranath Tagore in course of Bengali drama.

CO4: Assess the historical drama of Dwijendralal Roy.

CO5: Assess the patriotic drama of Dwijendralal Roy.

CO6: Evaluate Manmatha Roy as a dramatist.

**COURSE –Selected dramas of 19<sup>th</sup> & 20<sup>th</sup> century.**

CO1: Assess Bur Salikher Ghare raon in a course of Bengali farce.

CO2: Explain the characters of Bur Salikher Ghare raon.

CO3: Assess Jana as a legendary drama.

CO4: Evaluate the character of Jana as a tragic character.

CO5: Evaluate Jana as a devotional drama.

CO6: Assess Nabanna in the light of Gana Natya Andhyolon.

CO7: Explain the characters of drama Nabanna.

CO8: Evaluate Nabanna as theatre of social realism.

**COURSE –Classical Indian aesthetics.**

CO1: Discuss about 'Riti' with suitable examples.

CO2: Identify the difference between Riti & Style.

CO3: Discuss in details about Dhawani.

CO4: Discuss in details about Rasa.

CO5: Analyse different Lakshana of Bhaba.

**COURSE – Western theories of criticism.**

CO1: Discuss in details about Romantic Movement and its impact on 19<sup>th</sup> century Bengali literature.

CO2: Explain Historical criticism.

CO3: Analyse the novel Rajshingha in the light of historical criticism.

CO4: Discuss the main features of post structuralism.

CO5: Discuss about comparative criticism and its impacts on Bengali literary criticism.

**COURSE – Poetics by Aristotle**

CO1: Explain the features of Greek Tragedy in the light of poetics.

CO2: Discuss the features of epic in the light of poetics.

CO3: Identify the difference between tragedy & epic in reference with Aristotle's poetics.

CO4: Explain Mimesis Theory in reference with Aristotle's poetics.

CO5: Discuss the construction of Greek Tragedy in reference with poetics.

**COURSE –Theory of translation, Transformation & Literary inspiration.**

CO1: Compare novel Rajarshi with drama Bisharjan in the light of transformation.

CO2: Compare between the two editions of Rajani by Bankimchandra Chattopadhyay.

CO3: Discuss about eastern & western influence on Madhusudan Dutt.

CO4: Discuss about eastern & western influence on Rabindranath Tagore.

CO5: Discuss about eastern & western influence on Jibanananda Das.

CO6: Critique on various translation of Meghdoot (Purba Megh).

## **HISTORY**

### **Sample for course outcomes of the course – History of India from Earliest times to the end of 12<sup>th</sup> Century.**

#### **Sources of Early Indian History**

CO1 – Discuss the Literary source of Sources of Early Indian History

CO2 - Discuss the Archaeological source of Sources of Early Indian History

#### **Harappan Civilization**

CO1 – Describe the significance of early Harappan phase

CO2 – Describe the Harappan trade

CO3 – Discuss the decline of urbanization

#### **Vedic Civilization**

CO1 – Discuss the Indo- Aryans problems

CO2 – Discuss the economy and society of Vedic Civilization

CO3 – Classify early and Later Vedic texts

CO4 – Classify the varna and religion of Vedic Civilization

#### **State formation**

CO1 – Discuss the causes of the rise of Buddhism and Jainism

CO2 – Discuss the background of the rise of Buddhism and Jainism

#### **The Empire**

CO1 – Discuss the features of the Mourya Dynasty

CO2 – Discuss the nature and characture of Ashokas Dharma

CO3 – Describe the features of Maurya art and architecture

#### **Post Mauryan India**

CO1 – Discuss the political achievement of Goutomiputra Satakorni

CO2 – Narrate the brief history of the achievement of Kaniska

#### **Gupta and Vakataka period in Indian History**

CO1 – Discuss the revenue system of the Gupta period

CO2 – Discuss the military conquest of Samudra Gupta

CO3 – Describe the Agrarian system of the Gupta period

#### **Expantion of the Gupta Empire**

CO1 – Discuss the causes of then downfall of the Gupta period

CO2 – Discuss the Literature , science , Art and Architecture of Gupta period

#### **Regional Confederation in North and South India**

CO1 – Describe the economic and social structure of South India

#### **Southn India**

CO1 – Narrate briefly the history about the administrative structure of North India.

## **HISTORY**

### **Sample for course outcomes of the course – History of India 1200 – 1765 A.D**

#### **Discuss the Sultanate Period in Medieval India.**

- CO1 – Describe Sources of Medieval Indian History
- CO2 – Discuss the reign of Iltutmish as real founder
- CO3 – Classify Balban's theory of kingship
- CO4 – Writedown economic reforms of Allauddin Khilji
- CO5 – Describe military conquests of Allauddin Khilji
- CO6 – Discuss administrative and economic reforms of Muhammad-Bin-Tughlaq
- CO7 – Identify How far responsible of Muhammad-Bin-Tughlaq of the downfall of Delhi Sultanate
- CO8 – Describe reforms of Firoz Saha Tughlaq
- CO9 – Writedown achievements of Krishnadeva Roy
- CO10 – Classify chief features of Bhakti and Sufi movements

#### **Discuss the Mughal period in Medieval Indian History**

- CO1 – Babar was soldier of fortune not an architect of the empire discuss
- CO2 – Writedown chief features of Sher Shah's administration
- CO3 – Describe Rajput policy of Akbar
- CO4 – Discuss Akbar's Mansabdary system
- CO5 – Writedown chief features of Din-in-ilahi
- CO6 – Classify Role of Nurjahan during the reign of Jahangir
- CO7 – Discuss the north west and central asian policy of Sahajahan
- CO8 – Discuss Sahajahan's reign making the climax of the Mughal dynasty and empire
- CO9 – Discuss Aurangjeb decean policy
- CO10 – Discuss Aurangjeb Rajput policy
- CO11 – compare between Akbar and Aurangjeb Rajput policy

#### **Discuss the Mughal Administration System :**

- CO1 – Describe Land revenue system of the Mughal
- CO2 – Discuss Akbar's North and South India expedition
- CO3 – Discuss the Trade and Commerce system of the Mughal Dynasty
- CO4 – Discuss the characterist of the Zamindar class
- CO5 – Discuss the role of caste and religion peasent revolution
- CO6 – Discuss the causes of the decline of Mughal Dynasty
- CO7 – Discuss the art and architecture of the mughal empire
- CO8 – Discuss the miniature painting of the mughal empire

#### **Company in Bengal Discuss the Rise of power of East – India**

- CO1 – Discuss the causes of the battle of plassey
- CO2 – Discuss the causes of the battle of Buxer
- CO3 – Discuss the political and economic significance of the compact of Dewani
- CO4 – Discuss the significance of Bengali and Persian literature
- CO5 – Discuss the features of the Sibhaji's administration
- CO6 – Discuss how co. Took the Dewani power

- CO7 – Discuss the role of Dual system of government in Bengal
- CO8 – Classify Private trade and its characteristic
- CO9 – Identify the causes dissatisfaction between Mirqasim and English East India Company.

## **HISTORY**

### **Sample for course outcomes of the course - Greek History and Civilization, 510 BCE-356 BCE.**

#### **The Greek Polis**

- CO1 – Describe Origins and characteristics of polis
- CO2 – Describe structure of the Polis
- CO3 – Identify the Assembly of Citizens, the Council , and the Magistrates of the Polis:
- CO4 – Classify causes of the decline of the Polis:

#### **Social and economic organization of Polis**

- CO1 - What is Metics, Periocci, and slaves?
- CO2 – Describe Helots, and other servile classes role in the economy of the polis
- CO3 – Describe Economic life of Citizens and Metics of the polis

#### **The Spartan oligarchy**

- CO1 – Identify Social of the Spartan polity
- CO2 - Describe Spartan discipline and education
- CO3 - Describe Spartan women, and army organization
- CO4 – Describe the Peloponnesian League and its structure of the Spartan

#### **Athenian democracy**

- CO1 – Identify evolution of the Athenian constitution
- CO2 – Describe constitutional reforms under Ephialtes and Pericles

#### **The Athenian Empire**

- CO1 - Growth of Athenian sea-power
- CO2 - The causes of the Persian War
- CO3 – Describe the role of Herodotus of the Persian War
- CO4 – what is the confederacy of Delos

#### **Domestic and Foreign Affairs: War and Peace**

- CO1 – Classify Features of the Greek economy in the Hellenic Age:
- CO2 – Describe Features of Athenian foreign policy of expansion:
- CO3 – What is Delian League:
- CO4 – Describe the significance of the Thirty years peace

#### **The Peloponnesian war**

- CO1 – How the Peloponnesian league are established
- CO2 - Pereclean Strategy of the Peloponnesian war

- CO3 – Describe the causes and effect of Plague
- CO4 – Describe Periclean funeral and moral conviction of the Peloponnesian war

### **Historiography of the War and the Heroes**

- CO1 - Thucydides views of the Peloponnesian war
- CO2 - The Origin and character of the Peloponnesian war
- CO3 – Describe the Pericles strategy
- CO4 - Describe the political , economic and cultural system of the Greece
- CO5 - Classify the rise of Cleon
- CO6 – Describe the cause of Mytilene revolt
- CO7 – Describe the cause of the down fall of the Mytilene revolt
- CO8 – Write down about Cleon and Diodotus debate between the Mytilene revolt

### **History as a discipline in classical Greece**

- CO1 – Describe Herodotus view of the Peloponnesian war
- CO2 – Describe Thucydides as a historian
- CO3 – Describe Herodotus as a historian
- CO4 – Write down the contrast between Herodotus
- CO5 – Describe logographer’s history

### **Greek thought, drama, and art**

- CO1 – who are a Sophists
- CO2 - origin and characteristics of the Greek tragedy
- CO3 – Describe Socrates as a Philosopher
- CO4 – Describe Aeschylus as a Philosopher
- CO5 – Describe Sophocles as a Philosopher
- CO6 – Describe Aristophanes as a comedian
- CO7 – Describe the art and architectural of Greek
- CO8 – Describe the sculpture and painting of Greek

## **HISTORY**

### **Sample for course outcomes of the course - The History of Medieval Europe,800 – 1200**

#### **A.D**

#### **Islam and the Carolingian Empire**

- CO1 - Identify Mohammed and Charlemagne
- CO2 – Describe Pirenne thesis:
- CO3 – Classify Charlemagne inconceivable without Mohammed
- CO4 – Describe Frankish institutions under Charlemagne

#### **The darkest hour in the West**

- CO1 – Describe dissolution of the Charlemagne empire
- CO2 – Identify what is Norseman, Magyars ?
- CO3 – Describe The significance of Norse migrations in history

#### **Birth and development of the German Empire**

- CO1 – Describe Revival of German kingship under Henry the Fowl and Otto I;
- CO2 – Describe long term consequences of German involvement in Italy:
- CO3 – Classify Frederick Barbarossa and Italian politics:
- CO4 – Describe Growth of the Italian communities-imperfect defeat and recovery.

#### **Church reform and rise of the Papacy**

- CO1 – Classify condition of the church since Charlemagne;
- CO2 – Describe Cluny and monastic revival
- CO3 – Identify Gregory VII, Henry IV, and the Concordat of Worms:
- CO4 – Describe the political triumph of the Papacy in Western Christendom.

#### **The Church and the people**



- CO1 – Describe the new monastic orders of the twelfth century;
- CO2 – Describe the contribution of the monasticism to western civilization;
- CO3 – Identify The Friars, the Orsicans, and Dominicans and their influence
- CO4 – Describe popular religious movements and the growth of heresy;
- CO5 – Describe Albigensian Crusade and the Inquisition;

### **The emergence of national kingship**

- CO1 – Describe Frederick and the imperial tragedy
- CO2 – Classify Medieval European feudal System
- CO3 – Describe Italy Philip Augustus, St. Louis,
- CO4 – Describe the growth of a strong monarchy in France
- CO5 – Describe why national monarchies in France and England

### **The evolution of the feudal society**

- CO1 – Describe what is feudal society?
- CO2 – Describe Features of feudalism in Western Europe in the twelfth and the thirteenth centuries
- CO3 – Identify what is vassalage and fief:
- CO4 – Describe barons and knights:
- CO5 – Describe Growth and decay feudalism

### **The medieval economy**

- CO1 – Describe the manor, its origin and growth:
- CO2 – Classify Population, agriculture and industry-
- CO3 – Describe trade in the early Middle Ages; revival of trade, and factors in the commercial revolutions:
- CO4 – Describe the question of the economic growth in Europe in the twelfth and thirteenth centuries

### **The rise of burgesses and towns**

- CO1 – Identify origin and growth of the medieval towns:
- CO2 – Describe permanent establishment of merchants in towns:
- CO3 – Describe the burgesses; town constitutions
- CO4 – Describe the development of guilds and industrial organization
- CO5 – Describe the impact of guilds on production and economic growth.

### **Patterns of culture in Medieval Europe**

- CO1 – Describe thought and the Schoolmen Scholastic philosophy and science in the Middle Ages:
- CO2 – Classify The Medieval Universities
- CO3 – Describe literature and art
- CO4 – Describe transition from Romanesque to Gothic style;
- CO5 – Describe the rise of new vernacular literature from epic romance.

## **HISTORY**

### **Sample for course outcomes of the course – history of india , (1765 – 1964)**

#### **East India company's territorial expansion in India**

- CO1 – Identify Company,s Relations with Avadh, Rohilkhand , Mysore , the Marathas , and the Sikhs

**CO2 – Identify the relationship between the company trade and territorial acquisitions**

**CO3 – Discuss** the growth of an administrative framework in India

**CO4 – Discuss** about Regulating Act to the Queen's Proclamation

Relations with Avadh, Rohilkhand, Mysore, the Marathas, and the Sikhs :

Relationship between the Company's trade and territorial acquisitions :

### **Colonial economic and social policies in India**

CO1 – Write down about commercialization of agriculture

CO2 – **Identify** deindustrialisation

CO3 – Classify the growth of modern industries and emergence of a new working class

CO4 – **Discuss** peasant uprisings like Chuar, Sannyasi-Fakir, Kol, Santhal etc.

CO5 – **Discuss about** Deccan Riots

#### **'The Revolt of 1857**

CO1 – **Identify the cause of the Revolt of 1857**

CO2 – **Discuss about the failure and impact of the Revolt**

CO3 – **Discuss the characteristic of the Revolt**

### **Indian response to colonial social policies**

CO1 – **Identify the role of** Rammohan Ray, Vidyasagar, and the young Bengal Movement

CO2 – Classify Brahmo, Farazi, and Wahabi Movements

CO3 – **Discuss** the debate about an Indian 'renaissance'

### **Early phase of the Indian freedom movement**

CO1 – **Discuss about** Partition of Bengal and Swadeshi Movement

CO2 – **Discuss the** Morley-Minto Reforms

CO3 – Analyse the demand and for separate electorate

CO4 – Describe the main features of Lucknow Pact

### **The Gandhian era**

CO1 – Explain the reasons behind Gandhi's rise

CO2 – Analyse how Gandhi reacted to Rowlatt Act

CO3 – Describe the Character and trends in the Non-Cooperation Movement:

CO4 – Describe various stage of Civil Disobedience Movement

CO5 – Write down the ideological trends in the Indian National Congress

### **Pre-war political developments and the Partition**

CO1 – Describe the role of Subhas Chandra Bose and the INA:

CO2 - Write down the significance of Government of India Act of 1935

CO3 – Explain the activities of Cripps Mission, the Wavell Plan, and the Cabinet Mission

### **India between 1947 and 1964**

CO1 – Describe the integration of the Princely states

CO2 – Describe the foreign policy of Nehru

CO3 – Discuss about NAM

CO4 – Explain the causes of Kashmir Problem.

## **History**

### **Sample for course outcomes of the course – History of Europe, 1789-1945**

#### **French Revolution**

- CO1 – Discuss the Social and economic condition of the French Revolution
- CO2 – Discuss the Aristocratic Revolt in France
- CO3 – Discuss the rise of Napoleon Bonaparte
- CO4 – Causes and effects of 1830 Revolution
- CO5 – Causes and effects of 1848 Revolution
- CO6 - The Vienna Congress, the Concert of Europe

#### **Society and economy in 19<sup>th</sup> century Europe**

- CO1 - Discuss The causes and effect of the Crimean War
- CO2 - Discuss The unification of Italy
- CO3 – Discuss Difference in the industrialization process between England and the continental powers like France, Germany and Russia

#### **The age of Nationalism**

- CO1 – Discuss reforms of Alexander 2<sup>nd</sup>
- CO2 – Discuss the significance of the edict of emancipation of 1861, 19<sup>th</sup> Feb
- CO3 – Discuss the features of Bismark's foreign policy
- CO4 – Discuss the internal Policy of Bismark
- CO5 – Discuss the causes of the 2<sup>nd</sup> Balcan war

#### **First World War**

- CO1 – Discuss Early Utopia Socialist thought Marxism
- CO2 – Classify art, literature, and science with special reference to Romanticism and its culture and political aspects
- CO3 – Discuss Colonial conflicts as a background to the outbreak of World War 1<sup>st</sup>:

#### **Second World War**

- CO1 – Discuss the French search for recruits
- CO2 – Identify Rise of Fascism in Italy
- CO3 – Identify Rise of Fascism in Germany
- CO4 – Discuss origins of the Russian Revolution and the success of the Bolsheviks:

#### **World War 2<sup>nd</sup> and the Quest for Peace**

- CO1 – Discuss the outbreak of the second world war
- CO2 – Identify the cause of the war
- CO3 - Write down about the quest for peace
- CO4 – Discuss the evolution of the UNO

## **History**

### **Sample for course outcomes of the course-The Making of the Contemporary World (1945-c.2000)**

#### **The Cold War**

CO1 – Identify origins of the cold war

CO2 – Describe emergence of the American and Soviet blocs

#### **Bipolarism and regional conflicts**

CO1 – Describe The Stalin and the post-Stalin eras

CO2 – Describe The European scene (Hungary, Czechoslovakia, Poland) and Asia and Latin America (Vietnam, Korea, Cuba):

CO3 - Describe Afghanistan diplomacy of the big Power

#### **Imperialism in transition**

CO1 – Discuss the emergence of the third world

CO2 - The impact of the Cold War on the Third World:

CO3 - Problems of economic development in the Third World:

#### **The rise of Communist China**

CO1 - Changes in world politics-the second Cold War-d'entante

#### **The oil politics of post-War world-OPEC and the imperialist strategy**

CO1 – Discuss the role of OPEC in the post war world

CO2 – Narrate of the rise Arab Nationalism

#### **De-Stalinisation and Soviet politics From Khrushchev to Gorbachev**

CO1 – Discuss the brief history of Glasnost and Perestroika

CO2 - Describ the history of the reunification of Germany:

#### **Globalisation**

CO1 – Discuss the socio-economic and cultural impact of the third world

#### **NAM**

CO1 - Identify its rise and growth

CO2 – Describe the Third World's reaction to the domination of the USA and the UNO

CO3 - Rise of regional organisations like ASEAN and SAARC

#### **India's foreign policy**

CO1 – Describe India's foreign policy in the post-War world-Nehru and post-Nehru eras-relation with the USA and the USSR

CO2 - Classify India and her Asian neighbours

CO3 - Describe China,Pakistan, Bangladesh, and Sri Lanka

## **History**

### **Sample for course outcomes of the course- HISTORY OF EAST ASIA, 1839-**

**1949**

#### **CHINA**

- CO1 – Do you think that opium was the occasion and not the cause of the war
- CO2 – Discuss the condition and signification of the treaty of Nanking
- CO3 – Discuss the nature of Chinese traditional society and china's Pre-modern economy
- CO4 – Describe the significance of the tribute system
- CO5 – Classify chief features of the Canton trade and its decline
- CO6 - Discuss treaty system of China (1842 – 1860 ).
- CO7 – Identify Nature and character of Taiping Rebellion
- CO8 – Discuss the causes of the downfall of the Taiping Rebellion
- CO9 – Describe the causes of the Boxer Rebellion
- CO10 – Discuss the causes of the downfall of Boxer Rebellion
- CO11 – Discuss the nature of consortium developed by western powers to construct railway in China
- CO12 – Discuss the brief note on 4<sup>th</sup> May Movement in China
- CO13 – Discuss the importance of Dr. Sun Yat Sen's three principles
- CO14 - Discuss the causes of the success of the communists in China
- CO15 – Brief account of Long March.

#### **JAPAN**

- CO1 – Describe socio economic condition of Japan
- CO2 – Explain the system of Shogunate
- CO3 – Discuss the causes of the downfall of Shogunate
- CO4 – Identify what led to the rise of the Zaibatsu in Japan
- CO5 – Discuss Washington Conference really limit Japan's naval strength
- CO6 – Discuss the Sino-Japan war
- CO7 – Explain the significance of Simonosiki
- CO8 – Describe causes of the Russo-Japan war
- CO9 – Identify the chief features of Japanese constitution
- CO10 – Discuss the nature and character of Meiji restoration.

## **Philosophy.**

## **PAPER-I**

### **INDIAN PHILOSOPHY**

- CO.1- Describe the basic features of Indian Philosophy.
- Co.2- Explain Carvaka's Indriyatmavada
- Co.3- Describe in short the four noble truth of Baudha philosophy.
- Co.4- Explain Jaina theory of Anekantabada.
- Co.5- Describe the Vaisesika concept of Abhava.
- Co.5- Distinguish between Prama and Aprama.
- Co.6- Discuss the Naya view of perception and its classification.
- Co.7- Explain the place of God in the Naya Philosophy.
- Co.8- Explain the Sankhya conception of Prakriti and the proofs for it's existence.
- Co.9- Outline the Sankhya theory of evolution.
- Co.10- Explain the nature and forms of Yoga.
- Co.11- Define Arthapatti as source of knowledge.
- Co.12- Relate Bramha and Jiva after Ramanuja.
- Co.13- Write down the understanding meaning of the Advaita statement 'The Worlds is false'
- Co.15- Explain Suddhadvaita Vedanta of Vallabha.

## **PAPER-II :**

### **HISTORY OF WESTERN PHILOSOPHY**

- Co. 1- Brief outline of Pre Socratic Philosophy
- Co.- Discuss Socratic Method
- Co. 3- Describe Plato's Theory of Good and its relation to God
- Co.4- Discuss Aristotle criticism about Plato's theory of Form.
- Co.-5 Explain the nature of method used by Decart's in his Philosophical Investigation.
- Co.6- Discuss the classification of Ideas as made by Decartes.
- Co.7- Explain Decarte's Theory of Knowledge and critical exposition.
- Co.- 8 Discuss the proofs given by Decartes for proving the Existence of God.
- Co. 9- Define Spinoza's concept of substance.
- Co.10- what is attribute according to Spinoza.
- Co.11- Discuss how modes are related to another.
- Co.12- Explain Spinoza's dictum "Determination negation"
- Co.13- Discuss the doctrine of monads as propounded by Leibnitz.
- Co.14- Discuss the importance of the theory of pre established harmony in the Philosophy of Leibnitz.
- Co.- 15- Explain Leibnitz concept of reason and truths of facts.
- Co.-16 Discuss the two fundamental logical principles formulated by Leibnitz and their Metaphysical Implication.
- Topic- Empiricism, Critical Philosophy and Phenomenology.
- Co.- 17 Discuss refutation of innate Idea as profounded by John Locke.
- Co.- 18- Discuss Locke's theory of Idea and their classification.
- Co.- 19- Discuss how Locke established Representative Realism by means of his theory of Ideas
- Co.-20- Mention the different grades of knowledge as propounded by Locke.
- Co.-21- Distinguish between the Primary and secondary qualities of Locke.

- Co.22- Discuss Berkeley's arguments against Locke's theory of Abstract Idea.  
Co. 23- Explain after Berkeley the rejection of the distinction Primary and secondary qualities.

### **Paper-III**

#### **PSYCHOLOGY & PHILOSOPHY OF MIND AND SOCIAL & POLITICAL PHILOSOPHY**

- Co.1- Outline the experimental method as it's used by psychologist.  
Co.2. Compare and contrast between Sensation and perception.  
Co.3- Specify the marks of good memory.  
Co.4- Discuss Gestalt theory of learning with reference to classical example.  
Co.5- explain and examine Thorndike's theory of learning 'trial and error'.  
Co.6- Discuss B.F Skinner theory of operant conditioning.  
Co.-7- explain and examine the main theory's of Behaviorism.  
Co.- 8.- Show the relation between political and social philosophy.  
Co.9- explain different forms of social institutions and their importance our social life.  
Co.10- Write short note on state and nation.  
Co.-11 Define example Gandhiji's concept of non-violence.  
Co.-12- explain the relation between invalidity and truth.  
Co- 13- Explain fully the concept of freedom with special reference to the view of Marx.

### **Paper – IV**

#### **WESTERN LOGIC**

- Co.1- Explain the relation between the invalidity and truth.  
Co.2- Outline the rules of obverse.  
Co.3- State and explain the law of different kinds of opposition.  
Co.4- State and explain the rule of valid Disjunctive categorical syllogism.  
Co. 5- State and explain the rule of valid Hypothetical – categorical syllogism.  
Co.6- Write down the example of Modus Ponens and Modus Tollens.  
Co.7.- Determine the value of unscientific Induction.  
Co.8- Discuss the two principle theories about probability.  
Co.9- Example with illustration the inductive method of probability.  
Co.10- State and explain the addition theorem of the probability calculus.  
Co.11- Explain and illustrate the nature of Dilemmatic arguments.  
Co.12- Describe the criteria for appraising analogical arguments.

### **PAPER -V**

#### **Tarkasangraha of Annambhatta**

- CO 01. Annambhatta's definition of Padartha, Dravya and Guna.  
CO 02. Definition of Smriti as following Dipika Tika.  
CO 03. Annambhatta distinguish Between Smriti And Anubhava.  
CO 04. Annambhatta's definition of Prama.  
CO 05. Annambhatta does not consider Yathartha Smriti to be a kind of Prama.  
CO 06. Discussion about whether according to this definition the cognition " there potness in the pot" can be called Prama.  
Co.7- Explain Annambhatta's definition of Buddhi.  
Co.8 Elucidate the different kind of sannikarsas with suitable example.  
Co.9- Explain two views about 'KARANA'.  
Co. 10- Explain parartha- pramanyavada.

- Co. 11- Distinguish between sakti and Laksana.
- Co.12- Explain the definition of upamiti .
- Co.13- State and explain the marks of sat –hetu.
- Co.14- Elucidate the definition of Upadhi.

## **Paper-VI**

### **ETHICS**

- Co.I- Define Ethics or write down the definition and scope of ethics.
- Co.2- Compare and contrast moral and non-moral action.
- Co.3- Discuss the nature and characteristics of moral judgments.
- Co.4- Specify what exactly is the object of moral Judgement.
- Co.5- Compare and contrast between psychological hedonism and ethical hedonism.
- Co.6- Discuss Kant’s Deontological Moral theory.
- Co.7- Explain the arguments advanced by Peter Singer against racial consciousness.
- Co.8- Write down an essay on caste system of India.
- Co.9- Analyze the main principles of Deep-Ecology.
- Co.10- Explain and examine the arguments for and against Euthanasia.
- Co.11- Discuss “ Suicide is a moral crime”
- Co.- 12- outline the Indian concept of ‘Purusartha’
- Co.13- Outline the core concept of Applied Ethics.
- Co.14- Write down the different theories of punishment.
- Co.15- Assess whether discrimination on the basis of Gender or caste is approte.

## **PAPER – VII**

### **Philosophy of Language, Epistemology and Metaphysics**

- CO – 01: Discuss the scope of Definition.
- CO – 02: Comment on this statement that “there is no clear difference between the analytic and synthetic.
- CO – 03: Explain with illustration the different kinds of possibility and impossibility.
- CO – 04: Compare and contrast between knowledge by acquaintance and knowledge by description.
- CO – 05: Explain the conditions of philosophical knowledge.
- CO – 06: Compare Empiricism with Rationalism.
- CO – 07: Describe Kants’ critical theory.
- CO – 08: Discuss the different theories of truth – correspondence, coherence and pragmatic theories of truth.
- CO – 09: Define determinism and explain its main tenets. Discuss why self contrast determinism from freedom.
- CO – 10: Explain critically Aristotle’s theory of universal.
- CO – 11: Describe Ptato’s theory of universals.
- CO – 12: Explain and examine the common sense view of substance.
- CO – 13: Write down what you know about Representative Realism.
- CO – 14: Explain the view called Naive Realism.
- CO – 15: Compare and contrast Naive Realism and Scientific Realism.



- CO – 16: Explain why Phenomenologist consider the term ‘Sense data’ preferable to: (a) Ideas,  
(b) sense experience, (c) Sensation.
- CO – 17: Explain and examine Berkeley’s thesis ‘Esse est percipi’.
- CO – 18: Explain the meaning of Law of Nature. Find out the distinctive between laws and theories.
- CO – 19: Describe the Scientific Explanation.

### **Paper-VIII**

#### **PHILOSOPHY OF RELIGION AND PHILOSOPHICAL CLASSICS/ESSAY-WRITING**

- Co.1- Explain the nature of Religion.
- Co.2- Describe the different view about the religion Analyses the different theories about of origin of Religion.
- Co.3- Write down the characteristics of the universal Religion.
- Co. 4- out-line the nature of Religious conciseness.
- Co.5- Critically estimates the merits and demerits of cosmological arguments.
- Co.6- Discuss the western theories Naturalism and positivism against the existence of God.
- Co.7. Elucidate Jain and Buddha arguments for God.
- Co. 8- Distinguish after Russell between appearance and reality.
- Co.9- Explain Descartes method of systematic doubt following Russell.
- Co.-10- Describe how Russell refute Idealism.
- Co.11- Analyse and assess Russell’s theory of truth.
- Co.-12 – Describe how Russell’s set a limit to philosophical knowledge.
- Co.-13- Explain Russell’s position regarding the nature of universal.
- Co14- Describe the deferent view about the relation of Magic and Religion.

### **Political Science**

#### **Paper – I History of Political Thought**

After successful completion of this course the students will acquire knowledge of western and Indian Political Thought. They will be able to answer questions on these fields and these are the possible course outcomes...

- CO1 What are the main features of Western and Indian ancient Political Thought ?
- CO2 What are the main features of Western and Indian Medieval Political Thought ?
- CO3 Write about the contribution of Hobbes, Lockes and Rousseau .
- CO4 Describe the substance of Utilitarianism .
- CO5 Classify Socialism .
- CO6 Write about the contribution of Raja Rammohan Roy .
- CO7 Write a comparative analysis of the ideas of Nationalism of Bankimchandra , Vivekananda and Rabindranath Tagore .

- CO8 Explain the ideas of Doctrine of Synthesis (S.C. Bose) and Radical Humanism (M.N. Roy) .
- CO9 Describe Gandhi's theory of Trusteeship .
- CO10 Write down B.R. Ambedkar's concept of Social Justice .

### **Paper – II Government and Politics in India**

After successful completion of this course the students will learn about the philosophical basis of Indian Constitution, Rights and duties of Indian Citizens and structures and functions of the Indian Executive, Legislatures and Judiciary. Other features of Indian Politics like Political Parties, Political defection, Interest Groups also be learnt by the students. Possible course outcomes are...

- CO1 Write down the Constitutional evaluation in India .
- CO2 Describe the Fundamental Rights and Duties of the Indian citizen .
- CO3 Analyse the nature and Characteristics of the Indian Federalism .
- CO4 Write a comparative analysis of the power and status of Indian President and Prime Minister .
- CO5 Describe the role of the cabinet and council of Minister in India .
- CO6 Write down the formation and functions of the Indian Legislature .
- CO7 Describe the role and power of the Chief minister of State Government.
- CO8 Write the composition and functions of the Supreme Court, High Court .
- CO9 Describe the role of Caste and tribe, religion-communalism as the cleavages of Indian Politics .
- CO10 Write about the Women's Movements, Human Rights Movements and Environmental Movements in India .

### **Paper – III Political Theory**

After successful completion of this course the students will attain thorough knowledge about Political Theory, different approaches to the study of politics, some basic Political Theory and concepts like Political power Authority, Nationalism and Internationalism, Democracy and Marxian Approaches to the study of politics and Marxism. They will be able to answer questions like these...

- CO1 Describe different approaches to the study of politics .
- CO2 Write about the idealist, individualist and Socialist theories of the state.
- CO3 Mention the difference between power and Political Authority .
- CO4 Describe the concepts of Nationalism and Internationalism .
- CO5 Classify Democracy .
- CO6 Write about the Marxian approach to study of politics .
- CO7 Analyse dialectical and historical materialism .
- CO8 Write about the theory of class and class struggle .
- CO9 Describe contribution of Lenin and Mao in Marxism .
- CO10 Write down the objectives of Socialist Society .

### **Paper – IV Comparative Governments and Politics**

After successful completion of this course the students will attain knowledge about the Government and Politics of UK,USA,Switzerland and people's Republic of China. They will be able to answer questions like these...

- CO1 What is the necessity and significance of studying Comparative Politics.
- CO2 Make a Comparative analysis of Liberal Political System of UK, USA and Switzerland .
- CO3 Write a Comparative analysis between the Legislature of UK and USA .
- CO4 What are the unique features of the Legislature of PRC .
- CO5 Describe the similarities and differences of the party system of UK, USA and PRC .
- CO6 Write about the Rights and duties of the citizen of PRC .
- CO7 Make a Comparative study between the British Crown and American Presidency .
- CO8 Write notes on state Council of PRC, House of Lords of UK and Procuratorate of PRC .
- CO9 Make a comparative analysis of status and power of the British Prime Minister and American President .
- CO10 Write about the direct democratic methods like Referendum and Initiative in Switzerland .

### **Paper – V International Relations**

After successful completion of this course the students will acquire knowledge about International Relations. They will be able to answer questions like these...

- CO1 Write down the nature and Scope of International Relations .
- CO2 Describe the concepts of Balance of Power, Bi-Polarity and Unipolarity, Colonialism and Imperialism .
- CO3 What are the techniques of framing Foreign Policy .
- CO4 Write about Terrorism, Environment Movements and Human Rights Movements .
- CO5 Write about the evolution of Cold War .
- CO6 Analyse the relevance of NAM .
- CO7 Describe the foreign policies of USA & Russia .
- CO8 Write about the success and failures of SAARC, ASEAN & EU .
- CO9 Discuss the basic principles and objectives of India's foreign Policy .
- CO10 Analyse the bilateral relations between India and Bangladesh .

### **Paper – VI Society, State and Politics**

After successful completion of this course the students will be aware of the Society, State and politics in general and Indian Society in special. They will be able to answer questions like these...

- CO1 What are the Social basis of politics ?
- CO2 Write about the relationship between State and Civil Society .
- CO3 Define Nationalism and internationalism .
- CO4 What are the basic differences between Nationalism of the west and the Third World .
- CO5 What is social inequality ? Discuss the role of caste and class in Indian society .
- CO6 Write about the impediments of Women's empowerment in India ?
- CO7 Analyse the Non-Marxist and Marxist views on religion .
- CO8 Write about the social changes .
- CO9 Classify Political System .
- CO10 Define Political party, Pressure group and Interest group and describe their role in politics .

### **Paper – VII Public Administration**

After successful completion of this course the students will acquire thorough knowledge of Public Administration in general and Indian Administration in special. They will be able to answer questions like these...

- CO1 Write about the nature and scope of Public Administration .
- CO2 What are the basic differences between comparative Public Administration and Development Administration .
- CO3 Describe the concepts –Hierarchy, unity and Command, span of Control, Delegation and Decentralization .
- CO4 Describe the structure of organization with special mention of Line and Staff and Boards and Commissions .
- CO5 Write notes on decision making, CO-ordination, communication and Accountability .
- CO6 Analyse the Bureaucratic theory of organization of Max Weber .
- CO7 Write about the evolution of Indian Administration .
- CO8 Write about the formation and functions of the organization of the central Government .
- CO9 Describe the organization of the State Government .
- CO10 Write about the organization and major functions of Panchayats and Municipalities . (With particular reference to West bengal)

### **Paper – VIII Colonialism and Nationalism in India**

After successful completion of this course the students will acquire knowledge about Colonialism and Nationalism in India. They will be able to answer questions like these...

- CO1 Write a brief note on Liberal and Marxist approach to the study of Nationalism in India.
- CO2 Discuss on Major Constitutional developments and Legal foundation of Colonial India.
- CO3 Write a brief note on Aims and nature of Social and Religious(special reference to Brahma Samaj, Arya Samaj and Aligarh) movement.
- CO4 Discuss on Causes and effects of Great Revolt in 1857.
- CO5 Discuss the role of Moderates, Extremists and Revolutionary radicals in the National Movements.
- CO6 Evaluate the Role of Gandhi in Indian National Movement.
- CO7 Write a brief note on Role of Congress alternatives (special reference to Socialists and Communists) in Indian National Movements.
- CO8 Brief note on Social and Political Movements special reference to Women's, Dalit, Peasant and Working Class Movements.
- CO9 Write a note on nature of Communalism in Indian Politics.
- CO10 Evaluate the Role of last phase(special reference to Azad Hind Fauz, INA Trial and RIN uprising) of Indian National Movement.

## **English**

OLD ENGLISH LITERATURE AND THE HISTORY OF ENGLISH LANGUAGE

- CO1 How have the foreign languages influenced the formation of English as the language we know today?
- CO2 How have Native resources contributed in the evolution of the modern English language?
- CO3 How is the social and cultural aspects of Old English documented in the literature of the times?
- CO4 Why is Geoffrey Chaucer considered to be the ‘father of English literature’?
- CO5 What are the aspects of a tragedy? How has the form evolved over the times”?
- CO6 Why do you consider Comedy to be a socially viable form of expression?
- CO7 What is the best form of lyric? How close is lyric to music?
- CO8 Analyze the novel from the perspective of the contemporary times.
- CO9 What are the instruments of ornamentation in literature? How is the rhyme scheme or meter of the lines important in the assessment of a piece of literature?
- CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### ENGLISH LITERATURE 1500 – 1630

- CO1 Why are the plays of Shakespeare relevant even today?
- CO2 What sources did Shakespeare use for his plays?
- CO3 Assess Christopher Marlowe as a dramatist with a difference.
- CO4 Comment on the Sonnet form during the Renaissance in England.
- CO5 What is meant by Metaphysical poetry? Elucidate with reference to Donne and Herbert.
- CO6 Comment on the prose of Bacon.
- CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### ENGLISH LITERATURE 1630 - 1780

- CO1 How did Dryden represent his age?
- CO2 Comment on the rise and flourish of the Gothic novel.
- CO3 Was the art of essay writing at its best during the turn of the century?
- CO4 Assess Milton as a revolutionary poet.
- CO5 Comment on the poetry that was changing at the turn of the century.

CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### ENGLISH LITERATURE 1780 – 1840

- CO1 Comment on the development of the Romantic novel.
- CO2 How were Lamb and Hazlitt different as essayists from their predecessors?
- CO3 The post French Revolutio9n era was witness to a completely different style of poetry. Elucidate.

CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### ENGLISH LITERATURE 1840 – 1900

- CO1 How did the Industrial Revolution influence the art of the novel in English literature?
- CO2 Discuss the Essay as a vibrant modern art form.

CO3 How does Victorian poetry visualize England as a colonizing and scientifically developing nation?

CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### ENGLISH LITERATURE 1900 – 2000

CO1 Discuss the novels of Conrad and Golding as a commentary on the times.

CO2 Trace the development of the English short story and its increasing popularity.

CO3 Enumerate the characteristics of modern and post modern poetry.

CO4 What are the modern schools of drama? How have they succeeded in changing the stage?

CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### INDIAN WRITING IN ENGLISH AND INDIAN WRITING IN TRANSLATION

CO1 Comment on the birth and growth of Indian poetry in English under the aegis of the Raj in India.

CO2 What social commentaries do the modern Indian English Theatre project?

CO3 Assess Anita Desai as a woman writing in Twentieth century in India.

CO4 From Narayan to Khushwant Singh is an interesting journey of the Indian English novel. Elucidate.

CO5 How far is the short story as a genre of Indian English writing successful?

CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### PHONETICS

CO1 What are the different speech organs and how do they function?

CO2 What are vowel sounds and what are consonant sounds?

CO3 What are the methodologies of any successful transcription?

CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

#### AMERICAN LITERATURE AND NEW LITERATURE

CO1 Discuss the development of the novel in American writing.

CO2 What is “American” in the drama of the twentieth century written/performed in America?

CO3 How are slave narratives crucial to the understanding of the American culture?

CO4 what is the contribution of the short – story to American life?

CO5 Why is Whitman regarded as the father of American poetry?

CO6 What impact does Frost create in the development of modern poetry?

CO7 What is the essence of Black poetry and what effect does it have on American lives?

- CO8 Comment on the body of West Indian postcolonial writing.  
CO9 How have the new literatures changed the façade of contemporary English literature?

CREDITS 3 theory classes of 45min duration per week over a period of one year  
1 tutorial class of 1hr duration per week over a period of one year.

## **Education**

### **COURS LEARNIG OUTCOMES FOR YOUR SYLLABUS**

#### **Core Course**

#### **Principles of Education**

##### **UNIT-1**

- CO1- Give the meaning of education.  
Co2- Write down difference between narrower and broader education.  
Co3- Identify the different types of disciplines.  
Co4- Describe the role of education.  
Co5- Identify the various aim of education.  
Co6- Write down education is a social process.

##### **UNIT-2**

#### **FACTOR OF EDUCATION**

- Co1- Describe the different factors of education.  
Co2- Discuss the role of teacher in modern education.  
Co3- Identify the co-curricular activities in school.  
Co4- Write on difference between curriculum and syllabus.  
Co5- Write on relation between teacher and student.  
Co6- Discuss the basic principles of curriculum construction.

##### **UNIT-3**

#### **AGENCIES OF EDUCATION**

- Co2- Classify the agencies of education.  
Co2- Describe the functions of school as a formal agency of education.  
Co3- Discuss the family is the eternal school of life.  
Co4- Describe various types of mass media.  
Co4- Identify audio-aids, visual-aids and audio- visual aids of mass media.  
Co4- Write down state as an educational agency.

##### **UNIT-4**

#### **CHILD-CENTRIC EDUCATION**

- Co1- Write on a short essay on child-centric education.  
Co2- Describe difference between life-centric and child-centric education.

##### **UNIT-5**

#### **PLAY AND PLAY-WAY IN EDUCATION**

- Co1-** Describe the meaning of play.
- Co2-** Write on different between work and play.
- Co3-** Discuss the main principles of basic education.
- Co4-** Identify gifts and occupation that Frobel use in kinder-garden.

## **COUR COUSE**

### **CORE-2**

### **EDUCATIONAL PSYCHOLOGY**

#### **UNIT-1**

- Co1-** Describe the relation between psychology and education.
- Co2-** Mention the function of education psychology.
- Co3-** Identify the various stages of development.
- Co4-** Discuss the difference between growth and development.

#### **UNIT-2**

- Co1-** Discuss the theories of Personality.
- Co2-** Give meaning of emotion.
- Co3-** Discuss the law of habit formation.
- Co4-** Discuss the role of emotion in the education of the child.

#### **UNIT-3**

- Co1-** Discuss the nature of intelligence.
- Co2-** Classification of intelligence test and examples of each type of test.
- Co3-** Discuss critically the various theories of intelligence.
- Co4-** Discuss, indicate different type of attention.
- Co5-** Write on related between attention and interest.
- Co6-** Identify the conditions of attention.

#### **UNIT-4**

- Co1-** Identify various type of learning element.
- Co2-** Give the meaning of Gestalt and uses of this theory in education.
- Co3-** Discuss, in brief B.F.Skinner's theory of operant conditioning and uses its educational bearing.
- Co4-** Discuss, Thordike's major law of learning indicating their application in the class rooms.
- Co5-** Discuss the stage involved in the process of memorization.
- Co6-** Write a short note of forgetting.

## **DEVELOPMENT OF EDUCATION IN MODERN INDIA**

### **COURSE:UNIT 1**

- CO1-** Discuss about A synoptic view of Ancient history of education in India.
- CO2-** Compare between Brahmanik and Buddhist educatin system.
- CO3-** Describe the medieval history of education in India and its importance.
- CO4 -**Importance of Serampore Missionaries activities.
- CO4-** Critically analyse the objectivies and purposes of English education by Lord Macaulay.
- CO5-** Discuss critically the Educational policy of Lord Bentinck in English education.



**CO6-** Evaluation of the Report and recommendations placed by William Adams.

**CO7-** Discuss main recommendations of the Despatch of 1854 and its importance.

**COURSE:UNIT-II**

**CO1-** Contributions of Raja Rammohan and Vidyasagar in social and educational reforms.

**CO2-** Discuss main recommendations of Hunter commission regarding primary and secondary education and these recommendations implemented subsequently.

**CO3-** Estimate the educational reforms brought about by Lord Curzon in higher education and culture.

**CO4-** Contributions of Vivekananda, Rabindranath and Aurobindo in educational reforms.

**COURSE:UNIT-III**

**CO1-** Enumerate the recommendations of Calcutta University commission and evaluate its importance in the present System of education.

**CO2-** Discuss major recommendations of Abbot-Wood report on vocational education.

**CO3-** Evaluate briefly the main proposals of the Sargent committee report for the post-war educational reconstruction in India.

**CO4-** Discuss the main features of Wardha Scheme and also discuss the causes for its failure.

**CO5-** State the recommendations of India University commission about education structure and curriculum.

**CO6-** Explain the recommendations of Secondary Education commission about aim, objectives and structure of secondary education.

**COURSE:UNIT-IV**

**CO1-** Discuss recommendations of India Education commission about the objectives of education in different stages.

**CO2-** Discuss comparative study Kothari commission and Mudaliar commission.

**CO3-** Discuss recommendations of NPE-1986 about reorganization of education at different stages.

**CO3-** Discuss Women education in after independence problems and measure adopted.

**Evaluation and Guidance in education**

**COURSE UNIT-I**

**CO1-** They know about evaluation and its procedure and its utility at the same time.

**CO2-** They would learn how to implement evaluation and all really in different institutions.

**COURSE UNIT-II**

**CO1-** Known about how to make good test

**CO2-** Discuss about different measures of central tendency and their uses.

**CO3-** Discuss general principles of construction of graphs and know about its importance in psychology, education and sociology.

**CO4-** Know about measures of variability and their educational uses.

**CO5-** Describe Idea of Linear Correlation.

**COURSE UNIT-III**

**CO1-** Discuss about Guidance concept and their scope.

**CO2-** Discuss the different types of Guidance.

**CO3-** Describe the Guidance functions at different stages of education.

**CO4-** Describe methods of educational Guidance.

- CO5- Different between Individual and group Guidance.
- CO6- Discuss the implecations of vocational guidance.
- CO7- They understands counseling and its application at different stages.
- CO8- Discuss the major techniques of counseling.
- CO9- Distinguises between directive and non-directive counseling

#### **COURSE UNIT-IV**

- CO1- Know about adjustment and discouse the role of adjustment in human life.
- CO2- Discuss the Maladjustment behavior,which are found among the school children.
- CO3- Discuss the role of a school to control the said behavior.
- CO4- Describe the different types of Maladjustment behavior.
- CO5- Discuss the different causes of Maladjustment.
- CO6- How can they prevent and cure the Maladjstment of the students.

## **Geography**

### **COURSE LEARNING OUTCOMES FOR YOUR SYLLABUS For Under Graduate Syllabus**

#### **Semester-1**

#### **Core Course**

#### **Core -1**

**Students who complete this course will be able to:**

#### **Core T1 - Geotectonics and Geomorphology**

#### **Geotectonics and Geomorphology**

**6 Credits**

#### **Course: Unit I: Geotectonics**

**2 Credits**

C1: Earth's tectonic and structural evolution with reference to geological time scale.

CO<sub>1</sub> –Describe the Earth's tectonic and structure evolution with reference to geological time scale.

CO<sub>2</sub> – Wright down the entire geological time scale, including eras, system, and series.

CO<sub>3</sub> – Briefly explain the geological history of the earth with special reference to geologic time scale.

C2: Earth's interior with special reference to seismology. Isostasy: Models of Airy and Pratt.

CO<sub>1</sub> – Sketch the earth in cross-section, indicating the various zones and thermal and physical state of each.

CO<sub>2</sub> – Explain the discontinuity in identified in a structural layers of Earth.

CO<sub>3</sub> – Describe the difference between the model of J. H. Pratt and G. B. Airy explaining Isostasy and equilibrium of the Earth.

C<sub>3</sub>: Plate Tectonics: Processes at constructive, conservative, destructive margins and hotspots; resulting landforms.

CO<sub>1</sub> – Wright down the unified theory of global tectonics and resultant landforms.

CO<sub>2</sub> – Describe the causes of movement of plates.

CO<sub>3</sub> – Sketch and label the structure of the crustal and Oceanic plates.

CO<sub>4</sub> – Wright down the difference between constructive, conservative and destructive plate margins.

CO<sub>5</sub> – Explain the origin of hotspot and wright down the, how it is worked to plate movement.

- CO<sub>6</sub> – Explain the plate movement can cause earthquakes.
- CO<sub>7</sub> – Describe the movement of plate using the idea of convection cells.
- CO<sub>8</sub> – Describe the origin of folded mountains in the light of plate tectonics.
- CO<sub>9</sub> – Describe the significance of Benioff zone in terms of earthquake intensity.

C<sub>4</sub>: Folds and Faults—origin and types.

- CO<sub>1</sub> – Classify the different types of faults and folds and explain their surface expression.
- CO<sub>2</sub> – Write down the different part of folds and faults.
- CO<sub>3</sub> – Describe between overturned and recumbent fold structures.
- CO<sub>4</sub> – Sketch and explain how a Graben and Horst are formed.
- CO<sub>5</sub> – Identify the mechanism of folding and faulting.

**Course: Unit II: Geomorphology**

**4 Credits**

C<sub>1</sub>: Degradational processes: Weathering, mass wasting and resultant landforms

- CO<sub>1</sub> – Explain relationship between energy and weathering.
- CO<sub>2</sub> – Write down the residues of landforms resulted after the weathering process.
- CO<sub>3</sub> – Write down the direct and indirect role of water in mass movement.
- CO<sub>4</sub> – Explain the major types of mass-movements and their resulted landforms.
- CO<sub>5</sub> – Explain mass movement plays such a significant role in altering the landscape.
- CO<sub>6</sub> – Describe role of gravity as an underlying cause of mass movement.
- CO<sub>7</sub> – Write down the processes of weathering and erosion.
- CO<sub>8</sub> – Identify the different type of mechanical and chemical weathering.
- CO<sub>9</sub> – Write down the landforms resulted after the weathering process.

C<sub>2</sub>: Processes of entrainment, transportation and deposition by different geomorphic agents.  
Role of humans in landform development.

- CO<sub>1</sub> – Explain mechanisms of wind erosion and wind transportation.
- CO<sub>2</sub> – Explain mechanisms of fluvial erosion and fluvial transportation.
- CO<sub>3</sub> – Explain mechanisms of coastal erosion and coastal transportation.
- CO<sub>4</sub> – Explain role of humans in landform development.
- CO<sub>5</sub> – Describe the different processes of different geomorphic agents.

C<sub>3</sub>: Development of river network and landforms on uniclinal and folded structures

- CO<sub>1</sub> – Describe the characteristics of uniclinal structure and folded structure.
- CO<sub>2</sub> – Explain rectangular drainage pattern is developed in the uniclinal structure.
- CO<sub>3</sub> – Describe the characteristics of uniclinal structure and folded structure.
- CO<sub>4</sub> – Describe the landform evolution in uniclinal and folded structure.
- CO<sub>5</sub> – Describe landform evolution and drainage evolution in folded structure.
- CO<sub>6</sub> – State differences between antecedent stream and superimposed stream.
- CO<sub>7</sub> – Explain how inversion of relief takes place in the folded structure.

C<sub>4</sub>: Landforms on igneous rocks with special reference to Granite and Basalt

- CO<sub>1</sub> – Write down the different landforms of Granite and Basalt igneous rocks.

C<sub>5</sub>: Karst landforms: Surface and sub-surface. Coastal processes and landforms.

- CO<sub>1</sub> – Write down the various karst and coastal processes.
- CO<sub>2</sub> – Explain the sinkholes and dolines are developed in the karst landscape.
- CO<sub>3</sub> – Write down the difference between shoreline features of erosion and deposition.
- CO<sub>4</sub> – Identify the characteristic features related to shoreline of emergence and shore line of submergence.

C<sub>6</sub>: Glacial and fluvio-glacial processes and landforms; fluvio-glacial landforms

- CO<sub>1</sub> – Write down the various Glacial and fluvio-glacial processes.
- CO<sub>2</sub> – Write down the features resulted from glacial erosion.
- CO<sub>3</sub> – Describe the characteristic of valley glaciers.

C<sub>7</sub>: Aeolian and fluvio-aeolian processes and landforms; fluvio-aeolian processes

- CO<sub>1</sub> – Write down the various Aeolian and fluvio-aeolian processes.
- CO<sub>2</sub> – Describe geometry of various types of sand dunes and how they are formed.
- C<sub>8</sub>: Models on landscape evolution: Views of Davis, Penck, King and Hack
- CO<sub>1</sub> – Describe and suitable example non-cyclic concept of landscape evolution after J. Hack.
- CO<sub>2</sub> – Describe the cyclic concept of landscape evolution after W. M. Davis.
- CO<sub>3</sub> – Write down the difference between cyclic and non-cyclic concept.
- CO<sub>4</sub> – state concept of W. Penck explaining landscape evolution.
- CO<sub>5</sub> – Describe significance of the concept of base level on controlling a stream's activity.
- CO<sub>6</sub> – Describe the difference between W. M. Davis and W. Penck views.
- CO<sub>7</sub> – Explain dynamic equilibrium concept after Hack.

## **Core -2**

### **Core T2 – Cartographic Techniques**

#### **Course: Cartographic Techniques**

**4 Credits**

- C<sub>1</sub>: Maps: Classification and types. Components of a map.
- CO<sub>1</sub> – Classify and types of maps with different keys.
- CO<sub>2</sub> – Describe components of map.
- C<sub>2</sub>: Concept and application of scales: Plain, comparative, diagonal and Vernier
- CO<sub>1</sub> – Classify scale with different keys.
- CO<sub>2</sub> – Describe the concept, merits, demerits and application of different type of scale.
- CO<sub>3</sub> – Write down the different between Direct (positive) and retrograde (negative) Vernier.
- C<sub>3</sub>: Coordinate systems: Polar and rectangular. Concept of geoid and spheroid.
- CO<sub>1</sub> – Write down the properties and differentiate of polar and rectangular coordinate system.
- CO<sub>2</sub> – Describe the concept of Geoid and Spheroid.
- CO<sub>3</sub> – Identify the characters and differentiate of Geoid and Spheroid.
- C<sub>4</sub>: Concept of generating globe. Grids: angular and linear systems of measurement.
- CO<sub>1</sub> – Write down the concept of generating globe.
- CO<sub>2</sub> – Calculate and find out the angular and linear measurement of Grids system.
- C<sub>5</sub>: Bearing: Magnetic and true, whole-circle and reduced.
- CO<sub>1</sub> – Write down the concept and classify the different type of Bearing with different keys.
- CO<sub>2</sub> – Describe the characteristics and merits or demerits of different type of Bearing.
- C<sub>6</sub>: Map projections: Classification, properties and uses. Concept and significance of UTM projection.
- CO<sub>1</sub> – Classify the projections with the different types of keys.
- CO<sub>2</sub> – Describe the principle, properties also merits or demerits and used of the different types projections.
- CO<sub>3</sub> – Describe the concept and significance of UTM projection.
- C<sub>7</sub>: Basic concepts of surveying and survey equipment: Prismatic compass, dumpy level, theodolite, Abney level, clinometer.
- CO<sub>1</sub> – Write down the basic concepts of surveying and noted survey equipment.
- CO<sub>2</sub> – Describe the different source of error of the noted survey instruments.
- CO<sub>3</sub> – Explain the used and write down the merits and demerits of the noted survey Instruments.
- C<sub>8</sub>: Survey of India topographical maps: Reference scheme of old and open series. Information on the margin of maps
- CO<sub>1</sub> – Identify and describe the meaning of different key of Indian topographical maps.
- CO<sub>2</sub> – Write down the characteristics of different physical and cultural features of Indian topographical maps.
- CO<sub>3</sub> – Identify the source of old and open series of Indian topographical maps.
- CO<sub>4</sub> – Describe the information on the margin of maps.

## **Core P2 - Cartographic Techniques Lab**

**Course: Cartographic Techniques**

**2 Credits**

*A Project File, comprising one exercise each is to be submitted*

C<sub>1</sub>: Graphical construction of scales: Plain, comparative, diagonal and Vernier

CO<sub>1</sub> – Draw the different types of scales.

CO<sub>2</sub> – Used the different types of scales.

C<sub>2</sub>: Construction of projections: Polar Zenithal Stereographic, Simple conic with two standard parallels, Bonne's, Cylindrical Equal Area, and Mercator's.

CO<sub>1</sub> – Draw the noted projections.

C<sub>3</sub>: 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.

CO<sub>1</sub> – Draw and interpreted the different type of relief profiles of Indian topographical maps.

CO<sub>2</sub> – Draw and interpreted the relative relief map, slope map (Wentworth) and stream ordering (Strahler) on a drainage basin area of Indian topographical maps.

C<sub>4</sub>: Correlation between physical and cultural features from Survey of India topographical maps. Using transect chart.

CO<sub>1</sub> – Draw and interpreted the correlation between physical and cultural features from survey of topographical maps.

## **PART – II (Honours) PAPERS**

**Paper – III (Honours)**

**Climatology, Soil Geography & Biogeography**

**Full Marks - 100**

**(University Exam – 90 & Internal Assessment – 10)**

**Students who complete this course will be able to:**

**Course: CLIMATOLOGY-I**

C<sub>1</sub>: Composition and layering of the atmosphere.

CO<sub>1</sub> - Describe the major characteristics of different layer of atmosphere with suitable sketches.

CO<sub>2</sub> - Apply their knowledge of atmospheric layers to weathering forecasting.

CO<sub>3</sub> - Explain the atmospheric impact on human Bing.

CO<sub>4</sub> - Tabulate the average composition of the atmosphere.

CO<sub>5</sub> - Bring out the layered structure of the atmosphere on the basis of composition and atmospheric characteristics.

CO<sub>6</sub> - Discuss the climatic elements which influence the lower atmospheric condition.

C<sub>2</sub>: Factors controlling insolation, terrestrial heat balance, horizontal and vertical distribution of temperature, temperature inversion.

CO<sub>1</sub>–Write down the role of different factors in the scattering and absorption of incoming solar radiation.

CO<sub>2</sub>–Explain the spatial pattern of temperature distribution on the earth's surface and its seasonal variation.

CO<sub>3</sub>– Explain the different global pattern of horizontal and vertical distribution temperature with suitable sketches.

CO<sub>4</sub>– Describe the conditions under which different types of temperature inversion occurs on the different height of the atmosphere.

CO<sub>5</sub>–They know that different types of temperature inversion occur.

- CO<sub>6</sub> – They explain the vertical and horizontal distribution of temperature in the different layers of the atmosphere.
- CO<sub>7</sub> – Write down the how the radiation balance and the energy budget are completed.
- CO<sub>8</sub> – Explain the how global surface air temperature has changed in recent past.

C<sub>3</sub>: Planetary wind system: Tricellular model, upper air circulation- Jet stream; Genesis of monsoon.

- CO<sub>1</sub> – Explain how wind are blowing on the earth surface with suitable sketches.
- CO<sub>2</sub> – They know that relationship between global pressure belts and planetary wind system.
- CO<sub>3</sub> – Explain the global pressure belts and state their characteristics in brief.
- CO<sub>4</sub> – Explain the relationship between global pressure belts and planetary wind system.
- CO<sub>5</sub> – Write down the different types of Jet stream and their major characteristics.
- CO<sub>6</sub> – Describe the genesis of Indian monsoon.
- CO<sub>7</sub> – Applied their knowledge, to explain that how jet streams influence on Indian monsoon.
- CO<sub>8</sub> – Explain the influence of jet streams of Indian monsoon.
- CO<sub>9</sub> – Explain how Indian monsoon play on the agricultural practices and economy of the country.

C<sub>4</sub>: Origin and classification of air mass. Origin and characteristics of tropical and temperate cyclones.

- CO<sub>1</sub> – Describe the air mass and classified of the different basis.
- CO<sub>2</sub> – Determined that the different principal factors of the air mass. And also know that, how the air masses get modified.
- CO<sub>3</sub> – Write down the difference between cyclones and anticyclones and also explain their different characteristics.
- CO<sub>4</sub> – Explain the different stage of cyclones and anticyclones development in the tropical and temperate region.
- CO<sub>5</sub> – Apply their knowledge to explain the any type of cyclones and anticyclones which development in the tropical and temperate region.
- CO<sub>6</sub> – Explain the different similarities and dissimilarities between tropical and temperate cyclone.

#### **Course: CLIMATOLOGY-II**

C<sub>1</sub>: Forms and processes of condensation; Mechanism of precipitation.

- CO<sub>1</sub> – Write down the different mechanism processes of precipitation.
- CO<sub>2</sub> – Critically examine the different types of precipitation.

C<sub>2</sub>: Processes and significance of Ozone depletion and greenhouse warming; Southern Oscillation and their significance: El Nino and La Nina.

- CO<sub>1</sub> – Describe the mechanism of El Nino and La Nina.
- CO<sub>2</sub> – Write down the, how human activities may lead to global greenhouse warming and may lead to ozone depletion.

C<sub>3</sub>: Weather forecasting: Basic elements and significance in hazard management.

- CO<sub>1</sub> – Write down the basic elements of weather forecasting and also gain the knowledge of significance in hazard management.
- CO<sub>2</sub> – Apply their knowledge to the weathering forecasting.

C<sub>4</sub>: Classification of World climate: Schemes of Koppen and Thornthwaite

- CO<sub>1</sub> – Describe the Koppen's and Thornthwaite's world climate classification and correspondence of the climatic types with the global vegetation realms.
- CO<sub>2</sub> – Write down the merits and demerits of the above classification.

#### **Course: SOIL GEOGRAPHY**

C<sub>1</sub>: Soil: Definition, soil forming factors and development of soil profiles. Mechanism of formation of podzol, laterite, chernozem and salinealkalinesoils.

CO<sub>1</sub> – Student discuss the development of a soil profile and the properties with special reference to laterite, podzol, chernozem and salinealkaline formation.

CO<sub>2</sub> – To know the factors those are responsible for the development of soil.

C<sub>2</sub>: Properties of soil and their significance in sustaining soil fertility and productivity; Physical properties: Texture, structure, soil porosity, soil water, soil air, soil colour. Chemical properties: pH, Organic Matter, Total Soluble Salt (TSS), Cation Exchange Capacity (CEC) and BaseExchange Capacity (BEC).

CO<sub>1</sub> – Discuss the chemical and physical properties of soil.

CO<sub>2</sub> – Write down the characteristics of different types of soil structure and mention the impacts of structure on soil productivity.

CO<sub>3</sub> – Analyzed the role of soil P<sup>H</sup> and organic matter in determining soil fertility.

CO<sub>4</sub> – Analyzes the differentiated the TSS, CEC and BEC.

CO<sub>5</sub> – Explain, how the colours develop in soils.

CO<sub>6</sub> – Describe the roles of soil moisture and soil organic matter in augmenting soil productivity.

CO<sub>7</sub> – Analyses the roles of N,P and K in plant's growth.

C<sub>3</sub>: Principles of taxonomic soil classification and land capability classification after USDA.

CO<sub>1</sub> – Wright down the classification of soil on the basis of their taxonomic and land capability after USDA.

C<sub>4</sub>: Soil erosion and land degradation: Types and factors, their impacts on soil fertility and their management.

CO<sub>1</sub> – Write down the factors and types of soil erosion and different management methods to control soil erosion.

CO<sub>2</sub> – Explain the methods of soil conservation and soil management or conservation.

CO<sub>3</sub> – Explain various causes of soil degradation.

### **Course: BIO GEOGRAPHY- I**

C<sub>1</sub>: Biogeography: Concept, importance and relevance. Definition of ecology. Ecosystem: Definition, principles and subdivisions.

CO<sub>1</sub> – Explain the structural organization of the biosphere.

CO<sub>2</sub> – Describe the concept, importance and relevance of biogeography.

CO<sub>3</sub> – Classify, Concept, principles and component of ecosystem.

C<sub>2</sub>: Micro-ecosystem: Ponds and Meadows.

CO<sub>1</sub> – Wright down the component and ecosystem of Pond and Meadows.

C<sub>3</sub>: Ecosystem mechanism: Homeostasis and productivity. Biosphere and energy: Energy sources, food chain and food web and energy flow in ecosystem. Ecological Pyramids.

CO<sub>1</sub> – Wright down the different pathways of energy flow in an ecosystem with special reference to grazing food chain and meadows.

CO<sub>2</sub> – Explain the significance of food chain and food wen.

C<sub>4</sub>: Role of soil moisture, organic matter and mineral composition in supplying nutrients and augmenting primary productivity. Bio-Geo- Chemical Cycles: gaseous (Nitrogen, Carbon) and sedimentary(Phosphorous).

CO<sub>1</sub> – Wright down the carbon cycle as it operates in nature with a reference to human interferences.

CO<sub>2</sub> – Describe various phases of Nitrogen and carbon cycle.

CO<sub>3</sub> – Describe the carbon cycle as it operates in nature with a reference to human interferences.

### **Course: BIO GEOGRAPHY- II**

C<sub>1</sub>: Spatial dimensions in Ecology: Definition of Ecotope, Ecotone, Habitat, Biotope and Landscape. Floristic and Zoo geographical realms; Factors of plant ecology: Light, temperature, moisture, wind, soil and topography. Impact of climate and soil on distribution of plants and animals.

CO<sub>1</sub> – Explain the major types of Zoogeographical realms with special reference to India.

CO<sub>2</sub> – Write down the plants adopt under water deficit condition.

CO<sub>3</sub> – Student know that the role of water in plant growth.

CO<sub>4</sub> – Write down the nature of plant's response to light.

CO<sub>5</sub> – Describe how plants react to different conditions of water availability.

CO<sub>6</sub> – Describe roles of soil moisture and soil organic matter in augmenting soil productivity.

C<sub>2</sub>: Classification and characteristics of terrestrial biomes with special reference to tropical rain forests (Selva), temperate grass land (Prairie) and tropical grass land (Savanna).

CO<sub>1</sub> – Explain the classification of terrestrial biomes, their bioclimatic or floral – faunal characteristics and describe their characteristics of with special reference to Selva, Prairies and Savanna biomes.

CO<sub>2</sub> – Write down the interrelationship between tropical and temperate grass lands on the basis of their floral and faunal activities.

CO<sub>3</sub> – Explain the features and biodiversity of tropical rainforest biome.

CO<sub>4</sub> – Describe characteristics of flora, fauna and their interrelationship in tropical and temperate grass lands.

C<sub>3</sub>: Ecosystem disturbance, speciation and extinction; Migration of animals due to habitat destruction in South Bengal with special reference to elephants.

CO<sub>1</sub> – Identify the different factors and cause of animals to migrate.

CO<sub>2</sub> – Classify of the types of animal migration.

CO<sub>3</sub> – Write down the circumstances of the animals migrate.

CO<sub>4</sub> – Describe migration of animals due to habitat destruction in south Bengal with special reference to elephants.

C<sub>4</sub>: Succession of plants; Concept of interaction (Symbiotic, Parasitic, Competition and Predation) among organisms in ecosystem; Conservation of biodiversity and its significance.

CO<sub>1</sub> – Write down the significance of Biodiversity.

CO<sub>2</sub> – Explain the modern principles of nature of conservation.

CO<sub>3</sub> – Describe the concept of interaction among organisms in ecosystem.

CO<sub>4</sub> – Write down the conservation of biodiversity and its significance.

## **PART – II (Honours) PAPERS**

### **Paper-IV: (Honours)**

#### **Geographical Thought & Geography of India**

**Full Marks: 100.**

**(University Exam – 90 & Internal Assessment – 10)**

*Number of lectures to be delivered for each Unit: 20*

*Examination Time: 4 hours.*

**Students who complete this course will be able to:**

#### **Course: GEOGRAPHICAL THOUGHT- I**

C<sub>1</sub>: Definition, scope and content of geography, Concept of space, location, areal differentiation and spatial interaction.

CO<sub>1</sub> – Write down the Definition, scope and content of Geography.

CO<sub>2</sub> – Describe the concept of space, location, areal differentiation and spatial interaction.

CO<sub>1</sub> – Briefly discuss the contents of geography.



**C<sub>2</sub>:**Development of geography in the ancient and mediaeval periods.

CO<sub>1</sub> –Wright down the ancient and mediaeval periods of Geography.

**C<sub>3</sub>:** Development of geography in the 19th century with particular reference to the contributions of Humboldt and Ritter.

CO<sub>1</sub> –Describe the contribution of Humboldt and Ritter to develop the 19<sup>th</sup> century of geography.

CO<sub>1</sub> – Wright down the Humboldt’s contribution to establish the concept ‘Geography is a Science’.

**C<sub>4</sub>:** Development of Geography in the 20th century with special reference to quantitative revolution. Contributions of Indian geographers.

CO<sub>1</sub> –Describe the development of geography in the 20<sup>th</sup> century.

CO<sub>2</sub> –Wright down the merits and demerits of the quantitative revolution.

CO<sub>3</sub> – Describe the contribution of Indian geographers.

**Course: GEOGRAPHICAL THOUGHT-II**

**C<sub>1</sub>:** Concepts of determinism, possibilism and neo-determinism.

CO<sub>1</sub> –Wright down the concept of determinism, possibilism and neo-determinism.

CO<sub>2</sub> – Describe the difference between determinism and possibilism.

CO<sub>3</sub> – Wright down the difference between possibilism and neo – determinism.

**C<sub>2</sub>:** Approaches to geographical studies: Systematic, regional and ecological.

CO<sub>1</sub> –Wright down the different approaches to geographical studies.

CO<sub>2</sub> –Explain the systematic approaches to the geographical studies.

**C<sub>3</sub>:** Approaches to geographical studies: Positivism, humanistic and radical approaches. Behavioural geography and feminism.

CO<sub>1</sub> –Explain the different geographical approaches like positivism, humanistic and radical approaches.

CO<sub>2</sub> – Describe the origin of behavioral approach in geography.

**C<sub>4</sub>:** Emergence and significance of applied geography.

CO<sub>1</sub> –Write down the emergence and significance of applied geography.

**Course: INDIA: PHYSICAL GEOGRAPHY**

**C<sub>1</sub>:** Relief and structure with special reference to Himalayan and the Peninsular India.

CO<sub>1</sub> – Describe the Relief and structure with special reference to Himalayan and the Peninsular India

CO<sub>2</sub> –Write down the difference between Himalaya and Peninsular India on the basis of relief.

**C<sub>2</sub>:** Drainage system: Evolution and characteristics of peninsular and extra peninsular rivers.

CO<sub>1</sub> – Write down the characteristics of peninsular and extra peninsular rivers.

CO<sub>2</sub> – Describe the evolution of Indian drainage system.

CO<sub>3</sub> – Describe the difference between peninsular and extra peninsular rivers.

**C<sub>3</sub>:** Climatic Classification (Koppen) and characteristics. Seasonality, unevenness and unreliability of rainfall.

CO<sub>1</sub> –Wright down the koppen climatic classification and characteristics.

CO<sub>2</sub> – Describe the seasonality of Indian climate, unevenness and unreliability of Indian rainfall.

**C<sub>4</sub>:** Classification(USDA) and characteristics of soil and natural vegetation; Causes and consequences of deforestation.

CO<sub>1</sub> –Wright down the classification (USDA) and characteristics of Indian soil and natural vegetation.

CO<sub>2</sub> –Describe the causes and consequences of deforestation of India.

**Course: INDIA: ECONOMIC GEOGRAPHY**

C<sub>1</sub>: Agricultural policy and development since Independence. Green revolution and food security.

CO<sub>1</sub>– Wright down the Indian Agricultural policy and development since independence.

CO<sub>2</sub> – Explain merits and demerits of green revolution in India.

CO<sub>3</sub> – Wright down the causes of food security.

C<sub>2</sub>: Industrial policy and development since Independence. Locational factors and growth of non-synthetic fiber industries with special reference to jute.

CO<sub>1</sub> –Wright down the Indian industrial policy and development since independence.

CO<sub>2</sub> – Describe the locational factors of jute industry in India.

CO<sub>3</sub> – Describe the growth of non-synthetic fiber like jute industries in India.

C<sub>3</sub>: Development of tourism industry in India, tourist centers and flows of tourists.

CO<sub>1</sub> –Describe the development of tourism industry in India.

CO<sub>2</sub> – Identify the Indian tourist centers and briefly explain the flows of tourists.

C<sub>4</sub>: Population growth since independence and role of human resources in economic development. Population distribution and economic development.

CO<sub>1</sub> – Explain the population growth in India since independence.

CO<sub>2</sub> – Wright down the role of human resources in economic development.

CO<sub>3</sub> – Wright down the population distribution in India.

CO<sub>4</sub>– Describe the relationship between population distribution and economic development in India.

### **Course: INDIA: REGIONAL GEOGRAPHY WITH SPECIAL REFERENCE TO WEST BENGAL**

C<sub>1</sub>: Darjeeling as a physiographic region.

CO<sub>1</sub> –Wright down the physiographical characteristics of Darjeeling (W.B.) region.

C<sub>2</sub>: Paschimanchal of West Bengal.

CO<sub>1</sub> – Wright down the physiographical and cultural characteristics of Paschimanchal of West Bengal.

C<sub>3</sub>: Sundarban and Coastal Plain of Medinipur.

CO<sub>1</sub> –Wright down the physiographical and cultural characteristics of sundarban and coastal plain of West Bengal.

CO<sub>2</sub> – Describe the biodiversity of the sundarban region of West Bengal.

C<sub>4</sub>: Marusthali as a climatic region.

CO<sub>1</sub> – Wright down the physiographical and cultural characteristics of Marusthali of India.

### **Paper – V (Honours)**

#### **(Practical)**

#### **APPLIED & ANALYTICAL GEOGRAPHICAL TECHNIQUES**

#### **Full Marks – 100**

*Number of periods to be assigned for each of the Units: 20*

*Examination Time: 6 hours.*

### **Students who complete this course will be able to:**

#### **Course: SCALE 15 MARKS**

C<sub>1</sub>:Concept of scale: Definition and Types.

CO<sub>1</sub> – Classify and types of scale.

CO<sub>2</sub> – Describe the merits and demerits of the sale.

C<sub>2</sub>:Magnitude of Reduction and enlargement of map and calculation of corresponding scale.

CO<sub>1</sub>– Magnitude of reduction and enlargement of map, also calculation of corresponding scale.

C<sub>3</sub>: Drawing of Graphical scales: linear, comparative (unit), diagonal, and vernier (linear and angular) scales.

CO<sub>1</sub> – Draw the different types of scales.

CO<sub>2</sub> – Used the different types of scales.

C<sub>4</sub>: Calculation of area from map (Graphical Methods).

CO<sub>1</sub> – Calculated area from the map by graphical methods.

**Course: ANALYSIS OF GEOLOGICAL MAPS MARKS-20**

C<sub>1</sub>: Construction of geological section of horizontal, uniclinal and folded structures.

CO<sub>1</sub> – Draw or construction of geological section of horizontal, uniclinal and folded structures.

CO<sub>2</sub> – Explain the surface expression of the horizontal, uniclinal and folded structures.

C<sub>2</sub>: Succession of rock groups.

CO<sub>1</sub> – Highlight the succession of rock groups.

C<sub>3</sub>: Topography and drainage in relation to underlying structures.

CO<sub>1</sub> – Write down the relation between topography and drainage on underlying structures.

C<sub>4</sub>: Geological history.

CO<sub>1</sub> – Describe geological history.

**Course: MAP PROJECTION 20 MARKS**

C<sub>1</sub>: Concept and classification of map projections.

CO<sub>1</sub> – Classify, concept and types of maps projection with different keys.

C<sub>2</sub>: Principle, properties, construction (Graphical / Trigonometric), use and limitations of the following projections

CO<sub>1</sub> – Write down the principle, properties, construction, use and limitations of following projections.

3.2.1 Cylindrical Equal-Area and Mercator's projection.

CO<sub>1</sub> – Draw the noted projections.

3.2.2 Gnomonic, Stereographic and Equal Area projections (polar cases).

CO<sub>1</sub> – Draw noted projections.

3.2.3 Simple Conic (One standard parallel), Bonne's and Sinusoidal projection.

CO<sub>1</sub> – Draw above noted projection.

**Course: SURVEYING & MAPPING 25 MARKS**

C<sub>1</sub>: Concept of Surveying. Traverse Survey by Prismatic Compass (Plotting by Parallel Meridian and Included Angle); Calculation and representation of area.

CO<sub>1</sub> – Write down the basic concepts of surveying and noted prismatic compass survey equipment.

CO<sub>2</sub> – Describe the different source of error of the prismatic compass survey instruments.

CO<sub>3</sub> – Explain the used and write down the merits and demerits of the prismatic compass survey Instruments.

CO<sub>4</sub> – Calculated and plotted or presentation of surveying area, by different method.

C<sub>2</sub>: Construction of profiles by Dumpy Level. Preparation of contour map of a small area by Prismatic Compass and levelling instruments on triangle.

CO<sub>1</sub> – Write down the basic concepts of surveying and noted Dumpy level survey equipment.

CO<sub>2</sub> – Describe the different source of error of the Dumpy level survey instruments.

CO<sub>3</sub> – Explain the used and write down the merits and demerits of the Dumpy level survey Instruments.

CO<sub>4</sub> – Calculated and plotted or presentation of surveying area, by different method.

CO<sub>1</sub> – Calculated and plotted or presentation of contouring of surveying area, by different method.

C<sub>3</sub>: Determination of height [with accessible and inaccessible bases (Same Vertical Plane)] by Theodolite.

- CO<sub>1</sub> – Write down the basic concepts of surveying and noted theodolite survey equipment.  
 CO<sub>2</sub> – Describe the different source of error of the theodolite survey instruments.  
 CO<sub>3</sub> – Explain the used and write down the merits and demerits of the theodolite survey Instruments.  
 CO<sub>4</sub> – Calculated the height and distance of the object.

**Course: Rocks and Minerals Identification Marks 10**

Identification of common minerals and rocks with their characteristics  
 (Megascopic):

Quartz, Feldspar (Plagioclase and Orthoclase), Mica (Biotite and Muscovite), Haematite, Magnetite, Chalcopyrite, Galena, Calcite, Gypsum, Bauxite and Talc.

Granite, Basalt, Dolerite, Pegmatite, Conglomerate, Sandstone, Shale, Limestone, Gneiss, Schist, Phyllite, Quartzite, Marble.

CO<sub>1</sub> – Identify and noted the characteristics of the given rocks and minerals.

**Course: LABORATORY NOTEBOOK & VIVA-VOCE 10 MARKS**

CO<sub>1</sub> – Developed skill.

**Paper – VI (Honours)**

**Population Geography Settlement Geography**

**Regional planning and Remote Sensing & GIS**

**Full Marks – 100**

**(University Exam – 90 & Internal Assessment – 10)**

*Number of lectures to be delivered for each Unit: 20*

*Examination Time: 4 hours.*

**Students who complete this course will be able to:**

**Course: POPULATION GEOGRAPHY -I**

C<sub>1</sub>: Definition, scope and content of population geography; Basic sources of population data. Difference between population geography and demography.

CO<sub>1</sub> – Describe the concept, scope and content of population geography.

CO<sub>2</sub> – Write down the basic sources of population data.

CO<sub>3</sub> – Describe the difference between population geography and demography.

C<sub>2</sub>: Measures of population density. Population growth: Concept, type, changing trend. Spatial variation in developed and developing countries.

CO<sub>1</sub> – Describe different measures process of population density.

CO<sub>2</sub> – Write down the concept, type, changing trend of population growth.

CO<sub>3</sub> – Explain spatial variation in developed and developing countries.

C<sub>3</sub>: Population composition in India: Sex ratio and its determinants, rural urban and caste composition.

CO<sub>1</sub> – Write down the population composition in India.

CO<sub>2</sub> – Describe the measurement processes of sex ratio in India.

CO<sub>3</sub> – Explain different types of rural urban and caste composition.

C<sub>4</sub>: Age composition and its determinants, different structures of Age-Sex Pyramid found in developing and developed countries and their significance.

CO<sub>1</sub> – Describe the different determination processes of Age composition.

CO<sub>2</sub> – Write down the different structures of Age-Sex pyramid found in developing and developed countries and their significance.

**Course: POPULATION GEOGRAPHY -II**

C<sub>1</sub>: Critical analysis of overpopulation, optimum population and under population; Demographic Transition Model.

CO<sub>1</sub> – Describe general concept of overpopulation, optimum population and under population.

CO<sub>2</sub> – Write down the difference between overpopulation, optimum population and under population.

CO<sub>3</sub> – Describe demographic Transition Model.

C<sub>2</sub>: Migration: Types, pattern, streams and consequences on place of destination and origin.

CO<sub>1</sub> – Describe different types and causes of population migration.

CO<sub>2</sub> – Write down the difference between immigration and emigration.

CO<sub>3</sub> – Describe the factors of internal and international migration.

CO<sub>4</sub> – Write down the factors of urban-urban and rural – rural migration.

CO<sub>5</sub> – Describe the advantages and disadvantage of international migration.

CO<sub>6</sub> – State reasons for internal migration in India.

CO<sub>7</sub> – Write down the socio-economic consequences of external migration.

C<sub>3</sub>: Fertility and Mortality: Concept, determinants, different measures and interregional variation in India.

CO<sub>1</sub> – Write down the concept and determinants of fertility and mortality.

CO<sub>2</sub> – Analyzed the different measures of fertility, mortality and interregional variation in India.

C<sub>4</sub>: Concept of HDI and GDI. Population policy in India and China, Population – Resource relationships. Population-Resource regions (Ackerman model).

CO<sub>1</sub> – Describe the concept of HDI and GDI.

CO<sub>2</sub> – Write down the population policy in India and China.

CO<sub>3</sub> – Explain difference between population policy in India and China.

CO<sub>4</sub> – Classify the population – resource regions and describe the population – resource regions according to Ackerman model.

CO<sub>5</sub> – Write down the population – resource relationships.

### **Course: INTRODUCTION TO SETTLEMENT GEOGRAPHY**

C<sub>1</sub>: Settlement: General definition, evolution of settlement, site and situation. Concept of settlement systems.

CO<sub>2</sub> – Explain the general concept of settlement, site, situation and also defined the evolution of settlement of settlement.

CO<sub>2</sub> – Write down the concept of settlement systems.

C<sub>2</sub>: Rural settlement: Type and pattern, factors affecting settlement pattern.

CO<sub>1</sub> – Describe the factors that influence the site, pattern and distribution of rural settlements in India.

CO<sub>2</sub> – Analyze factors responsible for the evolution and growth of rural settlement.

CO<sub>3</sub> – Write down the rural house types influenced by climate, with examples.

CO<sub>4</sub> – Describe factors responsible for the development of economic background of rural settlement.

CO<sub>5</sub> – Describe different types of rural settlement with sketches.

CO<sub>6</sub> – Write down the different patterns of rural settlement.

C<sub>3</sub>: Urban settlement: Definition, size-class distribution and census category.

CO<sub>1</sub> – Write down the difference between rural and urban settlements.

CO<sub>2</sub> – Describe factors for the growth of urban settlements with examples.

CO<sub>3</sub> – Analyzed causes of origin of different types of urban settlement.

CO<sub>4</sub> – Describe problems of urban settlement.

C<sub>4</sub>: Urban Morphology: Concentric Zone, Sector Model, Multiple Nuclei Theory. Urban function and functional classification of urban centers (C.D. Harris, Nelson).

CO<sub>1</sub> – Write down the concept of urban morphology.

CO<sub>2</sub> – Describe concept of urban morphological model of concentric zone, sector model and multiple nuclei theory.

CO<sub>3</sub> – Classify different type of urban centers on their different basis.

CO<sub>4</sub> – Explain different type of urban function.

CO<sub>5</sub> – Classify towns and cities based on their functions.

CO<sub>6</sub> – Classify towns and cities by the C. D. Harris and Nelson.

**Course: REGION, REGIONAL PLANNING AND DEVELOPMENT**

C<sub>1</sub>: Concept of region and regionalization in geography; Types of region: Formal, functional and planning region and methods of their delineation; Hierarchy of regions: Macro, meso and micro regions with suitable examples.

CO<sub>1</sub> – Describe concept of region and regionalization in Geography.

CO<sub>2</sub> – Write down the different types of region on the different bases.

CO<sub>3</sub> – Explain different between formal and functional and planning region.

CO<sub>4</sub> – Describe the hierarchy of regions.

CO<sub>5</sub> – Write down the characteristics and suitable examples of macro, meso and micro regions.

C<sub>2</sub>: Regional Planning: Concept, principle, types and role in regional development. Schemes of regionalization in India: V. Nath (1964), P. Sengupta (1968) and Chandrasekhara (1972).

CO<sub>1</sub> – Write down the concept, principle, types and role of regional development and planning.

CO<sub>2</sub> – Describe the different schemes of regionalization in India – V. Nath, P. Sengupta and Chandrasekhara.

C<sub>3</sub>: Planning: Types and hierarchy. Objectives of physical, economic and environmental planning.

CO<sub>1</sub> – Describe the different types and hierarchy of planning.

CO<sub>2</sub> – Write down the objectives of physical, economic and environmental planning.

C<sub>4</sub>: Concept and purpose of rural and urban planning, centralized and decentralized planning with special reference to Panchayet Raj.

CO<sub>1</sub> – Describe the concept of purpose of rural and urban planning, centralized and decentralized planning.

CO<sub>2</sub> – Write down the difference between rural and urban planning, centralized and decentralized planning.

CO<sub>3</sub> – Explain regional planning of panchayet Raj in India.

**Course: REMOTE SENSING AND GIS**

C<sub>1</sub>: Remote Sensing: Definition, stages and its importance in geographical studies.

CO<sub>1</sub> – Write down the concept, different stages and its importance of remote sensing by the geographical studies.

C<sub>2</sub>: Sources of energy, EMR spectrum (short wave to long wave bands), energy interaction with the atmosphere (scattering, atmospheric window). Energy interactions with the earth surface features (spectral signature).

CO<sub>1</sub> – Write down the different sources of energy.

CO<sub>2</sub> – Describe the concept of EMR spectrum (short wave to long wave's bands).

CO<sub>3</sub> – Explain the energy interaction with the atmosphere (scattering, atmospheric window).

CO<sub>4</sub> – Describe the energy interact with the earth surface features (spectral signature).

C<sub>3</sub>: Satellite, sensor and its function; satellite platforms (ground, air and space); Geostationary and Sun synchronous satellites, Concept of resolution (spatial, spectral, radiometric and temporal resolution).

CO<sub>1</sub> – Describe concept of satellite, sensor and its function.

CO<sub>2</sub> – Explain different types of platforms – ground, air and space.

CO<sub>3</sub> – Describe the different characteristics of geostationary and sun synchronous satellites.

CO<sub>4</sub> – Write down the difference between geostationary and sun synchronous satellites.

CO<sub>5</sub> – Classify and characteristics of the different types of resolution.

CO<sub>6</sub> – Write down the different between spatial, spectral, radiometric and temporal resolution.

C<sub>4</sub>: Geographic Information System (GIS): Definition, scope, concept of map layers in GIS, Data features of GIS: Points, lines and polygon (area). Data structures in GIS, Data Base Management System (DBMS).

CO<sub>1</sub> – Describe the concept and scope of geographic information system (GIS).

CO<sub>2</sub> – Write down the concept of map layers in GIS.

CO<sub>3</sub> – Explain data features of GIS – points, lines and polygon (area).

CO<sub>4</sub> – Write down the data structures in GIS.

CO<sub>5</sub> – Describe concept and characteristics of data base management system (DBMS).

## **Paper-VII (Honours)**

### **(Practical)**

### **CARTOGRAPHIC TECHNIQUES IN GEOGRAPHY**

**Full marks - 100**

*Number of periods to be assigned for each of the Units: 20*

*Examination Time: 6 hours.*

**Students who complete this course will be able to:**

**Pattern of setting Questions: Units 1.0 -4.0 :( two compulsory questions are to be set from each unit; each question may have at least two parts.)**

**Unit 5: Evaluation of Practical Notebook: 5 marks. Viva-voce: 5 marks.**

**Students who complete this course will be able to:**

**Course: INTERPRETATION OF TOPOGRAPHICAL MAPS: PLATEAU AND PLAIN REGIONS MARKS: 20**

C<sub>1</sub>: Characteristics of topographical maps (numbering system and scale).

CO<sub>1</sub> – Write down the characteristics of topographical maps.

C<sub>2</sub>: Construction of profiles: superimposed, projected and composite.

CO<sub>1</sub> – Draws and interpreted the different type of relief profiles of Indian topographical maps.

C<sub>3</sub>: Drawing of representative profiles, broad physiographic divisions and general interpretation.

CO<sub>1</sub> – Draws and general interpretation of representative profiles, broad physiographic divisions.

**Course: MORPHOMETRIC ANALYSIS Marks 20**

### **Instructions for Practical Work**

- Practical works are to be completed in the class room
- Practical Works are to be done in pencil and are to be handwritten and signed by respective class teachers (No need of final sheets).
- Practical Note books will be like those used in other laboratory based science subjects; Binding of note book is not required.

C<sub>1</sub>: Interpretation of relief [Amplitude of relief, Average slope (Wentworth's method) and Ruggedness Index], drainage (Drainage Density, Stream Ordering and Bifurcation Ratio after Strahler) and vegetation characteristics. **(For morphometric technique basic spatial unit would be 1sq. km)**

CO<sub>1</sub> – Draw and interpreted the relative relief map, slope map (Wentworth), drainage (Drainage Density, Stream Ordering and Bifurcation Ratio after Strahler) and vegetation characteristics of Indian topographical maps.

C<sub>2</sub>: Interpretation of settlement (types and patterns), transportation systems (density measurement), Shortest Path Analysis (Shimbel Index).

CO<sub>1</sub> – Draw and interpreted the type and patterns of settlement, transportation systems of density measurement and shortest path analysis of shimbel Index.

C<sub>3</sub>: Relationship between physical and cultural elements.

CO<sub>1</sub> – Identify and write down the properties of relationship between physical and cultural elements.

### **Course: Cartograms [Graphical Construction and Computer Use (MS Excel)] MARKS 15**

C<sub>1</sub>: Linear Diagrams: (Simple, Comparative and Composite). Age-Sex Pyramid (Graphical Methods only)

CO<sub>1</sub> – Draw different types of linear diagrams – simple, comparative and composite by computer application.

CO<sub>1</sub> – Draw and identified the characteristics of the age-sex pyramid by graphical methods.

C<sub>2</sub>: Proportional Diagram: Square and Pie Diagrams.

CO<sub>1</sub> – Draw and interpreted the proportional diagram of square and pie diagrams.

### **Course: ANALYSIS OF CLIMATIC DATA & MAPS MARKS-20**

C<sub>1</sub>: Rainfall Dispersion Diagram.

CO<sub>1</sub> – Draw and interpreted the rainfall dispersion diagram.

C<sub>2</sub>: Climograph, Hythergraph and Ergograph.

CO<sub>1</sub> – Draw, interpreted and implementation of the above noted diagram.

C<sub>3</sub>: Interpretation of weather map (Pre-Monsoon, Monsoon and Winter) (Pressure, Wind, Cloud and Rainfall, Identification of Season).

CO<sub>1</sub> – Interpretation the different sessional weather maps and draw the suitable diagram.

C<sub>4</sub>: Weather Instruments: Reading of Barometer, Hygrometer.

CO<sub>1</sub> – Read and note down the data of the above noted instrument, and also interpreted.

### **Course: LABORATORY WORK & PREPARATION OF SURVEY**

#### **SCHEDULE MARKS-15**

C<sub>1</sub>: Analysis of Soil Texture (Sieve).

CO<sub>1</sub> – Analysis the soil texture by sieve.

C<sub>2</sub>: Determination of soil pH by soil kit.

CO<sub>1</sub> – Determination of soil P<sup>H</sup> by soil kit.

C<sub>3</sub>: Preparation of Survey Schedule and collection of Primary Data (20 Household Units)

CO<sub>1</sub> – Prepare the survey schedule and skill development for primary data collection.

### **Course: LABORATORY NOTEBOOK AND VIVA- VOCE MARKS-10**

CO<sub>1</sub> – Skill developed.

### **Paper-VIII (Practical)**

#### **Modern techniques in Geography and Remote Sensing & Geographic Information System**

**Full marks: 100**

*Number of periods to be assigned for each of the Units: 20*

*Examination Time: 6 hours,*

**Pattern of setting Questions: Units 1 and 2: (two compulsory Questions are to be set from each Unit; each Question is to have at least two parts).**



**Unit 3 and 4: (one compulsory questions has to be attempted).**

**Unit -5: Evaluation of Field Report: 10, Viva-voce: 10.**

**Unit-6: Evaluation of Practical Notebook: 5 marks. Viva-voce: 5marks.**

**Students who complete this course will be able to:**

**Course: DATA COLLECTION AND REPRESENTATION MARKS: 20**

C<sub>1</sub>:Data: Classification, collection, tabulation. Concept of Sampling.

CO<sub>1</sub> – Classify, collection and tabulation of the data.

CO<sub>2</sub> – Describe the concept of sampling.

C<sub>2</sub>:Frequency distribution: Graphical representation (histogram, frequency polygon, curve and ogives).

**Instructions for Practical Work**

- Practical works are to be completed in the class room
- Practical Works are to be done in pencil and are to be hand written and signed by respective class teachers (No need of final sheets).
- Practical Note books will be like those used in other laboratory based science subjects; Binding of note book is not required.

CO<sub>1</sub> – Calculate and suitable diagram of interpretation of the above problem.

C<sub>3</sub>:Measures of central tendencies: Mean, median and mode; Skewness. Characteristics of Normal Distribution; Partition Value (Quartile,Dacile and Percentile).

CO<sub>1</sub> – Measures the different central tendencies and their uses.

CO<sub>2</sub> – Write down the characteristics of normal distribution.

CO<sub>3</sub> – Calculate the partition value of quartile, Dacile and percentile.

C<sub>4</sub>:Measures of dispersion and variability: Range, quartile deviation, mean deviation and standard deviation, co- efficient of variation.

CO<sub>1</sub> – Measures different dispersion and variability – range, quartile deviation, mean deviation and standard deviation and co-efficient of variation.

**Course: DATA ANALYSIS AND INTERPRETATION MARK-25**

C<sub>1</sub>:Simple correlation and regression (bivariate data). Scatter diagram and fitting of straight line by least square method, product moment correlation coefficient, And Rank Correlation Coefficient.

CO<sub>1</sub> – Calculated the different statistical techniques mention the above.

CO<sub>2</sub> – Find out the correlation between two or more variables.

C<sub>2</sub>: Measures of Inequality: Location quotient, Lorenz curve (Spatial Data), Gini coefficient,

CO<sub>1</sub> – Calculated and suitable diagram the different statistical techniques mention the above.

CO<sub>2</sub> – Interpreted application the above techniques.

C<sub>3</sub>: Time Series Analysis (Moving Average and Regression).

CO<sub>1</sub> – Calculated and interpreted the moving average and regression.

C<sub>4</sub>: Rank-size rule, Crop combination (Weaver), Nearestneighbour analysis.

CO<sub>1</sub> – Calculated and applied the above statistical techniques.

**Course: Satellite image interpretation & GPS Tracking (Laboratory Work): Marks-20**

C<sub>1</sub>: Reference scheme of IRS satellite data: L3 and L4 images. Procedure of indenting procedure.

CO<sub>1</sub> – Identify and Interpreted the L3 and L4 satellite FCC image.

C<sub>2</sub>: Visual interpretation of satellite images.

CO<sub>1</sub> – Identify and visual Interpreted the L3 and L4 satellite FCC image.

C<sub>3</sub>: Change detection from satellite images and maps using visual techniques.

CO<sub>1</sub> – Indentified the change detection and Interpreted the comparative study of satellite images and topographical map.

C<sub>4</sub>: Principles of Global Positioning System (GPS), Reading at Survey Points and Graphical Plotting.

CO<sub>1</sub> – Write down the global positioning system (GPS).

CO<sub>2</sub> – Reading at survey points and Graphical plotting.

**Course: FIELD REPORT [WRITTEN REPORT (15) + VIVA VOCE ON FIELD REPORT (10)]; TOTAL MARKS-25**

C<sub>1</sub>: One mouza (Rural /Urban) is to be selected and the followings are to be done:

a) Plot-to-plot land use survey (Depending on Objectives).

b) Collection of socio-economic and physical data.

c) Classification and tabulation of data.

d) Preparation of map on cadastral plan (Depending on Objectives).

e) Preparation of maps and diagrams showing physiography, drainage, soil, forest, settlement, irrigation, cropping pattern, demographic characteristics etc.

f) Correlation and analysis of data, maps, and diagram.

CO<sub>1</sub> – Working ability development.

**C<sub>1</sub>: A report is to be prepared under the following sections:**

a) Introduction: Objective, extent and space relations, sources of information, methodology etc.

b) Physical components: Lithology, drainage, surface condition, slope, climate, soil vegetation, etc.

c) Population: Number, sex ratio, literacy, occupational structure, ethnic and religious composition, language, mobility, media exposure, per capita income etc.

d) Settlement: Number of houses, building materials, number and size of rooms, amenities etc.

e) Agriculture: Soil properties, irrigational facilities, general land use, cropping intensity, crop-combination, use of fertilizer, production and marketing etc.

f) Other economic activities: Fishing, horticulture, brick-making industries.

g) Problems, prospects, suggestions and conclusion.

h) Bibliography.

C<sub>2</sub>: Field report is to be hand-written (Bengali/ English).

CO<sub>1</sub> – Writing skill developed.

C<sub>3</sub>: Text of the report should not exceed 5,000 words.

CO<sub>1</sub> – Writing limitation skill developed.

C<sub>4</sub>: Maps and diagrams excluding photo-plates should not exceed 20 A4- size pages (Diagrams may be drawn in MS-Excel).

CO<sub>1</sub> – Skill and mental sharpness developed.

**Course: Preparation of Laboratory Note Book + Viva Voce Marks-10**

CO<sub>1</sub> – Skill developed.

## Mathematics

### CC1

#### Unit-I

CO1 Hyperbolic functions, higher order derivatives, Leibnitz rule

CO2 Applications of Leibnitz Rule to problems of type  $e^{ax+b}\sin x$ ,  $e^{ax+b}\cos x$ ,  $(ax+b)^n\sin x$ ,  $(ax+b)^n\cos x$

- CO3 Concavity and inflection points
- CO4 Envelopes
- CO5 Asymptotes
- CO6 Curve tracing in cartesian coordinates
- CO7 Curve tracing in polar coordinates of standard curves
- CO8 L'Hospital's rule and related Problems
- CO9 Applications of L'Hospital's rule in business, economics and life sciences.
- PO Understand the basic concept and apply these to various problems.

#### Unit-II

- CO10 Reduction formulae, derivations and illustrations of reduction formulae
- CO11 Reduction formulae of the type  $\int \sin nx \, dx$ ,  $\int \cos nx \, dx$ ,  $\int \tan nx \, dx$ ,  $\int \sec nx \, dx$ ,  $\int (\log x)^n \, dx$ ,  $\int \sin^n x \cos^m x \, dx$ ,
- CO12 Problem solving
- CO13 Parametric equations, parameterizing a curve
- CO14 Arc length of a curve, arc length of parametric curves
- CO15 Area under a curve, area and volume of surface of revolution
- CO16 Problem Solving
- CO17 Techniques of sketching conics.

#### Unit-III

- CO18 Reflection properties of conics
- CO19 Rotation of axes and second degree equations
- CO20 Classification of conics using the discriminant
- CO21 polar equations of conics.
- CO22 Problem Solving
- CO23 Problem Solving
- CO24 Spheres
- CO25 Problem Solving
- CO26 Cylindrical surfaces
- CO27 Problem Solving
- CO28 Central conicoids
- CO29 Paraboloids
- CO30 Plane sections of conicoids
- CO31 Generating lines
- CO32 Problem solving
- CO33 Classification of quadrics
- CO34 Problems related to quadrics
- CO35 Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

#### Unit-IV

- CO36 Differential equations and mathematical models
- CO37 General, particular, explicit, implicit and singular solutions of a differential equation
- CO38 Exact differential equations and integrating factor
- CO39 Separable equations and equations reducible to this form
- CO40 Linear equation and Bernoulli equations
- CO41 Special integrating factors and transformations.
- CO42-CO60 Tutorial

## CC2

### Unit-I

- CO1 Complex numbers
- CO2 Polar representation of complex numbers
- CO3 nth roots of unity
- CO4 De Moivre's theorem for rational indices
- CO5 Application of De Moivre's theorem
- CO6 Problem Solving
- CO7 Polynomials, Theory of equations
- CO8 Relation between roots and coefficients
- CO9 Transformation of equation
- CO10 Descartes rule of signs
- CO11 Cubic equations and Cardan's method
- CO12 Biquadratic equation and Ferrari's method
- CO13 Problem Solving
- CO14 Inequality:
- CO15 The inequality involving  $AM \geq GM \geq HM$
- CO16 Cauchy-Schwartz inequality.
- CO17 Problem Solving

### Unit-II

- CO18 Relations, Equivalence relations
- CO19 Functions
- CO20 Composition of functions, Invertible functions, one to one correspondence and cardinality of a set.
- CO21 Well-ordering property of positive integers, division algorithm
- CO22 Divisibility and Euclidean algorithm
- CO23 Congruence relation between integers
- CO24 Principles of Mathematical induction, statement of Fundamental Theorem of Arithmetic.

### Unit-III

- CO25 Linear Equations and System of Linear equations
- CO26 Row reduction and row echelon forms
- CO27 Problem Solving
- CO28 Vector equations, the matrix equation  $Ax=b$
- CO29 Solution sets of linear systems
- CO30 Applications of linear systems, linear independence
- CO31 Problem Solving

### Unit-IV

- CO32 Introduction to linear transformations
- CO33 Matrix of a linear transformation
- CO34 Inverse of a matrix, characterizations of invertible matrices.
- CO35 Vector Space, Subspaces of  $R^n$
- CO36 Dimension of subspaces of  $R^n$ , Rank of a matrix
- CO37 Problem Solving
- CO38 Eigen values, eigen vectors and characteristic equation of a matrix
- CO39 Problem Solving

CO40 Cayley-Hamilton theorem and its use in finding the inverse of a matrix.  
CO41-CO60: Tutorial

### Paper -III

CO1 Scalar triple products and vector triple products, product of four vectors  
CO2 Reciprocal sets of vectors. Application of vectors in mechanics, geometry and trigonometry.  
CO3 Vector equations of straight lines and planes.  
CO4 Volume of a tetrahedron, shortest distance between two skew lines in vectors.  
CO5 Ordinary derivative of vector. Space curves, parametric equations.  
CO6 Continuity and differentiability.  
CO7 Partial derivatives of vectors. Differential of vectors  
CO8 Elements of differential geometry. Frenet Srenet's formula.  
CO9 Application of vector calculus in mechanics particularly  
CO10 Application of vector calculus to planetary motions.  
CO11 Gradient, divergence and rot (or curl) of a vector.  
CO12 The vector differential operator  $\nabla$ , gradient, divergence, rot (or curl).  
CO13 Geometrical and physical interpretations of gradient, divergence, rot(or curl)  
CO14 Formulae involving  $\nabla$ . Invariance.  
CO15 Vector integral  
CO16 Line integrals. Surface integrals.  
CO17 Problem Solving  
CO18 Volume integrals. Green's theorem.  
CO19 Statement and verification of the divergence theorem of Gauss and Stoke's theorem.  
CO20 Related integral theorems, applications.

### Geometry

CO21 Rectangular cartesian co-ordinates in space  
CO22 Concept of a geometric vector (directed lines segment).  
CO23 Projection of a vector on a co-ordinate axis, inclination of a vector with an axis  
CO24 Co-ordinates of a vector, direction cosines of a vector, distance between two points.  
CO25 Division of a directed line segment in a given ratio, the equation of a surface and the equation of a curve.  
CO26 Problem Solving  
CO27 Equation of plane: General, intercept and normal form.  
CO28 The sides of a plane, signed distance of a point from a plane.  
CO29 Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes,  
CO30 Bi-sectors of angle between two intersecting planes, Parallelism and perpendicularity of two planes.  
CO31 Straight line in space: its equation in symmetrical (canonical) and parametric forms.  
CO32 Direction ratio and direction cosines, canonical equation of the line of intersection of two intersecting planes.

CO33 Problem solving  
CO34 Angle between two lines.  
CO35 Condition for Parallelism and perpendicularity of two straight lines of a straight line and a plane,  
CO36 Equations of skew lines, Distance of a point from a straight line.  
CO37 Shortest distance between two skew lines.  
CO38 Problem solving  
CO39 Sphere  
CO40 Cone  
CO41 Cylinder.  
CO42 Surface of revolution  
CO43 Ruled surface: study of their shapes and canonical equations.  
CO44 Related problems  
CO45 Enveloping cone and enveloping cylinder.  
CO46 Tangents, tangent planes,  
CO47 Normals and generating lines of quadrics.  
CO48 Transformation of rectangular axes: translation rotation and their combinations.  
CO49 General equation of second degree in three variables:  
CO50 Reduction to canonical (normal) forms.  
CO51 Classification of quadrics and their equation in canonical forms.

#### Linear Programming

CO52 Inequalities, formation of problems from daily life involving inequalities, slack and surplus variables, definition of L.P.P.  
CO53 Canonical, standard and matrix form of L.P.P., solution of L.P.P by graphical method.  
CO54 Basic solutions, feasible solution and basic feasible solutions,  
CO55 Degenerate and non-degenerate B.F.S., vectors, bases and dimension  
CO56 Convex sets, convex hull, convex cone, convex polyhedral and simplex,  
CO57 Hyperplane, polytope, polyhedral, separating and supporting hyperplane.  
CO58 The related theorems :collection of all feasible solution of a L.P.P. constitutes a convex set whose extreme point correspond to its B.F.S.  
CO59 The objective function has its optimum value at an extreme point of the convex polyhedron generated by the set of feasible solutions, a B.F.S. to a L.P.P. corresponds to an extreme point of the convex set of feasible solutions, if the objective function assumes its optimal value at more than one extreme points, then every convex combination of these extreme points also gives the optimal value of the objective function.  
  
CO60 If the L.P.P. admits an optimal solution then at least one B.F.S. must be optimal.  
Reduction of a F.S. to B.F.S.

CO61 Theory of simplex method, feasibility and optimality conditions,  
CO62 The algorithm, Unbounded solution, alternative optimal.  
CO63 Some problems  
CO64 Two phase method,  
CO65 Charne's Big-M method,  
CO66 Degeneracy in L.P.P. and its resolution.  
CO67 Duality, The dual of the dual is primal, weak and strong duality theorems,  
CO68 Solution of the dual (primal) from the simplex table of the primal (dual).  
CO69 Transportation problem, Formulation, solution  
CO70 Assignment problems: Formulation of balanced and unbalanced problems and their optimal solutions travelling salesman problems and their optimal solutions.

CO71 Game theory: Concept of game problems, rectangular game.  
CO72 Pure strategy and mixed strategy, saddle point, optimal strategy and value of the game  
CO73 Dominance, fundamental theorem of rectangular games,  
CO74 Various methods (algebraic method, graphical method, dominance principle and Simplex method) of solving rectangular games.  
CO76 Problem Solving

CO77-CO90 Tutorial

Paper-IV

Analytical Dynamics of Particles

CO1 Basic Concepts: Particle and rigid body; frame of reference, rest and motion,  
CO2 Position vector, velocity and acceleration, mass,  
CO3 Force and Newton's laws of motion.  
CO4 Motion of a particle in one dimension: Rectilinear motion under constant and variable forces, impulse and impulsive forces,  
CO5 Linear momentum, kinetic energy, work, power, conservative forces depending on position,  
CO6 Potential energy and principle of conservation of linear momentum and energy  
CO7 Collision of elastic bodies, falling bodies including various problems,  
CO8 Motion under gravity with resistance varying as integral powers of velocity.  
CO9 S.H.M. linearly damped oscillation, forced oscillations,  
CO10 Damped forced oscillations, principle of superposition, strings and springs, CO11 varying mass problem, rockets and falling rain.  
CO12 Motion of a particle in a plane: Expressions for velocity and acceleration in cartesian and polar coordinates,  
CO13 Expressions for tangential and normal acceleration,  
CO14 Equation of motion in cartesian (w.r.to fixed and rotation frames) and polar coordinates, momentum (linear and angular), work, energy, conservative forces, principle of conservation of linear momentum, angular momentum and energy.  
CO15 Central forces and central orbits,  
CO16 motion under inverse square law (attractive and repulsive).  
CO17 Escape velocity.  
CO18 Planetary motion and Kepler's laws, motion of an artificial satellite,  
CO19 Geo-stationary orbits, stability of nearly circular motion, disturbed elliptic orbit,  
CO20 Constrained motion, simple and cycloidal pendulum,  
CO21 Motion on rough curves (circle, parabola, ellipse, cycloid etc.) under gravity.  
CO22 Motion in resisting medium. Projectiles in a resisting medium when resistance varies as an integral power of velocity.

Analytical Statics

CO23 Friction: Laws of Friction, Angle of friction, Cone of friction.  
CO24 To find the positions of equilibrium of a particle lying on a (i) rough plane curve, (ii) rough surface under the action of any given forces.  
CO25 Centre of Gravity: General formula for the determination of C.G.

CO26 Determination of position of C.G. of any arc, area of solid of known shape by method of integration.

CO27 Astatic Equilibrium, Astatic Centre.

CO28 Positions of equilibrium of a particle lying on a smooth plane curve under action of given forces.

CO29 Action at a joint in a frame work.

CO30 Virtual work: Principle of virtual work for a single particle.

CO31 Deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work.

CO32 The principle of virtual work for a rigid body. Forces which do not appear in the equation of virtual work. Forces which appear in the equation of virtual work.

CO33 The principle of virtual work for any system of coplanar forces acting on a rigid body. Converse of the principle of virtual work.

CO34 Stable and Unstable equilibrium. Co-ordinates of a body and of a system of bodies.

CO35 Field of forces. Conservative field. Potential energy of a system.

CO36 The energy test of stability. Condition of stability of equilibrium of a perfectly rough heavy body lying on fixed body. Rocking stones.

CO37 Forces in three dimensions. Moment of a force about a line.

CO38 Axis of a couple. Resultant of any two couples acting on a body.

CO39 Resultant of any number of couples acting on a rigid body.

CO40 Reduction of a system of forces acting on a rigid body. Resultant force in an invariant of the system but the resultant couple is not an invariant.

CO41 Conditions of equilibrium of a system of forces acting on a body.

CO42 Deductions of the conditions of equilibrium of a system of forces acting on a rigid body from the principle of virtual work.

CO43 Poincot's central axis. A given system of forces can have only one central axis. Wrench, Pitch, Intensity and Screw.

CO44 Condition that a given system of forces may have a single resultant. Invariants of a given system of forces. Equation of the central axis of a given system of forces.

#### Differential Equations

CO45 Simultaneous differential equation with constant coefficients up to second order.

Co46 Power series solution of ordinary differential equation at an ordinary point.

CO47 Power series solution of ordinary differential equation at a singular point.

CO48 Partial differential equation: Introduction

CO49 Formulation of P.D.E. Solution of first order linear P.D.E.: Lagrange's method.

CO50 Definition of Laplace transform, Elementary properties of Laplace transform,

CO51 Laplace transform of derivatives, Laplace transform of integrals,

CO52 Formulae of inverse Laplace transform, Statement of Convolution theorem,

CO53 solution of G.D.E. up to second order with constant coefficient using Laplace transform.

CO54 Problem solving

CO55 Problem solving

#### **Paper - V**

CO1 Riemann theory of integration: Partition and refinement of partition of a closed and bounded interval,

CO2 Upper Darboux sum and Lower Darboux sum and associated results, upper integral and lower integral,



CO3 Darbbux theorem, Darboux definition of integration over a closed and bounded interval  
CO4 Riemann's definition of integrability, equivalence of Darboux definition of integrability (statement only)  
CO5 Necessary and sufficient conditions of Riemann integrability, Integrability of continuous function  
CO6 Integrability of monotonic and piecewise continuous functions with finite number of points of discontinuities, infinite number of points of discontinuities having finite number of limit points  
CO7 integrability of sum, scalar multiple, product, quotient, modulus of integrable functions.  
CO8 Functions defined by integrals, their continuity and differentiability,  
CO9 Fundamental theorem of integral calculus.  
CO10 First mean value theorem and second mean value theorem (Bonnet and Weierstrass's form (no proof of integral calculus.  
Co11 Definition of  $\log x$  as an integral and deduction of simple properties.  
CO12 Problems  
CO13 Improper integral: Necessary and sufficient condition for convergence of improper integral(for unbounded function and unbounded range of integration),  
CO14 comparison and limit test for convergence  
Co15 absolute and non-absolute convergence,  
CO16 Abel's and Dirichlet's test for convergence of the integral of a product(statement only),  
CO17 Beta and Gamma functions, their convergence, relation  
CO18 simple properties of Beta and gamma function  
Co19 Problem Solving  
CO20 Problem solving  
CO21 Differentiation and integration w.r.to parameter under integral sign,  
CO22 statement of relevant theorem. And related problems  
CO23 Multiple integral: Concept of upper sum, lower sum, upper integral, lower integral and Double integral (no rigorous statement is needed),  
CO24 statement of existence theorem for continuous function,  
CO25 change of order of integration,  
CO26 Triple integral, change of variables in double and triple integral (problem only),  
CO27 determination of volume and surface area by multiple integral (problem only).  
CO28 Problem solving  
Co29 Concept of implicit function: statement of implicit function theorem  
CO30 simple application of implicit function theorem for two variables, differentiation of implicit function.  
CO31 Mean value theorem for two variables  
CO32 Taylor's theorem for function of two variables  
CO33 Transformation of variables.  
CO34 Maxima and minima of functions of two or more variables.  
CO35 Lagrange's method of undetermined multipliers (up to four variables), concept of saddle point.  
CO36 Problem Solving

### **Metric Space**

CO37 Definition and examples of metric spaces  
CO38 Spaces such as  $\mathbb{R}^n$  ( $n \geq 1$ ),  $l_\infty$ ,  $l_p$ ,  $C[a,b]$ .  
CO39 Open and closed ball, Neighborhoods of a point, open set, closed set (defined as a complement of an open set).

CO40 Union and intersection of open and closed sets, limit point of a set, interior point and interior of a set,  
 Co41 boundary points and boundary of a set, elementary properties of interior, closure and boundary of a set,  
 CO42 bounded set, distance between a point and a set, distance between two sets.  
 CO43 Sub-space of a metric space, sequence, convergence sequence,  
 CO44 Cauchy sequences. Complete and incomplete metric spaces completeness of  $R^n$  ( $n \geq 1$ ),  $C[a,b]$ .  
 CO45 Cantor's intersection theorem.

### **Complex Analysis**

CO46 Complex numbers as ordered pairs.  
 CO47 Geometrical representation of complex numbers.  
 CO48 Extended Complex plane. Stereographic projection.  
 CO49 Complex functions: Limit, Continuity  
 CO50 differentiability of complex functions.  
 CO51 Cauchy - Riemann Equations in Cartesian and Polar forms,  
 CO52 Analytic functions. Sufficient conditions of Differentiability (Statement only),  
 CO53 Harmonic function. Conjugate harmonic function,  
 CO54 statement of Milne's Method. And related problems

### **Tensor Calculus**

CO55 Spaces of  $n$  dimension, Transformation of co-ordinates,  
 CO56 Contravariant and covariant vectors. Scalar invariants,  
 Co57 contravariant, covariant and mixed tensor. The Kronecker delta. Symmetric and Skew-symmetric tensor.  
 Co58 Addition, subtraction, outer product, contraction,  
 Co59 inner multiplication, Quotient law.  
 Co60 The line element and the metric tensor;  
 Co61 Riemannian space, conjugate or reciprocal tensor.  
 Co62 Christoffel symbols and their laws transformation,  
 Co62 covariant differentiation of vectors and tensors, covariant differentiations of sum and products.  
 Co63 Divergence of a vector, Laplacian of a scalar invariant.  
 Co64 Curvature tensors and Ricci tensor,  
 Co65 covariant curvature tensor.

### **Paper - VI**

CO1 Moment and product of inertia, Momental ellipsoid,  
 CO2 Equimomental system, Principal axis, D'Alembert's principle.  
 CO3 D'Alembert's equations of motion. Principles of moments,  
 CO4 Principles of conservations of linear and angular momentum. Independence of the motion of centre of inertia and the motion relative to the centre of inertia. Co5 Principle of energy. Principle of conservation of energy.  
 CO6 Equation of motion of a rigid body about a fixed axis.  
 CO7 Expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis.

CO8 Compound pendulum. Interchangeability of the points of a suspension and centre of oscillation.

CO9 Minimum time of oscillation. Reaction of axis of rotation.

CO10 Problem Solving

CO11 Equations of motion of a rigid body moving in two dimensions.

CO12 Expression for kinetic energy and angular momentum about the origin of a rigid body moving in two dimensions.

CO13 Two dimensional motion of a solid of revolution down a rough inclined plane.

CO14 Necessary and sufficient condition for pure rolling. Two dimensional motion of a solid of revolution moving on a rough horizontal plane.

CO15 Equations of motion under impulsive forces. Equation of motion about a fixed axis under impulsive forces.

CO16 Centre of percussion.

CO17 To show that (i) if there is a definite straight line such that the sum of the moments of the external impulses acting on a system of particles about it vanishes, then the total angular momentum of the system about that line remains unaltered, (ii) the change of K.E. of a system of particles moving in any manner under the application of impulsive forces is equal to the work done by the impulsive forces.

CO18 Impulsive forces applied to a rigid body moving in two dimensions.

CO19 Problem SOLVING

### **Hydrostatics**

Co20 Definition of Fluid, Perfect Fluid, Pressure.

Co21 To prove that the pressure at a point in a fluid in equilibrium is the same in every direction.

CO22 Transmissibility of liquid pressure. Pressure of heavy fluids.

CO23 To prove :In a fluid at rest under gravity the pressure is the same at all points in the same horizontal plane. In a homogeneous fluid at rest under gravity the difference between the pressures at two points is proportional to the difference of their depths.

CO24 To prove :In a fluid at rest under gravity horizontal planes are surfaces of equal density. When two fluids of different densities at rest under gravity do not mix, their surface of separation is a horizontal plane.

CO25 Pressure in heavy homogeneous liquid. Thrust of heavy homogeneous liquid of plane surfaces.

CO26 Definition of centre of pressure. Formula for the depth of the centre of pressure of a plane area.

CO27 Position of the centre of pressure. Centre of pressure of a triangular area whose angular points are at different depths.

CO28 Centre of pressure of a circular area. Position of the centre of pressure referred to co-ordinate axes through the centroid of the area.

CO29 Centre of pressure of an elliptical area when its major axis is vertical or along the line of greatest slope. Effect of additional depth on centre of pressure.

CO30 Equilibrium of fluids in given fields of force: Definition of field of force, line of force.

CO31 Pressure derivative in terms of force. Surface of equi-pressure.

CO32 To find the necessary and sufficient conditions of equilibrium of a fluid under the action of a force whose components are X, Y, Z along the co-ordinate axes.

CO33 To prove (i) that surfaces of equal pressure are the surfaces intersecting orthogonally the lines of force. (ii) when the force system is conservative, the surfaces of equal pressure are equipotential surfaces and are also surfaces of equal density.

CO34 To find the differential equations of the surfaces of equal pressure and density.

CO35 Rotating fluids. To determine the pressure at any point and the surfaces of equal pressure when a mass of homogeneous liquid contained in a vessel,  
CO36 To determine the pressure at any point and the surfaces of equal pressure when a mass of homogeneous liquid revolves uniformly about a vertical axis.

CO37 Thrust on Curved Surface.

CO38 The stability of the equilibrium of floating bodies. Definition, stability of equilibrium of a floating body, metacentre, plane of floatation, surface of buoyancy.

CO39 General propositions about small rotational displacements. To derive the condition for stability.

CO40 Problem Solving

## **Group - C**

### **Discrete Mathematics**

CO41 Sets and Propositions: Cardinality,

CO42 principle of inclusion and exclusion, connectives,

CO43 Tautology and contradictions, equivalence formula.

CO44 Graph Theory: Graphs: undirected graphs, Directed graphs, basic properties,

CO45 complete graph, complement of a Graph, bipartite Graphs, Necessary and Sufficient condition for a Bipartite Graph

CO46 Weighted Graphs, Walk, Path, Cycles, Circuit,

CO47 Euler Graph, Konisberg Bridge Problem.

CO48 Trees: Basic properties, spanning tree.

CO49 Partial order relations and Lattices: Definitions of poset,

CO50 Lattice, chain and anti-chain, properties of a lattice

CO51 Distributive lattice with properties.

CO52 Discrete numeric functions.

CO53 Generating functions.

### **Mathematical Modeling**

CO54 Introduction, Basic steps of Mathematical modeling and its utility

CO55 preliminary concept of stability of differential equation.

CO56 -59 Mathematical models with their formulation, solution, interpretation and limitations

i) Single species models (Exponential and Logistic growth), (ii) Two species population models (Two competing species and Prey-predator).

CO60 Simple epidemic model (SI) with the formulation,

CO61 solution, interpretation and limitations.

## **Paper- VII**

### **Elements of Computer Science**

CO1 Elementary computers programming

CO2 Concepts of machine language, assembly language, different high level languages and compilers.

CO3 Application of computer programming: Different steps of solving a problem by a Computer.

CO4 Computer oriented algorithm. Flowchart.  
 CO5 Algorithms from various fields  
 CO6 Flowchart from various fields  
 CO 7 Binary arithmetic: binary numbers, binary-to-decimal conversion, decimal-to-binary conversion,  
 CO8 Addition, subtraction, multiplication and division of binary numbers,  
 CO9 Algebra of sets. Definition of Boolean algebra by Huntington postulates,  
 CO10 Two elements Boolean algebra and other examples, principle of duality  
 CO11 Basic theorems of Boolean Algebra  
 CO12 Boolean functions, truth table,  
 CO13 Disjunctive and conjunctive normal forms, Theorem on construction of a Boolean function from a truth table and examples.  
 CO14 Different binary operations and operators: AND, OR, NOT, NAND, NOR.  
 CO15 Bistable devices, Logic gates-AND, OR, NOT, NAND, NOR (including block diagram and input-output table).  
 CO16 Logic gates representations for Boolean expressions,  
 CO17 Binary half adder and full adder.  
**CO18** Character set in ANSI C. Key words:  
**CO19** if, while, do, for, int, char, float, etc.  
**CO20** Data type: character, integer, floating point, etc. Variables, Operators: =, ==, !=, < >, etc. (arithmetic, assignment, relational, logical, increment, etc.).  
**CO21** Expressions: arithmetic and logical expressions. Standard input/output.  
**CO22** Use of while, if-else, for, do - while, switch, continue, etc.  
**CO23** Arrays, strings, user defined function. Header File.  
**CO24-CO50** The various problems on Mathematics are to be studied during programming in C.

### **Mathematical Theory of Probability**

CO51 Concepts of mathematical probability, Random experiments,  
 CO52 The idea of probability as a long run relative frequency.  
 CO53 Sample space, mutually exclusive events, exhaustive events.  
 CO54 Union of events, intersection of events, Kolmogorov's axiomatic definition of probability, classical definition as a special case of the axiomatic,  
 CO55 Theorems on the probability of the union of an events. Theorem of total probability, Boole's inequality,  
 CO56 conditional probability, theorem of compound probability, theorem of inverse probability (Baye's theorem).  
 CO57 Statistical independence of events, independent trials,  
 CO58 Random variables, discrete and continuous distributions,  
 CO59 Probability distribution function,  
 CO60 expectation, variance, moments of a random variable,  
 CO61 basic ideas of moment generating function (m.g.f.) and characteristic function,  
 CO62 dependent and independent trials. Bernoulli's trials,  
 CO63 Binomial law, Joint distribution of two random variables and transformation of variables.  
 CO64 Marginal and conditional distributions, Sum law and product law of expectation, CO65 two dimensional expectation and conditional expectation,  
 CO66 Correlation and regression.  
 CO67 Tchebycheff's inequality, convergence in probability,

- CO68 Bernoulli's limit theorem, weak law of large numbers.  
 CO69 Central limit theorem (statement only).  
 CO70 Poisson's approximation to Binomial distribution, Normal approximation to Binomial distribution.  
 CO71 Detailed understanding of hyper-geometric binomial, negative binomial and Poisson distributions  
 CO72 rectangular, gamma, beta and normal distributions, t distributions.

### **Mathematical Statistics**

- CO73 Collection of data, Tabulation and graphical representation of data,  
 CO74 Qualitative and quantitative characteristics of discrete and continuous variables, Frequency table and its graphical representation.  
 CO75 Measures of central tendency: mean (simple and weighted), median mode.  
 CO76 Measures of dispersion: range, mean deviation and standard deviation,  
 CO77 coefficient of variation, moments, skewness and kurtosis.  
 CO78 Random sampling, sampling distribution of a statistic.  
 CO79 Sampling distribution of a sample means (normal population case) and sample proportion.  
 CO80 Statistical inference. Point estimation of a parameter unbiased and consistent estimates.  
 CO81 Method of maximum likelihood. Bivariate data, Scattered diagram,  
 CO82 simple correlation and regression, curve fitting (linear and parabolic).  
 CO83 Statistical hypothesis: Simple and composite, critical region of a test. Type-I and Type-II error. CO84 Confidence interval and confidence coefficients: Confidence interval for a single variance (normal distribution),  
 CO85 Neyman-Pearson theorem (statement only). Testing of Hypothesis (large and small sample, Normal distribution only).

## **Paper - VIII**

### **Numerical Analysis**

- CO1 Basic concepts: approximation of numbers, significant figures, absolute, relative and percentage errors,  
 CO2 truncation and round off errors,  
 CO3 Accumulation and propagation of errors.  
 CO4 Polynomial interpolation and application:  
 CO5 Lagrangian interpolation problem.  
 CO6 Linear interpolation formula. Lagrange's formula.  
 CO7 Differences: Forward, backward and divided difference tables,  
 CO8 linear difference equations with constant coefficients.  
 CO9- CO10 Newton's general interpolation formula with remainder term, Newton's forward and backward formulae, error in these formulae.  
 CO11 Numerical differentiation based on Newton's forward and backward formulae.  
 CO12 Numerical integration: Newton's Cotes formulae,  
 CO13 Trapezoidal rule, Simpson's one-third rule and inherent errors,  
 CO14 Weddle's rule, Summation of finite series by Euler-Maclaurin series (statement only).  
 CO15 –CO19 Solution of equations (algebraic and transcendental) : Solution of a single equation by –

- i. Graphical method,
- ii. Method of bisection,
- iii. Regula falsi method,
- iv. Fixed point iteration method,
- v. Newton-Raphson method.

CO20 Geometrical interpretation of these methods.

CO21 Convergence of fixed-point iteration and Newton-Raphson method.

CO22 Gauss-elimination method

CO23 Gauss-Siedal method for the solution of a system of linear equations.

CO24 Solution of differential equations: Solution of a first order differential equation by Euler's method

CO25 Modified Euler's method.

CO26 Runge-Kutta (2nd and 4th order) methods (emphasizing the problem only).

### **Real Analysis – III**

CO27 Real Valued functions defined on a subset (may not be an interval) of real numbers; limit of a real-valued function at a limit point of the domain (subset of  $R$ ) of the functions,

CO28 sequential and Cauchy's criteria for the existence of a limit of a function at a point. Algebra of limits in this context.

CO29 Continuity of a function at a point on a subset of  $R$ , Sequential criteria for continuity at a point, continuity on a set.

CO30 Algebra of continuous functions as a consequence of algebra of limits, continuity of composites of continuous functions.

CO31 Uniform continuity on a set. If  $f$  is continuous on a closed and bounded subset of  $R$ , then  $f$  is uniformly continuous there.

CO32 If  $f$  is uniformly continuous on a subset of real numbers then it is uniformly continuous on the closure of  $S$ . Related problems.

Co33 Sequence of functions: Pointwise and uniform convergence, Cauchy's criteria for Uniform convergence,

CO34 Weierstrass M-test, boundedness, continuity,

CO35 differentiability and integrability of the limit function in case of uniform convergence.

CO36 Series of functions: Pointwise and uniform convergence, Cauchy's criteria for uniform convergence,

CO37 Boundedness and continuity of the sum function in case of uniform convergence.

CO38 Term by term integration and differentiation.

CO39 Weierstrass M-test for uniform and absolute convergence.

CO40 Power series: Cauchy-Hadamard theorem, Radius of convergence,

CO41 Uniform convergence of power series and their related properties,

CO42 uniqueness of a power series.

CO43 Fourier series. Dirichlet's condition of convergence at a point.

CO44 Full range series

CO45 half range series.

### **Linear Algebra-II**

CO46 Linear Transformation on Vector spaces: Definition,

CO47 Null space, range space,

CO48 rank and nullity,

CO49 Sylvester's law, simple applications,

CO50 non-singular linear transformation,

CO51 Problem Solving

### **Computer Practical**

List of programs using C

CO52-CO60

1. General programs

(i) Area of circle, triangle, (ii) Summation of finite and convergent infinite series,

(iii) Maximum and minimum among three number and n numbers, (iv) Roots of a quadratic equation, (v) G.C.D. and L.C.M. between two integers, (vi) Testing of prime numbers, (vii) Split a number into digits, (viii) Computation of  ${}^n P_r$  and  ${}^n C_r$ ,

(viii) Searching and sorting (bubble sort only).

CO61-CO65

2. Problems on matrices

(i) Addition and subtraction, (ii) Product, (iii) Trace and (iv) Transpose.

CO65-CO75

3. Problems on strings

(i) Counting of words in a string, (ii) Palindrome testing, (iii) Conversion from upper case to lower case and lower case to upper case, (iv) Sorting of names, (v) Rewrite name of a person in short form, (vi) searching a sub-string among a set of strings.

CO76-CO84

4. Problems on Numerical Methods

(i) Interpolation by Lagrange's and Newton forwards difference methods, (ii) Finding of roots by bisection, regula-falsi, fixed point iteration and Newton-Rapshon methods, (iii) Integration by trapezoidal and Simpson 1/3 rule, (iv) Solution of a system of equations by Gauss-Siedal method, (v) Solution of a differential equation by Runge-Kutta methods.

CO84-CO90

5. Problems on Statistical methods

(i) Preparation of grouped frequency table, (ii) Mean, median and mode for simple and grouped frequency distribution, (iii) Standard deviation, mean deviation, (iv) Moments, skewness and kurtosis, (v) Correlation and regression, (vi) Fitting of straight and parabolic curve.

## **Physical Education**



## **PAPER – I (Principles and History of Physical Education)**

**CO-01.** Discuss the definitions of Physical Education

**CO-02.** : Explain the Aim and objectives of Physical Education

**CO-3.** Discuss the scope of Physical Education

**CO-04.** Describe the Traditional concept and Modern concept,

**CO-05.** Explain the Education and Physical Education

**CO-06.** History of Physical Education in Sparta and Athen

**CO-07.** Development of Physical Education and Sports in India: a) Pre-Independence (1856 -1947), b) Post-Independence.

**Co-08.** explain the Olympic movement

**CO-09.** Movement of Sports Schemes in India

**CO-10.** Describe the Modern Olympic Games

**CO-11.** Personality and its development through Physical Education and Sports.

**CO-12.** Describe the Social values of Sports.

**CO-13.** Explain the Instinct, Emotion, Attention, Interest and Motivation - Role in Physical Education and Sports

**CO-14.** Discuss the Skeletal System and Skeletal Deformities

**CO-15.** Types of Bones, Names of various bones of the body

**CO-16.** Describe the Types of Joints

**CO-17.** explain the Posture and Postural Defects.

**CO-18.** explain the Circulatory System

**CO-19.** explain the Respiratory System

**CO-20.** explain the Digestive System

**CO-21.** Endocrine System-Endocrine glands

**CO-22.** explain Basic Nutrients Proteins, Carbohydrates, Fats, Minerals, Vitamins and water.

## **PAPER – II Management of Physical Education and Sports**

**CO-01.** Discuss the Management of Sports and Games in School

- CO-02.Explain the various types Tournaments in physical Education
- CO-03.Briefly Explain the Care and maintenance of Sports equipments
- CO-04. Explain the various types Sports Training in Physical Education
- CO-05.Elaborate the Physical Fitness
- CO-06.Discuss the meaning of Load in Physical Education
- CO-07.Explain the various types of Training methods in Physical Education
- CO-08.Mechanical Principles Applied to Sports: Motion
- CO-09.Meaning of health-Explain it
- CO-10.Discuss about major areas of Health Education
- CO-11.Discuss the various types of Environment Hygiene
- CO-11.Elaborate the Mental Health in Physical Education
- CO-12.Meaning and Explain the Safety Education in Physical Education
- CO-13.Meaning of First Aid in Physical Education- Explain it
- CO-14.Discuss about Muscular System in Physical Education
- CO-15. Meaning of Blood pressure in our body. Effect of exercises on Circulatory system - Explain it.
- CO-16.Elaborate the Oxygen debt .Effect of exercises on Respiratory system- Explain it.
- CO-17. Discuss about measurement of cardiovascular endurance and muscular endurance in Physical Education
- CO-18. Meaning and Discuss the Types Fatigue
- CO-19.Explain the various types of muscles in our body
- CO-20.Effects of exercises on muscle in our body, Meaning of Muscular contraction  
Muscular Contraction- Explain it
- CO-21.Briefly discuss about Healthful Environment in education institutions, offices, playground, auditorium in Physical Education.

### **PAPER – IIITrack and Field**

- CO-01.Meaning of Track and Field and Explain about 100 M run,400 M run, 1500 M run

- CO-02.Putting the Shot, Discus throw, Javelin throw- Explain it
- CO-03.Meaning of Gymnastics: Elaborate the Forward Roll & Backward Roll
- CO-04.Briefly Discuss about Indian Games and Explain about Kabaddi &Kho-Kho.
- CO-05.Explain the volleyball game in Physical Education
- CO-06.Explain the Football game in Physical Education
- CO-07 Explain the Badminton game in Physical Education
- CO-08 Explain the Basketball game in Physical Education
- CO-09. Meaning and Explain about Yoga
- CO-10 Practice and explain in the various types of Yoga posture: sabasan ,Padmasana, Dhanurasana, Halasana,Ardhamatseyendrasana, Chakrasana, Sabbangasana, Shirsana, Mayurasana, Bakasana, Paschimatyasana, Kapakbhati, Anulomvilom.
- CO-11 Elaborate the First Aid Practical class and Discuss about management of sports injury in Physical Education
- CO-12Meaning and Describe about Sprain, Dislocation, Fracture, Wounds, Muscle cramps, Bandage,
- CO-13 Maintain about the Practical Exercise Book and Viva Voce and describe the Skills of practical activities to be recorded according to regular practical classes
- CO-14.Describe of the Dive roll, T. Balance and Hand Stan in Physical Education
- CO-15.Describe about High jump, Long jump and Triple jump.

**PAPER – IV Therapeutic Aspect of Physical Activity and Physical activities and life styles**

- CO-01.Meaning of Exercise and Explain about Hypokinetics diseases
- CO-02.Meaning of Osteoporosis and Discuss about obesity
- CO-03.Meaning of Hypertension Describe the Diabetes
- CO-04.Elaborate the Cardiovascular diseases.
- CO-05.Meaning ofExercise therapy-Explain it.
- CO-06.Corrective, Meaning of isotonic, isometric contraction

CO-07 Elaborate the Yogasanas as a therapy and Meaning of Massage therapy-Explain it

CO-08 Meaning and describe about Electrotherapy, hydrotherapy, cryotherapy and thermotherapy.

CO-09. Meaning and briefly discuss about Modalities and Relaxation Techniques in Physical Education

CO-10. Meaning of Physical activities-Discuss it

CO-11. Briefly discuss about Meaning of health and wellness-modern concepts

CO-12. Meaning and explain of the Health and fitness-active life style in Physical Education

CO-13. Meaning of Physical activity and women-pre-pubertal-Explain it

CO-14. Meaning and discuss about adolescent and post adolescent periods

CO-15. Explain about pregnancy in Physical Education

CO-16. Limitations of female in athletics-Discuss about it

CO-17. Briefly discuss about Physical activity for the aged

CO-18. Describe about effect of exercise and physiology of aging person

CO-19. Loss of functional capacity with age- Explain it

CO-20 Physical activity for the disabled- Explain it

CO-21. Types of disability in Physical Education

CO-22. Describe the Programme for the disabled persons in Physical Education

<b>CBCS B.SC 1<sup>ST</sup> SEM PHYSIOLOGY (CBCS) Generic Elective syllabus GE-I</b>	
Course -1 Blood	
CO-1	Composition and function ,blood cell formation and related disorders
CO-2	Blood groups, blood transfusion and its hazards disorders
Co-3	Blood clotting and its disorders, normal and abnormal haemoglobin.

Course-2 Immunity	
CO-1	Innate and acquired
CO-2	Antigens ,antibody –structure classification and functions
Co-3	Cytokines ,phagocytosis, allergy, inflammation
CO-4	Autoimmune diseases-arthritis, Graves disease, Myasthenia Graves, Hashimoto’s disease , Vaccine toxoids, HIV
Course -3 Cardiovascular system	
CO-1	Structure of heart and blood vessels , junctional tissue of the heart ,
CO-2	Cardiac cycle and heart sounds
CO-4	Cardiac output – factor affecting , Heart rate – regulation , bradycardia , tachycardia,
CO-5	Blood pressure – regulation , hypertension and hypotension ,Atherosclerosis
CO-6	ECG – principle , normal and abnormalities,
CO-7	Artificial pacemaker, Angina pectoris ,Cardiac hypertrophy, rheumatoid arthritis, Angiography
GE-1 P1 Practical	
A.	
CO-1	TC of WBC
CO-2	DC of WBC (with Leishman stain )
CO-3	Haemoglobin estimation by haematometer
CO-4	Haemin crystal
CO-5	BT, CT & Blood group
B.	
CO-1	Measurement of HR,PFI, STEP TEST .
CO-2	BP: Systolic , diastolic, mean arterial blood pressure, pulse pressure by Riva – Royce mercury manometer.
3 TIER EXAMINATION SYSTEM	
	<b>PAPER-II</b>
<b>COURSE-I:</b>	<b>Nerve-Muscle Physiology</b>
CO-1	Different types of muscles & their structures
CO-2	Concept of sarcomere system, Red and white muscles
CO-3	Mechanism of muscle contraction.
CO-4	Structural, chemical and mechanical changes in skeletal muscle during contraction & relaxation
CO-5	Isotonic and isometric contraction. Properties of muscle: all or none law, beneficial effect, summation, refractory period, tetanus and fatigue.
CO-6	Single-unit and multi-unit smooth muscle. A brief idea of muscle spindle.
CO-7	Structure & classification of nerves.
CO-8	Origin & propagation of nerve impulse.
CO-9	Velocity of impulse in different types of nerve fibres.
CO-10	Properties of nerve fibre: all or none law
CO-11	rheobase, chronaxie, refractory period, indefatigability
CO-12	Synapse: structure, classification, mechanism of synaptic transmission.

CO-13	Motor unit, motor point
CO-14	Neuromuscular junction: structure, mechanism of impulse transmission
CO-15	end plate potential
CO-16	A brief overview on neurotransmitter.
CO-17	Degeneration & regeneration of nerve fibre. Myelination
<b>COURSE-II:</b>	<b>Nervous System</b>
CO-1	A brief outline of the organization and functions of nervous system (sensory, motor, association).
CO-2	CNS (emphasis on the structure of spinal cord and brain stem).
CO-3	PNS (emphasis on the structure of spinal cord and brain stem).
CO-4	Ascending and descending tracts:
CO-5	pyramidal tract and extra pyramidal tracts (in brief).
CO-6	Reflex action: definition, reflex arc, classification, properties.
CO-7	Functions of spinal cord.
CO-8	Outline of functions of brain stem.
CO-9	A brief idea about the structure of cerebral cortex:
CO-10	A brief idea about the connection of cerebral cortex:
CO-11	A brief idea about the function of cerebral cortex:
CO-12	histological structure of cerebral cortex
CO-13	localization and function of cerebral cortex
CO-14	Basic concept of upper and lower motor neurons.
CO-15	A brief description of the organization of autonomic nervous system (sympathetic).
CO-16	A brief description of the organization of autonomic nervous system (parasympathetic).
CO-17	Formation of ANS
CO-18	circulation of ANS
CO-19	functions of ANS
CO-20	formation, of CSF
CO-21	circulation of CSF
CO-22	functions of CSF
<b>COURSE-III:</b>	<b>Skin &amp; Body Temperature Regulation:</b>
CO-1	Structure and functions of skin.
CO-2	Sensible and insensible perspiration.
CO-3	Composition and functions of sweat and sebum.
CO-4	Physiology of sweat secretion and regulation.
CO-5	Regulation of body temperature - physical, physiological processes involved in it
CO-6	Significance of body temperature.
CO-7	Types of Heat stress,
CO-8	Heat stroke and Management.
<b>COURSE-IV</b>	<b>Sensory Physiology:</b>
CO-1	Classification of general and special senses, and their receptors.
CO-2	Receptors as biological transducers. Muller's law of specific nerve energies. Weber-Fechner law. Concept of receptor adaptation.
CO-3	Structure of sensory organs, neural pathway of smell & taste sensation.
CO-4	Chemistry of taste & smell. Mechanism of taste sensation

CO-5	Olfactory and gustatory adaptation. After taste.
CO-6	Structure of ear, auditory pathway,
CO-7	organ of Corti,
CO-8	mechanism of hearing,
CO-9	perception of pitch and loudness
CO-10	Structure of the eye.
CO-11	Histology of retina
CO-12	visual pathway, light reflex
CO-13	chemical changes of retina on exposure to light.
CO-14	Accommodation: mechanism & pathway
CO-15	Error of refraction & correction
CO-16	Positive & negative after-image , optical illusion
CO-17	flicker, light & dark adaptation. Elementary idea of colour vision & colour blindness
<b>COURSE-V</b>	<b>Endocrine System</b>
CO-1	Anatomy of endocrine system.
CO-2	Classification of hormones
CO-3	Basic concept of the regulation of hormone actions
CO-4	Positive and negative feedback mechanisms
CO-5	Elementary idea of hormone action
CO-6	Histological structure of pituitary
CO-7	hormones and their functions of pituitary
CO-8	hypothalamo- pituitary axis. Hypo and hyper active states of pituitary gland
CO-9	Neuro-hormones, Vasopressin and oxytocin of pituitary gland
CO-10	Histological structure of Thyroid
CO-11	functions of T3, T4, thyrocalcitonin
CO-12	Hypo- and hyperactive state of thyroid. Goitrogens
CO-13	Histological structure of Parathyroid
CO-14	functions of parathyroid hormone
CO-15	Parathyroid tetany; Hyperparathyroidism
CO-16	Histological structure of Adrenal
CO-17	functions of medullary hormones
CO-18	Adrenal cortex
CO-19	Histological structure of cortical hormones
CO-20	functions of cortical hormones
CO-21	Hypo and hyperactive states of adrenal cortex
CO-22	Histology of islets of Langerhans
CO-23	Origin and functions of pancreatic hormones.
CO-24	Hormonal regulation of blood glucose/sugar level. Diabetes mellitus.
CO-25	The origin & functions of renin angiotensin system
CO-26	The origin & functions of Prostaglandins.
CO-27	The origin & functions of Erythropoietin and melatonin.
CO-28	The origin & functions of Elementary idea about gastrointestinal hormones
<b>COURSE-VI</b>	<b>Reproductive Physiology</b>
CO-1	Primary and accessory sex organs
CO-2	Secondary sex characters
CO-3	Puberty- A brief idea

CO-4	Testis: histology
CO-5	spermatogenesis
CO-6	Testicular hormones and their functions
CO-7	Ovary: Histology,
CO-8	oogenesis,
CO-9	ovarian hormones and their functions
CO-10	Estrous cycle, and their hormonal control
CO-11	menstrual cycle, and their hormonal control
CO-12	Fertilization
CO-13	implantation
CO-14	Placenta formation
CO-15	Placenta function
CO-16	Placental hormones
CO-17	maintenance of pregnancy
CO-18	hormonal factors, parturition. Pregnancy tests.
CO-19	Development of mammary gland and lactation
	<b>PAPER-III (PRACTICAL)</b>
<b>COURSE-I:</b>	<b>Histology</b>
CO-1	Leishman's staining of human blood film
CO-2	Leishman's staining of human blood to identification of different blood corpuscles
CO-3	Preparation of haemin crystals
CO-4	Estimation of haemoglobin
CO-5	Examination & staining of fresh tissue: squamous,
CO-6	Examination & staining of fresh tissue: ciliated epithelium,
CO-7	Examination & staining of fresh tissue: columnar epithelium,
CO-8	skeletal muscle fibre (Rat/Goat) by Methylene blue stain.
CO-9	Transitional epithelium, mesentery (Rat/Goat) (counter stain by Methylene blue).
CO-10	Staining of adipose tissue by Sudan III or IV
CO-11	Identification of permanent slides of Bone, cartilage, lung,
CO-12	Identification of permanent slides of trachea, spleen, lymph gland
CO-13	Identification of permanent slides of, liver, salivary glands, pancreas
CO-14	Identification of permanent slides of esophagus, stomach, small intestine, large intestine
CO-15	Identification of permanent slides of, ovary, adrenal, testis,
CO-16	Identification of permanent slides of thyroid, spinal cord
CO-17	Identification of permanent slides of, cerebellum, cerebral cortex
CO-18	Identification of permanent slides of, kidney, skin, tongue
CO-19	Demonstration of Eosin - Haematoxyline staining of blood film
CO-20	Demonstration of, Reticulocyte staining.
<b>COURSE-II:</b>	<b>Biochemistry</b>
CO-1	Qualitative tests for identification of starch, dextrin,
CO-2	Qualitative tests for identification of, lactose, sucrose,
CO-3	Qualitative tests for identification of, maltose, glucose,
CO-4	Qualitative tests for identification of, galactose, fructose,
CO-5	Qualitative tests for identification of albumin, gelatin,
CO-6	Qualitative tests for identification of peptone, lactic acid, HCl,
CO-7	Qualitative tests for identification of uric acid, acetone, Glycerol, bile salts, urea, blood



CO-8	Qualitative analysis of pulse, rice, milk to test the presence of carbohydrate,
CO-9	Qualitative analysis of protein, fat.
CO-10	Demonstration of qualitative identification of lipid & cholesterol.
CO-11	Quantitative estimation of glucose, sucrose by Benedict's method.
CO-12	Estimation of lactose from milk by Benedict's method
CO-13	Estimation of blood sugar by Folin-Wu method.
CO-14	Estimation of chloride by Mohr's Method.
CO-15	Estimation amino-nitrogen through formol-tritration method.
<b>COURSE-III:</b>	<b>Experimental Physiology</b>
CO-1	Demonstration of Kymograph, induction coil and keys using process.
CO-2	Recording of simple muscle curve with sciatic nerve-gastrocnemius muscle preparation of a toad. Determination of latent period, contraction period, relaxation period & maximum height of contraction.
CO-3	Normal tracing of unperfused toad's heart beat.
CO-4	Effect of warm saline on unperfused toad's heart beat.
CO-5	Effect of ion (K <sup>+</sup> & Ca <sup>2+</sup> ) on unperfused toad's heart beat.
CO-6	Effect of adrenaline and acetylcholine on unperfused toad's heart beat.
<b>COURSE-IV</b>	<b>Human Experiments</b>
CO-1	Determination of PFI of an individual by Harvard Step Test and graphical plotting of changes in pulse rate during recovery period.
CO-2	Determination of PFI of an individual by Harvard Step Test and graphical Plotting of changes in breathing rate during recovery period.
CO-3	Measurement of systolic and diastolic arterial blood pressure by sphygmomanometer
CO-4	Determination of pulse pressure & mean pressure during quiet rest and exercise.
<b>COURSE-V</b>	<b>Diet Survey Report</b>
CO-1	Report should be as per ICMR specification. Report should be hand written. Each student has to prepare and submit the report on his/her own family.
	<b>PAPER-IV A</b>
<b>COURSE-I:</b>	<b>Application of Physiology</b>
CO-1	Introduction to the application of Physiology in different fields – Hematology, Biochemistry,
CO-2	Molecular Biology, Immunology, Microbiology,
CO-3	Social Physiology, Work and Sports Physiology,
CO-4	Environmental Physiology, Space Physiology, Pharmacology.
<b>COURSE-II:</b>	<b>Clinical Biochemistry and Molecular Biology</b>
CO-1	DNA and RNA: types and functions.
CO-2	Elementary idea of gene, genome, genetic code,
CO-3	Transcription,
CO-4	Translation
CO-5	Genetic engineering
CO-6	Pathological significance of the following blood constituents: glucose, urea,
CO-7	Pathological significance of creatinine, uric acid, cholesterol
CO-8	Pathological significance of lipoproteins, bilirubin
CO-9	Pathological significance of SGPT and SGOT

CO-10	Pathological significance of alkaline and acid phosphatases and ketone bodies
CO-11	Dose response relationship. ED 50, LD 50,
CO-12	Dose response relationship CO, TLV,
CO-13	Dose response relationship therapeutic index of drugs,
CO-14	Safety factor for drugs and pollutants.
CO-15	Narcotic drug abuse and addiction, addiction of alcohol and nicotine
CO-16	Abuse of medicines: sulfa drugs, antibiotics, androgenic, steroids, doping.
<b>COURSE-III:</b>	<b>Environmental Physiology</b>
CO-1	Environment - its physiological aspect.
CO-2	Some common pollutants & their effect- Carbon monoxide, lead & arsenic.
CO-3	Effects of noise on human body and preventive measures.
CO-4	Pesticides: Bio magnification and effects on body.
CO-5	Radio-active wastes and their health effects.
CO-6	Natures Kidney as scavenger. Food pollution and adulteration & their effects on human body.
<b>COURSE-IV</b>	<b>Microbiology &amp; Immunology</b>
CO-1	Virus: DNA virus & RNA virus, phages.
CO-2	Bacteria - structure & morphological classification.
CO-3	Gram positive, gram negative
CO-4	pathogenic & non-pathogenic bacteria
CO-5	Sterilization, pasteurization, brief idea about antibiotics
CO-6	Idea about innate and acquired immunity.
CO-7	Humoral and cell mediated immunity
CO-8	Vaccination principles and importance of immunization
CO-9	Basic principles of immunological detection of pregnancy
CO-10	Immunization Program: Immunization against Polio, Hepatitis-B, Tetanus, through vaccine
CO-11	Immunization Program: Immunization against Measles, Whooping cough through vaccine
CO-12	Immunization Program: Immunization against Tuberculosis, Rabbits through vaccine
CO-13	AIDS- causative virus, mode of transmission, effects on human body, preventive measures, diagnostic test for AIDS (ELISA)
<b>COURSE-V</b>	<b>Work &amp; Sports Physiology</b>
CO-1	Definition of work, cardiac index, work index or pulse, O <sub>2</sub> debt,
CO-2	Classification of physical work - static & dynamic, positive & negative work,
CO-3	Cardiovascular & respiratory changes during physical exercise.
CO-4	Brief idea about VO <sub>2</sub> max, physical fitness index - Harvard step test
<b>COURSE-VI</b>	<b>Biostatistics and Modern Instrumentation (Biomedical) &amp; Basic Concepts of Computer</b>
CO-1	Sampling and its methods, frequency distribution,
CO-2	Properties & computation of Standard deviation.
CO-3	Sampling errors, standard error or difference between means.
CO-4	.Principle & application of artificial pacemaker, MRI,
CO-5	Principle & application of hemo-dialysis, USG, CT scan
CO-6	Principle & application of artificial pacemaker, X-ray, endoscopy.
CO-7	Basic concept of computer, uses of computer, elementary ideas about hardware, software and software packages.
<b>COURSE-</b>	<b>Community Health Management</b>

<b>VII</b>	
CO-1	Basic concept of population, society, community and community health.
CO-2	Population control & family planning,
CO-3	Causes and management of different types of diabetes, thalassemia,
CO-4	Causes and management of different types of nutritional anemia, atherosclerotic disorders,
CO-5	Causes and management of different types of gout, obesity,
CO-6	Causes and management of different types of filaria, endemic goiter. dental carries
	<b>PAPER-IV B</b>
<b>COURSE-I</b>	<b>Haematological Tests</b>
CO-1	DC of WBC,
CO-2	PCV
CO-3	MCV
CO-4	Determination of clotting time.
CO-5	Determination of bleeding time,
CO-6	Determination of ABO grouping.
CO-7	Demonstration - TC of RBC & WBC.
CO-8	Haematocrit,
CO-9	ESR
<b>COURSE-II</b>	<b>Clinical Pathology</b>
CO-1	Identification of abnormal constituents of urine - glucose
CO-2	Identification of abnormal constituents of urine - proteins
CO-3	Identification of abnormal constituents of urine - acetone,
CO-4	Identification of abnormal constituents of urine - blood,
CO-5	Identification of abnormal constituents of urine - bile salts.
CO-6	Pregnancy Test (strip method).
<b>COURSE-III</b>	<b>Human Experiments</b>
CO-1	Pneumographic recording of normal respiratory movements, recording during drinking water, talking, forced hyperventilation & breath holding.
CO-2	Spirometric measurement of vital capacity
CO-3	Determination of VO <sub>2</sub> max by Queen's College method
CO-4	Measurements of common anthropometric parameters: stature, eye height, shoulder height, elbow height, knee height (sitting).
CO-5	Circumference: head, chest, wrist, hip. BMI measurement.
CO-6	Calculation of body surface area.

## Sanskrit

### 1<sup>st</sup> Paper

#### Grammar

CO.01 The Alphabet ...

CO.02 Rules of Sandhi

CO.03 Swarasandhi, Halant Sandhi, Visargasandhi,

CO.04 Subanta or Declension of nouns, substantive and adjective..

- CO.05 Bases ending in Vowels, bases ending in consonants. Irregular bases, word of Irregular declension
- CO.06 Pronouns and their declension,
- CO.07 Numerals and their declension,
- CO.08 Degree of Comparison.
- CO.09 Compounds....
- CO.10 Danta, Tatpurusha, Karmadharaya, Upapada, Bahubrihi, and avyayibhava.
- CO.11 Formation of Feminine bases....
- CO.12 Secondary Nominal bases derived by the addition of the taddhit or Secondary affixes.
- CO.13 Avyayas or Indeclinables
- CO.14 Prepositions, Adverbs, Particles, Conjunction, Interjection.
- CO.15 Conjugation of Verbs.
- CO.16 Active and Passive Voice
- CO.17 Introduction of Case ending
- CO.18 1<sup>st</sup> case ending, 2<sup>nd</sup> case ending, 3<sup>rd</sup> case ending, 4<sup>th</sup> case ending, 5<sup>th</sup> case ending, 6<sup>th</sup> and 7<sup>th</sup> case ending,

### **Chhanda**

- CO.01 Define rhyme and discuss about the various types of rhyme. (Chhanda)
- CO.02 Define Indravajra, Upendravajra, Vanshasthivilam, rathoddhata
- CO.03 Discuss about the concept of Malini, Mandakranta, Vasantatilaka, and Sragdhara.

### **Bhatti Kavya (Canto-II)**

- CO.01 Justify the remark in respect of Bhatti kavya, and Commentator of Bhatti Kavya.
- CO.02 Determine the place and importance of Bhatti kavyam as Mahakavya in Sanskrit literature.
- CO.03 Discuss Bhatti kavyam is a grammatical poem, or a poetical grammar.
- CO.04 Summarise the description of autumn.
- CO.05 Rama's encounter with Maricha.
- CO.06 Marriage of Sri Rama.

### **2<sup>nd</sup> Paper**

#### **Abhignyana Shakuntalam**

- CO.01 Kalidasa - His life and Writing
- CO.02 Date of Kalidasa.
- CO.03 Source of the play and the story of Mahabharata.
- CO.04 Principal characters in the play.
- CO.05 Act. 01- The Nandi, Introduction of the play wright, the hunting expedition, the conversation between the king and the hermit girls.
- CO.06 Act. 02- Vidushaka's soliloquy, the top between him and Dushyanta. The Commander - in chief enters, the hunting expedition ceases, the king recounts of confidence his love for Shakuntala to Vidushaka, Karavaka brings the queen mothers messege, Vidushaka in sent to the Capital.
- CO.07 Act.03- Prelude. A Pupil of Kanva describe the indisposition of Shakuntala, King Dushyanta, love -lorn, goes to the bank of river Malini, Shakuntala and herb two friends in a creeper bower. Shakuntalas love letter, the king's conversation, with the hermit girls which confirms Shakuntala's love for him.
- CO.08 Act.4- Prelude. Shakuntala, engrossed in thoughts about Dushyanta, fails to welcome Durvaasa's, who curses her.
- CO.09 Act.5- Hansapadika's song, Vidushaka is sent to appease her. the king learns about the arrival of the arrival of the sages and leaves for the fire chamber.

- CO.10 Act.6- Conversation between the fisherman and the City -Guards. Sanumati arrives with a desire to understand Dushyanta's feelings. Kanchuki prohibits the spring festival.
- CO.11 Act-7- The king's descent from heaven to Hemakuta mountain. the king gradually learns that Sarvadamana is his own son. Shakuntala arrives. Reunion, Maricha blesses Dushyanta , Shakuntala and Sarvadamana, Bharatakavya.

### **Swapnavasavadattam**

- CO.01 Discuss the brief about the Bhasa as a playwright and analyse his plays in short.
- CO.02 Discuss the brief about Nandi and Bharat vakya .
- CO.03 Explain the appropriateness of the title of the drama Swapnavasava Dattam.
- CO.04 Description of Swapnavasavadattam. - Act- 01
- CO.05 Description of Swapnavasavadattam. - Act- 02
- CO.06 Description of Swapnavasavadattam. - Act- 03
- CO.07 Description of Swapnavasavadattam. - Act- 04
- CO.08 Description of Swapnavasavadattam. - Act- 05
- CO.09 Description of Swapnavasavadattam. - Act- 06
- CO.10 Discuss the relevance of the Bramhachari episode.
- CO.11 Discuss the importance of the role played by Yaugandharayana in the development of the drama Swapnavasava Dattam.
- CO.12 Compare and contrast the characters of Padmavati and Vasav Datta.
- CO.13 Explain the Dream incident content in the Act five of the set Drama.

### **Sahityadarpanam (Chapter-VI)**

- CO.01 Discuss about the Vishwanatha.
- CO.02 Briefly discuss about ' Rupaka '
- CO.03 Describe about 'Nataka'.
- CO.04 Explain in brief about 'Nandi'.
- CO.05 Define 'Patakasthanam' and discuss about the types of it.
- CO.06 Briefly discuss about 'Sandhi' and discuss about types of it.

### **3<sup>rd</sup> Paper**

#### **Kadamvari of Banabhatta(Mahasvetavrttanta)**

- CO-1 Discuss about the contribution of Banbhatta in the literary field.
- CO-2 Critically analyses about the artistic approach of Banbhatta.
- CO-3 Briefly discuss about 'Gadyakavya'
- CO-4 Describe about Mahasweta's concept of aestheticism.

#### **Raghuvamsam(Canto-I)**

- CO-01 Kalidasa - His life and Writing
- CO-02 Date of Kalidasa.
- CO-03 Source of the Mahakavya and the story of Ramayana .
- CO-04 Principal characters in the Mahakavya.
- CO-05 The virtues of the king's of the race of Raghu , who's history he proposes to describe .
- CO- 06Dilipa is an ideal King being a most efficient , binign and virtuous rular.
- CO- 07Dilipa starts for vasishtha's hermitage in company of his wife.
- CO-08 Vasistha explains that a curse formerly pronounced upon the king by the dfevine cow suravi.
- CO-09 Vasistha explains to the royal pair how to serve the cow after which they retired for the night.

#### **Kiratarjuniyam(Canto-I)**

- CO-01 Discuss the detail about the Kiraterjuniyam.
- CO-02 Detail about the Bharavi.

- CO-03 Justify the significance of the title Kiraterjunyam.
- CO-04 Discuss the short description of the content of canto-1.
- CO-05 Explain the running system of Judhithiras kingdom by Banachara.
- CO-06 Explanation the news of Banachara by judhithira to his four Brother and Droupadi.
- CO-07 The influenced speech of Droupadi to Judhithira for war.
- CO-08 Significance the Kiratarjunyam as an Epic.
- CO-09 Discussion about different Almkara.

### **Sisupalavadham(Canto-1)**

- CO-01 Characteristics of a Sisupalvadam .
- CO-02 Sources of the main theme of the Sisupalavadham of Magha.
- CO-03 Description of naradas discent from heaven to the abode of Basudeva.
- CO-04 Describe the atrocites of Sisupalvadam as Hiranyakasipu and Ravana in his previous birth.
- CO-05 Speech of Narada to Sri Krishna .
- CO-06 Discuss about 'Maghe Santi Traya Guna'.

### **4<sup>th</sup> Paper**

### **Kavyalamkarsutravrtti(Adhikarana-I)**

- CO-01 Discuss the detail of Kavyalamkara.
- CO- 02Detail about the vamaana.
- CO-03 Discuss the writing style of vamaana in this poetry.
- CO-04 Discuss the short description of adhikarana-1.
- CO-05 Defination of Kavyalamkara and it's necessity of kavya.
- CO-06 Discussion about the necessity of kavya.
- CO-07 Defination and explanation of Kavyalamkara.
- CO-08 Discussion about the necessity of Kavya.
- CO-09 Discussion the detail about the Adhikary of this Poetry.
- CO-10 The deffination,section,explanation of each section with example of Riti.
- CO-11 Different classification of Kavyanga and their detail.
- CO-12 Different classification of kavya and their detail.
- CO-13 Discuss the detail about the Dasarupaka.

### **Sahityadarpanam(X)**

- CO-01 Discuss about Sabdalamkara and Arthalamkara.
- CO-02 Define Anupras Alamkara and mention the classification of it.
- CO-03 Define Slesa Alamkara and discuss about the types of it.
- CO-04 Discuss about the classiffication of Upama Alamkara.
- CO-05 Define Rupaka Alamkara and discuss about the various types of it.
- CO-06 Discuss about Atisyotkti Alamkara and its classification.
- CO-07 Discuss in brief about Arthantarnyasa Alamkara and the various types of it.
- CO-08 Discuss about the Virodavas Alamkara and give the classification of it.
- CO-09 Discuss about Ekabali Alamkara.
- CO-10 Discuss about Swavabokti Alamkara.

### **History of Sanskrit Literature**

- CO-01 Discuss in this context the different stages of the composition of the epic.
- CO-02 Discuss short introduction of Ramayana.
- CO-03 Explain the age of Ramayana.
- CO-04 Discuss short introduction of Mahabharata.
- CO-05 Explain the age of Mahabharata.
- CO-06 Name of the principal Puran as and discuss their characteristic features and importance.

- CO-07 Write an informative note on Mahakavya.  
CO-08 Discuss the origin and development of Sanskrit lyrics.  
CO-09 Critically discuss the source of Gadyakavya.  
CO-10 Discuss the main content of Campukavya.

**A brief outline of Post-Independence Sanskrit Literature with special reference to Bengal**

- CO-01 Discuss the main content of Post-Independence Sanskrit Literature.

**5<sup>th</sup> Paper**

**History of Vedic Literature**

- CO.01 Introduction of Vedic literature.  
CO.02 Discuss the Vedic period and the general survey of vedic age.  
CO.03 Discuss the Bramhana, Aranyaka and Upanishadas.  
CO.04 The age of Rigvedic Hymns and the extent of the shruti period.  
CO.05 Rigveda- Contents and Compilation , Rishis, Regvedic Metres and Gods.  
CO.06 Viniyoga and Applications of hymns note of Surya sukta, Akshasukta, Hiranyagarbha sukta, devisukta, and Samgnyana sukta .  
CO.07 Rigveda and their 21 branches, Rigvedic Upanishadas , and Sutras.  
CO.08 Discuss The Yajurveda.  
CO.09 The branches of Yajurveda -  
1. Shukla Yajurveda , 2. Krishna Yajurveda and their shakhas (Branches.)  
Yajur vedic yagnya, and Upanishadas.  
CO.10 The brief history of Samaveda. the Contents and Compilation and Swaras.  
1. Prathama, 2. Dwitiya. 3.Tritiya. 4.Chaturtha. 5. Mandra. 6. Atiswara. 7.Prenkha. 8. Abhigitam.  
9. Namanam.10. Vinatam. etc.  
CO.11 Discuss about Kauthum Shakha, Ranayani Shakha and Jaimini Shakha.  
CO.12 Discuss Gaana Bhaga- Agneya Parva, Aindra Parva, Pavamana Parva, Aranyaka Parva , Ooha and Oohya Gaana Parva. And the Samhita (Rik) Bhaga.  
CO.13 The brief history of Atharvaveda .  
CO.14 The Rishi , Metres, and the Contents and Compilation.  
CO.15 The branches - Paippalada, And Shaunaka, and their Upanishadar.  
CO.16 Atharvavedic Suktas- Prithivi etc.  
CO.17 Discuss about Pada patha, and Vikriti Patha.  
CO.18 Vedic Grammar - Upasargas, Infinitives, Gerund , Subjunctive , Aorist and Vedic Declension.

**Ishopanishada**

- CO.01. Discuss the Main Thing of Ishopanishadas.  
CO.02 Discuss the importance of the Upanishada in the history of Indian thought.  
CO.03 Discuss the Main Teaching of Ishopanishadas.  
CO.04 The Devotee of Vidya enters in to the more deep darkness than the devotee of Avidya.  
CO.05 The Worshipper of Sambhuti enters into the more darkness than the worshipper of Asambhuti.  
CO.06 Discuss according to the death and immortality..

**6<sup>th</sup> Paper**

**Siddhantakaumudi(Karakaprakarana)**

- CO-01 Discuss the detail about the Karaka.  
CO-02 Explanation the detail about the introduction sutra of Karaka.  
CO-03 Explanation the detail about different sutra of Karaka and their example.  
CO-04 Discuss about kartre Karakam.

- CO-05 Discuss about Karma Karakam.  
CO-06 Discuss about Karan Karakam.  
CO-07 Discuss about Sampradana Karakam.

### **Siddhantakaumudi(samasprakarana)**

- CO-01 Discuss the detail about the Samasa.  
CO-02 Explanation the detail about the introduction sutra of samasa.  
CO-03 Explanation the detail about different sutra of Abyayeebhasamasama and their example.  
CO-04 Discuss about Tatpurusha.  
CO-05 Discuss about Bahuvrihi.  
CO-06 Discuss about Dwandwa.  
CO-07 Discuss about Ekasesha.  
CO-08 Discuss about Sarbasamasasesha.  
CO-09 Discuss about Sarbasamasanta.  
CO-10 Discuss about Alukasamasama.

### **Linguistics**

- CO-01 Write a brief note on the Indo-Iranian branch of language.  
CO-02 Institute a comparison between Vedic and Classical Sanskrit.  
CO-03 Write note on various types of phonetic laws.  
CO-04 Show the main points of difference between Centum and Satam groups of language.  
CO-05 Elucidate with illustrations the relation between Sanskrit and Prakrita languages.

### **7<sup>th</sup> Paper**

#### **Manusamhita(chapt.-vii)**

- CO-01 Discuss the concept and sources of dharma.  
CO-02 Discuss the place of smriti in the history of Indian law.  
CO-03 Discuss the Manusamhita's date and history.  
CO-04 Date and history of Manu.  
CO-05 Discuss about the Rajadhama.  
CO-06 Administration of Punishment.CO-07 Different rules of warfare'

#### **Yajnavalkyasamhita(Vyavaharadhyaay verses 1-94,114-158)**

- CO-01 Discuss critically according to Yajnavalkya, are the four constituents of Vyavahara.  
CO-02 Give a detailed account of the law of debt according to Yajnavalkya.  
CO-03 Trace the importance of witness in a legal suit according to Yajnavalkya.  
CO-04 State the circumstances in which a husband is empowered to take women's property according to Yajnavalkya.  
CO-05 Discuss law of inheritance after Yajnavalkya Samhita.  
CO-06 Reproduce the observation of Yajnavalkya in respect of Boundary dispute.  
CO-07 Compare and contrast between Sahasa and Steya following Yajnavalkya.  
CO-08 Name the different types of sons mentioned by Yajnavalkya and add a short note on their rights and duties.

#### **Kautilya's Arthasastra:Adhikarana-1**

- CO-01 Give an account of the different varieties of Vidya as mentioned in the Arthasastra of Kautilya.  
CO-02 Discuss,according to Kautilya,the four classes and four stages of life as depicted therein.  
CO-03 Explain the utility of Indriyajaya according to Kautilya.



- CO-04 Give an account of Matrajannam as discussed by Kautilya.  
 CO-05 Discuss, after Kautilya, the life or behavior of a wise king Rajasribhriti from the account given in the Arthashastra of Kautilya.  
 CO-06 Discuss the different views of the ancient political thinkers regarding selection of Amatyas recorded in the Arthashastra.  
 CO-07 Discuss after Kautilya the role and function of ambassador.  
 CO-08 Write a note on the difference between Dutas and spies.  
 CO-09 Give after Kautilya a comprehensive account of Spies.  
 CO-10 Discuss after Kautilya the methods to be adopted by a king for self protection.

### **History of Dharmasastra**

- CO-01 Discuss the concept and sources of dharmasastra.  
 CO-02 State of Manusmriti's importance in the ancient Indian society.  
 CO-03 Discuss the principle tenets of Dharmasastras.

### **8<sup>th</sup> Paper**

#### **Indian Philosophy.**

- CO 1. Introductory Speech of Indian Philosophy.  
 CO 2. The Vedas, Brahmanas, and their Philosophy.  
 CO 3. General Observation on the systems of Indian Philosophy. Astika- Nastika and Emancipation (Moksha).

#### **Buddha Darshana**

- CO 4. Buddhist Philosophy -- Buddha: his life, Early Buddhist literature, and Aarya satya chatushtaya .  
 CO 5. Pratitya samutpada tatwa, Ashtaangik marga and Nirvaana.  
 CO 6. The Discussion of four School of Buddhadarshana.  
     a. Sautrantik  
     b. Vaibhashik  
     c. Yogachaara  
     d. Madhyamik  
 CO 7. Brief survey of the Evolution of Buddhist Thought.

#### **Jaina Darshanam**

- CO 8. Introductory Speech of Jaina Darshana  
 CO 9. The origin of Jainism and the life of Mahaveera  
 CO 10. The Doctrine of Relative Pluralism (Anekanta Vaada) and Sapta Bhangi nyaya.  
 CO 11. The Discussion of 2 School Shwetambara, and Digambara, and Pudgala  
 CO 12. Moksha (emancipation) according to Jaina Darshana.

#### **Nyaya - Vaisheshika**

- CO 13. Introductory Speech of Nyaya and Vaisheshika Darshana  
 CO 14. pramana, padartha, and Paramanuvaadah according to nyaya and Vaisheshika  
 CO 15. The nature of Perception Determinate (Savikalpak): and Indeterminate (Nirvikalpaka)  
 CO 16. Anuman, Sadhya, Paksha, Hetu, And Vyapti. Panchavayava Nyaya..  
 CO 17. The main doctrine of Nyaya and Vaisheshika

#### **Sankhya - yoga Darshana**

- CO 18. Introductory Speech of Sankhya and yoga Darshana  
 CO 19. Discussion about Kapil and Patanjali.

- CO 20. Guna, Pramana, Prakriti And Purusha according to Sankhya .  
 CO 21. Satkaryavaada, Panchavinshati tatwa, and nirishwar vaada.  
 CO 22. Chittabhumi : the cognitive process and some characteristics of Chitta according to Yoga. Ashtanga Yoga.  
 CO 23. Samadhi , Seshwar vaada. Criticism of Sankhya and Yoga.

### **Mimansa Darshana**

- CO 24. Introductory Speech of Mimansha Darshana  
 CO 25. Difference between Purva and Uttara mimansha.  
 CO 26. Akhyativaada, Pramana, (Swatah- Paratah)  
 CO 27. Ishwar, Karmavaada, Dharma, and Apurva (Apavarga)  
 CO 28. Mimansha as Philosophy and Mimansha as Ritualism.

### **A.Vedanta Darshana**

- CO 29. Vedanta Philosophy -- Acharya Shankara : his life, Vedanta and Shankara(788-820 A.D).  
 CO 30. The main idea of Vedanta philosophy. and the school.  
 CO 31. Ajnana (nescience), Adhyasa, Maya, satta trayam.  
 CO 32. Aatma, Jiva, Vivartavaada, Jaganmithyatwa, Pramana, and Khyati.  
 CO 33. Bramha, Definition of Bramha, and Jagat.  
 CO 34. Moksha (emancipation) According to Shankara Vedanta.

### **Charvaka Darshana**

- CO 35. Charvaka Philosophy :- Epistemology :- Perception is the only source of knowledge Refutation of inference and Testimony as sources of knowledge.  
 CO 36. The world is made of four elements.  
 CO 37. There is no soul, no God. and only one Praman.  
 CO 38. Jadavaada, Nirishwar Vaad, and Dehatmavaada.

### **Tarkasangraha of Annambhatta**

- CO 01. Annambhatta's definition of Padartha, Dravya and Guna.  
 CO 02. Definition of Smriti as following Dipika Tika.  
 CO 03. Annambhatta distinguish Between Smriti And Anubhava.  
 CO 04. Annambhatta's definition of Prama.  
 CO 05. Annambhatta does not consider Yathartha Smriti to be a kind of Prama.  
 CO 06. Discussion about whether according to this definition the cognition " there potness in the pot" can be called Prama.

### **Brihadaranyaka Upanishad**

- CO 01. The Principal of Brihadaranyaka Upanishada .  
 CO 02. Etymology and structure of Brihadaranyaka Upanishada  
 CO 03. The fourth chapter of Brihadaranyaka Upanishadas starts as a dialogue between Janaka and Yajnavalkya.  
 CO04. "Soul exist" theory and its philosophical implication of soteriology .  
 CO05. Discuss the widely cited "neti - neti". and Aatma tatwa .

## **Srimad Bhagavat Gita**

- CO01. Gita presents a synthesis of the concept of Dharma, Bhakti, Yoga, Gnyana.  
CO02. The fourth chapter of Gita called “ Gyaana-Karma Sanyasa Yoga”-  
CO03. Religion of knowledge - Krishna reveals that he has lived through many births , always teaching yoga for the protection of the pious and the impious and stresses the importance of accepting a Guru.

### **General**

#### **1st Paper**

- CO.01 The Alphabet ...  
CO.02 Rules of Sandhi  
CO.03 Swarasandhi, Halant Sandhi, Visargasandhi,  
CO.04 Subanta or Declension of nouns, substantive and adjective..  
CO.05 Bases ending in Vowels, bases ending in consonants. Irregular bases, word of Irregular declension  
CO.06 Pronouns and their declension,  
CO.07 Numerals and their declension,  
CO.08 Degree of Comparison.  
CO.09 Compounds....  
CO.10 Danta, Tatpurusha, Karmadharaya, Upapada, Bahubrihi, and avyayibhava.  
CO.11 Formation of Feminine bases....  
CO.12 Secondary Nominal bases derived by the addition of the taddhit or Secondary affixes.  
CO.13 Avyayas or Indeclinables  
CO.14 Prepositions , Adverbs, Particles, Conjunction, Interjection.  
CO.15 Conjugation of Verbs.  
CO.16 Active and Passive Voice  
CO.17 Introduction of Case ending  
CO.18 1<sup>st</sup> case ending , 2<sup>nd</sup> case ending , 3<sup>rd</sup> case ending , 4<sup>th</sup> case ending , 5<sup>th</sup> case ending , 6<sup>th</sup> and 7<sup>th</sup> case ending ,  
CO-19 Discuss the concept and sources of dharma.  
CO-20 Discuss the place of smriti in the history of Indian law.  
CO-21 Discuss the Manusamhita’s date and history.  
CO-22 Date and history of Manu.  
CO-23 Discuss about the Rajadhama.  
CO-24 Administration of Punishment.  
CO-25 Different rules of warfare’  
  
CO.26 The foreword of Kalidasa  
CO.27 The style of composition of Kalidasa  
CO.28 The source of Kumarsambhava  
CO.29 The Synopsis of 1<sup>st</sup> canto of Kumarsambhava  
CO.30 The Summaries of Kumarsambhava  
CO.31 The complexion of Himalaya according to Kumarsambhava  
CO.32 Discuss the Slokas of 1<sup>st</sup> Canto with vyakhya, tika, and grammatical aspects.

#### **2<sup>nd</sup> Paper**

- CO.01 Kalidasa - His life and Writing  
CO.02 Date of Kalidasa.  
CO.03 Source of the play and the story of Mahabharata .

CO.04 Principal characters in the play.

CO.05 Act. 01- The Nandi , Introduction of the play wright, the hunting expedition, the conversation between the king and the hermit girls.

CO.06 Act. 02- Vidushaka's soliloquy , the top between him and Dushyanta. The Commander - in chief enters , the hunting expedition ceases , the king recounts of confidence his love for Shakuntala to Vidushaka, Karavaka brings the queen mothers messege, Vidushaka in sent to the Capital.

CO.07 Act.03- Prelude . A Pupil of Kanva describe the indisposition of Shakuntala , King Dushyanta , love -lorn, goes to the bank of river Malini, Shakuntala and herb two friends in a creeper bower. Shakuntalas love letter , the king's conversation ,with the hermit girls which confirms Shakuntala's love for him.

CO.08 Act.4- Prelude. Shakuntala, engrossed in thoughts about Dushyanta ,fails to welcome Durvaasa's,who curses her.

CO.09 Act.5- Hansapadika's song,Vidushaka is sent to appease her. the king learns about the arrival of the arrival of the sages and leaves for the fire chamber.

CO.10 Act.6- Conversation between the fisherman and the City -Guards. Sanumati arrives with a desire to understand Dushyanta's feelings. Kanchuki prohibits the spring festival.

CO.11 Act-7- The king's descent from heaven to Hemakuta mountain. the king gradually learns that Sarvadamana is his own son. Shakuntala arrives. Reunion, Maricha blesses Dushyanta , Shakuntala and Sarvadamana, Bharatakavya.

1. The author of *Hitopadesa* has been contested. The 19th-century Indologists attributed the text to Vishnu Sharma, a narrator and character that often appears in its fables. Upon the discovery of the oldest known manuscript of the text in Nepalese mountains, and dated to 1373 CE, followed by the preparation of a scholars generally accept two concluding verses as stating the author and patron of the text. These two verses mention [Narayana](#) as the author and a king called Dhavala Chandra as the patron of the text
2. The Mitralabhas introduced with the statement that wise and sincere friends may be poor or destitute, but it is they who may help one achieve successes in life. The book recommends that the good find good friends, they are like a vessel in which one deposits both joys and sorrows of life, and it is not words that define a friend but their behavior and actions.
- 3.

CO.12 The pigeons, the crow, the mouse, the tortoise and the de

CO.13 The traveler and the tiger

CO.14 The deer, the jackal and the crow

CO.15 The blind jackal, the cat and the birds

CO.16 The history of Hiranyaka the mouse

CO.17 The old man and his young wife

CO.18 The huntsman, the deer, the boar, the serpent and the jackal

CO.19 The rajah's son and the merchant's wife

CO.20 The jackal and the elephant

CO.21 Define rhyme and discuss about the various types of rhyme. (Chhanda )

CO.22 Define Indravajra, Upendravajra, Vanshasthivilam, rathoddhata

CO.23 Discuss about the concept of Malini, Mandakranta, Vasantatilaka, and Sragdhara.

4.

### **3<sup>rd</sup> Paper**

- CO-01 Discuss in this context the different stages of the composition of the epic.
- CO-02 Discuss short introduction of Ramayana.
- CO-03 Explain the age of Ramayana.
- CO-04 Discuss short introduction of Mahabharata.
- CO-05 Explain the age of Mahabharata.
- CO-06 Name of the principal Puran as and discuss their characteristic features and importance.
- CO-07 Write an informative note on Mahakavya.
- CO-08 Discuss the origin and development of Sanskrit lyrics.
- CO-09 Critically discuss the source of Gadyakavya.
- CO-10 Discuss the main content of Campukavya.
- CO.11. Discuss the Main Thing of Ishopanishadas.
- CO.12 Discuss the importance of the Upanishada in the history of Indian thought.
- CO.13 Discuss the Main Teaching of Ishopanishadas.
- CO.14 The Devotee of Vidya enters in to the more deep darkness than the devotee of Avidya.
- CO.15 The Worshipper of Sambhuti enters into the more darkness than the worshipper of Asambhuti.
- CO.16 Discuss according to the death and immortality..

### **4<sup>th</sup> paper**

- CO.01 Introduction of Vedic literature.
- CO.02 Discuss the Vedic period and the general survey of vedic age.
- CO.03 Discuss the Bramhana, Aranyaka and Upanishadas.
- CO.04 The age of Rigvedic Hymns and the extent of the shruti period.
- CO.05 Rigveda- Contents and Compilation , Rishis, Regvedic Metres and Gods.
- CO.06 Discuss about the Vishwanatha.
- CO.07 Briefly discuss about ' Rupaka '
- CO.08 Describe about 'Nataka'.
- CO.09 Explain in brief about 'Mahakabya'.
- CO.10 Define 'Gadyakavya' and discuss about the types of it.
- CO.11 Briefly discuss about 'Prakaranam'.
- CO-12 Describe in brief the growth and development of Medical Science.
- CO-13 Trace the history and development of the work on Ayurveda.
- CO-14 Give an account of the lexical literature in Sanskrit.
- CO-15 Discuss about the work Chandomanjari.
- CO-16 Discuss about Grammatical literature.
- CO-17 Discuss the influce of Astrology on Indian life and socity.

### **MA 1<sup>st</sup> Semester**

#### **Paper-101**

- CO-01 Rigveda- Contents and Compilation , Rishis, Regvedic Metres and Gods.

- CO-02 Viniyoga and Applications of hymns note of agni sukta, purusa, sukta, Kala sukta Nasadiya and Usa sukta .
- CO-03 Discuss The Yajurveda.
- CO-04 Discuss about Sivasamkalpa sukta of Yajurveda.
- CO-05 Explain about pancamahayajna of Satapatha Brahmana.
- CO-06 Discuss briefly about Sunahsepa Akhyana.
- CO-07 Justification Jajurveda in the explation of veda as first.
- CO-08 Justfication the features and evidence of Veda.
- CO-09 Justification the evidence of mantravaga in Veda.
- CO-10 Justification the evidence of the rules of Brahmana Vaga in Veda.
- CO-11 Justification the evidence of Arthabada in Brahmanavaga.
- CO-12 Justification if veda was written by person on not.
- CO-13 Justification the necessity was seen or unseen in learning the Veda.
- CO-14 Discuss about the suitable lerner to learn the Veda.

### **Paper-102**

- CO-01 Analysis of the Mantra of Kenopanisad.
- CO-02 Discuss relation between Jaiminiya Brahmana and Kenopanisad.
- CO-03 Explain briefly Atharvavedic Kenopanisad and its bhasya by Sankaracarya.
- CO-04 Distinction in approach of the two bhasyas.
- CO-05 Discuss the Meaning of Parabrahman.
- CO- 06 Explain briefly Abstruseness of Kenopanisad.
- co o7 Discuss the concept of nama and Akhyata, Meaning of Upasarga.
- co o8 Discuss The Meaning and categories of Nipatas, Sadbhavavikara.
- co o9 Discuss the following words Acarya, vira, Go, Samudra, vrtr, Aditya, usa.
- co 10 Distinction in Megha, Vak, Udaka Nadi, Asva jatavedas, Vaisvanara, Nighantu.

### **Paper-103**

- CO-01 History of pre Paniniyam age & Paniniyam age.
- CO-02 Explain briefly about Dixsit Brritti.
- CO-03 Discuss difference between Sutra and Brritti.
- CO-04 Justification the necessity of Kasika Brritti in learning the Samga Parivasa .
- CO-05 Discuss about halantam, Aadirantyena saheta, mukhanasikabcnoanunasikaha, Iko0 Guna bridhi, Paraha Sannikarsa Samhita, na Beti Bivasa, Taparstat Kalasya.
- CO-06 Elaborate Properly about “pratyagrahane ysmat sa Bihitastadadestadantasya Grahanam’, ’Ajadivih stritvasya Bisesanatreha -pancanji’
- CO-07 Explain Briefly Padasadhana about Pacanti, kurucari, Aja, Bhabati, Karika.

### **Paper-104**

- CO-01 Discuss with illustration the development of Indo-European language.
- CO-02 Write a brief note on the Indo-Iranian branch of language.
- CO-03 Institute a comparison between Vedic and Classical Sanskrit.
- CO-04 Write note on various types of phonetic laws.
- CO-05 Show the main points of differenc between Centum and Satam groups of language.
- CO-06 Elucidate with illustrations the relation between Sanskrit and Prakrita languages.
- CO-07 Describe briefly about manuscript and Manuscriptology.
- CO-08 Discuss about cataiogus and Catalogorum.
- CO-09 Explain briefly the causes of divergent reading in manuscripts of a text.
- CO-10 Discuss about the Recension.
- CO-11 Dscribe properly on Bower Manuscript.
- CO-12 Describe in brief the growth and development of Medical Science.
- CO-13 Trace the history and development of the work on Ayurveda.

- CO-14 Give an account of the lexical literature in Sanskrit.  
 CO-15 Discuss about the work Chandomanjari.  
 CO-16 Discuss about Grammatical literature.  
 CO-17 Discuss the influence of Astrology on Indian life and society.

<b>Curriculum for B.Sc. Honours in Zoology</b>	
<b>CBCS</b>	
	<b><u>C1T1 – Non-Chordates I</u></b>
<b>COURSE-I:</b>	<b>Basics of Animal Classification</b>
CO-1	Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy
CO-2	Taxonomic types
CO-3	Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy
CO-4	Six kingdom concept of classification (Card woese)
<b>COURSE-II:</b>	<b>Protista and Metazoa</b>
CO-1	Protozoa General characteristics and
CO-2	Classification of protozoa up to phylum (according to Levine et. al., 1981)
CO-3	Locomotion in <i>Euglena</i> , and <i>Amoeba</i> ;
CO-4	Locomotion in <i>Paramecium</i>
CO-5	Locomotion in <i>Amoeba</i>
CO-6	Conjugation in <i>Paramecium</i>
CO-7	Life cycle and pathogenicity of <i>Plasmodium vivax</i>
CO-8	Life cycle and pathogenicity of <i>Entamoeba histolytica</i>
CO-9	Evolution of symmetry of Metazoa
CO-10	Evolution of segmentation of Metazoa
<b>COURSE-III:</b>	<b>Porifera</b>
CO-1	General characteristics and Classification up to classes.
CO-2	Metagenesis in <i>Obelia</i> & <i>Aurelia</i>
CO-3	Metagenesis in <i>Aurelia</i>
CO-4	Polymorphism in Cnidaria
CO-5	Corals and coral reef
CO-6	coral reef diversity, function & conservation
<b>COURSE-IV</b>	<b>Cnidaria</b>
CO-1	General characteristics
<b>COURSE-V</b>	<b>Platyhelminthes</b>
CO-1	General characteristics and Classification up to classes
CO-2	Life cycle and pathogenicity and control measures of <i>Fasciola hepatica</i>
CO-3	Life cycle and pathogenicity and control measures of <i>Taenia solium</i>

<b>COURSE- VI</b>	<b>Nematoda</b>
CO-1	General characteristics and Classification up to classes
CO-2	Life cycle, and pathogenicity and control measures of <i>Ascaris lumbricoides</i>
CO-3	Life cycle, and pathogenicity and control measures of <i>Wuchereria bancrofti</i>
CO-4	Parasitic adaptations in helminthes
	<b><u>C2 T2 –Ecology</u></b>
<b>COURSE- I:</b>	<b>Introduction to Ecology</b>
CO-1	History of ecology, Autecology and synecology, Levels of organization,
CO-2	Laws of limiting.
CO-3	factors, Study of Physical factors,
CO-4	The Biosphere.
<b>COURSE- II:</b>	<b>Population</b>
CO-1	Unitary and Modular populations
CO-2	Unique and group attributes of population: Demographic factors,
CO-3	life tables, fecundity tables,
CO-4	survivorship curves, dispersal and dispersion.
CO-5	Geometric, exponential and logistic growth, equation and patterns,
CO-6	r and K strategies Population
CO-7	regulation - density-dependent and independent factors, Population Interactions,
CO-8	Gause's Principle with laboratory and field examples,
CO-9	Lotka-Volterra equation for competition.
<b>COURSE- III:</b>	<b>Community</b>
CO-1	Community characteristics
CO-2	species diversity, abundance, , dominance, richness,
CO-3	Vertical stratification, Ecotone and edge effect.
CO-4	Ecological succession with one example
<b>COURSE- IV</b>	<b>Ecosystem</b>
CO-1	Types of ecosystem with an example in detail, Food chain: Detritus and grazing food chains, Food web,
<b>COURSE- V</b>	Linear and Y-shaped food chains
CO-1	Energy flow through the ecosystem,
CO-2	Ecological pyramids
CO-3	Ecological efficiencies
CO-4	Nutrient and biogeochemical cycle with an example of Nitrogen cycle
CO-5	Human modified ecosystem
<b>COURSE- VI</b>	<b>Applied Ecology</b>
CO-1	Wildlife Conservation (in-situ conservation).
CO-2	Wildlife Conservation (ex-situ conservation).
CO-3	Management strategies for tiger conservation; Wild life protection act (1972)
CO-4	Wild life protection act (1972)
	<b><u>C1 P1 –Non-Chordates I Lab</u></b>



<b>COURSE-I:</b>	<b>Non-Chordates</b>
CO-1	Study of whole mount of <i>Euglena</i>
CO-2	Study of whole mount of <i>Amoeba</i>
CO-3	Study of whole mount of <i>Paramecium</i>
CO-4	Identification of <i>Amoeba, Euglena, Entamoeba</i>
CO-5	Identification of <i>Opalina, Paramecium,</i>
CO-6	Identification of <i>Plasmodium vivax</i> and <i>Plasmodium falciparum</i>
CO-7	Identification of <i>Sycon, Neptune's Cup, Obelia</i>
CO-8	Identification of <i>Physalia, Millepora, Aurelia,</i>
CO-9	Identification of <i>Tubipora, Corallium, Alcyonium,</i>
CO-10	Identification of <i>Gorgonia, Metridium, Pennatula</i>
CO-11	Identification of <i>Fungia, Meandrina, Madrepora</i>
CO-12	Identification and significance of adult <i>Fasciola hepatica</i>
CO-13	Identification and significance of <i>Taenia solium</i> and <i>Ascaris lumbricoides</i>
CO-14	Staining/mounting of any protozoa/helminth from gut of cockroach
	<b><u>C2 P2 –Ecology Lab</u></b>
CO-1	Study of life tables from the hypothetical/real data provided
CO-2	plotting of survivorship curves of different types from the hypothetical/real data provided
CO-3	Determination of population density in a natural/hypothetical community by quadrat method
CO-4	Determination of calculation of Shannon-Weiner diversity index for the same community
CO-5	Study of an aquatic ecosystem: Phytoplankton
CO-6	Study of an aquatic ecosystem: zooplankton,
CO-7	Study of an aquatic ecosystem: Measurement of area, temperature,
CO-8	Study of an aquatic ecosystem: turbidity/penetration of light, determination of pH,
CO-9	Study of an aquatic ecosystem: Dissolved Oxygen content (Winkler's method),
CO-10	Study of an aquatic ecosystem: Chemical Oxygen Demand
CO-11	Study of an aquatic ecosystem: free CO <sub>2</sub>
	<b>3 Tier Examination Pattern</b>
	<b>Paper- III</b>
<b>COURSE-I:</b>	<b>Introduction to Ecology</b>
CO-1	Introduction, subdivisions of ecology
CO-2	scope of ecology
CO-3	Concept and Components of Ecosystem
CO-4	Ecological factors: i) Abiotic: light and their effects on animals
CO-5	ii) Biotic: intra-specific and inter specific associations
CO-6	Types of ecosystem with an example in detail, Food chain: Detritus and grazing food chains, , Food web, Ecological pyramids
CO-7	Linear and Y-shaped food chains
CO-8	Energy flow through the ecosystem,
CO-9	Population Ecology : Natality & mortality,
CO-10	Population growth forms,
CO-11	Population age pyramids,
CO-12	regulation of population density

CO-13	Community characteristics
CO-14	species diversity, abundance, , dominance, richness,
CO-15	Vertical stratification, habitat & niche concept, Ecotone and edge effect.
CO-16	Ecological succession with one example
<b>COURSE- II</b>	<b>Ethology</b>
CO-1	Introduction to animal behaviour
CO-2	Innate behaviour
CO-3	learned behaviour
CO-4	fixed action pattern
CO-5	Learning and memory
CO-6	Biological rhythm
CO-7	Communication: Bee's dance language.
CO-8	Auditory signals,
CO-9	Chemicals communication.
CO-10	Bioluminescence in communication.
<b>COURSE- III</b>	<b>Environmental Biology and Environmental Management</b>
CO-1	Environmental toxicology
CO-2	LC50; LD50
CO-3	acute & chronic toxicity
CO-4	Environmental degradation
CO-5	natural & man-made pollution
CO-6	nature, sources & effects of major pollutants of air
CO-7	nature, sources & effects of major pollutants of water
CO-8	noise pollution
<b>COURSE- IV</b>	<b>Parasitology</b>
CO-1	Basic facts related to Parasitology, related terminologies
CO-2	Life cycle, pathogenicity, clinical features, control and zoonotic aspects of Plasmodium vivax
CO-3	Life cycle, pathogenicity, clinical features, control and zoonotic aspects of Plasmodium falciparum
CO-4	Life cycle, pathogenicity, clinical features, control and zoonotic aspects of Entamoeba histolytica
CO-5	Life cycle, pathogenicity, clinical features, control and zoonotic aspects of Wuchereria bancrofti
CO-6	Life cycle, pathogenicity, clinical features, control and zoonotic aspects of Echinococcus granulosus
CO-7	Vectors: Bio-ecology of Mosquitoes; role in disease transmission and control
CO-8	Vectors: Bio-ecology of Ticks; role in disease transmission and control
<b>COURSE- V</b>	<b>Immunology</b>
CO-1	Cells and organs in Immunity
CO-2	Outline structure and classification of immunoglobulin
CO-3	Concept of antigen, hapten, carrier and adjuvant
CO-4	Antigen-antibody interaction
CO-5	innate immune system with special reference to process
CO-6	Acquired immune system with special reference to process

CO-7	types and principle of vaccination
CO-8	Humoral and cell mediated immune system.
CO-9	T & B Cell co-operation
CO-10	antibody production and role of T cells
CO-11	cytokines
CO-12	Gel diffusion
CO-13	Immunoelectrophoresis; Immunofluorescence
CO-14	RIA; ELISA
CO-15	monoclonal antibody technique
<b>COURSE- VI</b>	<b>Biodiversity</b>
CO-1	Concept of biodiversity : Types of biodiversity
CO-2	biodiversity & human welfare
CO-3	Megadiversity countries
CO-4	Biodiversity Hotspots with special reference to India
CO-5	<i>In situ</i> conservation.
CO-6	<i>ex situ</i> conservation
CO-7	Wildlife (protection) Act & Schedules.
CO-8	Conservation of tiger
CO-9	Bioethics
CO-10	biosafety
<b>COURSE- VII</b>	<b>Economic Zoology</b>
CO-1	Aquaculture: resources in India;
CO-2	Induced breeding of carps; ecohatchery (basic concept);
CO-3	polyculture of fin fish; exotic fishes & their role;
CO-4	Fish diseases, symptoms & control;
CO-5	freshwater& brackish water prawn culture;
CO-6	fish byproducts & uses.
CO-7	Ornamental fishery,
CO-8	hatching of egg, rearing,
CO-9	aquarium management
CO-10	Sericulture : silk varieties in India; mulberry silkworm culture;
CO-11	Extraction & reeling of silk;
CO-12	natural enemies & diseases of silkworm and their control
CO-13	Apiculture: species of honey-bees in India; life history of <i>Apis cerana indica</i> ;
CO-14	apiculture technique; bee products & uses;
CO-15	Natural enemies & diseases of honey bees and their control.
CO-16	Basic idea of pest control methods & IPM.
CO-17	Life cycle of <i>Apion</i> and <i>Sitophilus</i>
CO-18	Animal husbandry: common poultry breeds (fowl),
CO-19	poultry breeds rearing methods, diseases & control
	<b>Paper- IV</b>
<b>COURSE- I:</b>	<b>Microbiology</b>
CO-1	Elementary knowledge on the organisational diversity of microorganisms with special reference to virus
CO-2	Elementary knowledge on the organisational diversity of microorganisms with

	special reference to bacteria
CO-3	Culture of bacteria
CO-4	Staining of bacteria (Gram's staining and Acid fast staining).
CO-5	Microbial Genetics-. Conjugation,
CO-6	Microbial Genetics-. Transformation
CO-7	Microbial Genetics-. transduction
CO-8	Applied Microbiology : Dairy-microbiology of milk & milk products;
CO-9	Agriculture-microbes in pest control & pesticides degradation;
CO-10	Common microbes in relation to serious endemic diseases (Cholera).
CO-11	Common microbes in relation to serious endemic diseases (AIDS).
CO-12	Common microbes in relation to serious endemic diseases (Shigella).
CO-13	Physical Control of Microbes
CO-14	Chemical Control of Microbes
CO-15	Sterilization
CO-16	Types of antibiotics
<b>COURSE-II</b>	<b>Biostatistics</b>
CO-1	Definition of sample and population in biometry
CO-2	frequency distribution
CO-3	histograms
CO-4	X~Y curves
CO-5	Pie chart
CO-6	Measures of central tendencies (mean);
CO-7	Measures of central tendencies (median);
CO-8	Measures of central tendencies(mode);
CO-9	Dispersion (SD).
CO-10	Dispersion (SE& variance).
CO-11	Analysis of simple correlation & related problems
CO-12	Analysis of regression & related problems
CO-13	Basic concept of hypothesis testing: Chi-square & Related problems
CO-14	Basic concept of hypothesis testing:Student-test & Related problems
<b>COURSE-III</b>	<b>Computer Application</b>
CO-1	Elementary idea of Desktop Computer devices: CPU; VDU
CO-2	Elementary idea of Desktop Computer devices: Key board; mouse; FD drive;
CO-3	Elementary idea of Desktop Computer devices: CDIDVD ROM drive; RAM.
CO-4	Concept of Internet
CO-5	Internet use in information collection
<b>COURSE-IV</b>	<b>Bio-informatics</b>
CO-1	Basic concept of Bioinformatics
CO-2	Internet based tool for DNA
CO-3	Internet based tool for protein sequence databases
CO-4	PUBMED
CO-5	ERRICA
<b>COURSE-V</b>	<b>Histology</b>
CO-1	Histology of liver

CO-2	Histology of endocrine pancreas
CO-3	Histology of kidney
CO-4	Histology of thyroid
CO-5	Histology of pituitary
<b>COURSE- VI</b>	<b>Histochemistry</b>
CO-1	Histological techniques: Fixation & fixatives
CO-2	Staining principles
CO-3	Staining with haematoxyline & eosin
CO-4	outline classification of dyes
CO-5	Basic concept of histochemistry.
CO-6	PAS,
CO-7	Millon's reaction
CO-8	Sudan Black B
<b>COURSE- VII</b>	<b>Endocrinology</b>
CO-1	Definition of endocrine glands;
CO-2	Hormones in the regulation of the body function with special reference to the carbohydrate.
CO-3	Hormones in the regulation of the body function with special reference to calcium metabolism
CO-4	Functions of hypothalamus, pituitary
CO-5	Functions of thyroid, parathyroid, adrenal
CO-6	Functions of pancreas, testis & ovary
CO-7	Types, sources & functions of steroid hormones
CO-8	Types, sources & functions of peptide hormones
CO-9	Endocrinology of Thyroid,
CO-10	Endocrinology of Testis
CO-11	Endocrinology of Ovary
CO-12	Mode of action of Insulin
CO-13	Role of Parathormone in calcium metabolism
CO-14	Local hormones
CO-15	Local hormones' functions
<b>COURSE- VIII</b>	<b>Bioinstrumentation</b>
CO-1	Basic principle of optical microscopes
CO-2	Basic principle of electron microscopes TEM, SEM
CO-3	Phase contrast microscopes
CO-4	Resolving power, Resolution and Magnification
CO-5	Electrophoresis,
CO-6	chromatography
CO-7	spectrophotometer
	<b>Paper- V (Practical)</b>
<b>COURSE- I:</b>	<b>Dissections</b>
CO-1	Earthworm : Nervous system
CO-2	Earthworm : reproductive system
CO-3	Cockroach : Nervous system

CO-4	Cockroach : male reproductive system
CO-5	Rohu: Afferent
CO-6	Rohu: Efferent branchial arteries
CO-7	Rohu: IXth & Xth Cranial nerves
CO-8	Salivary apparatus of cockroach (hypopharynx to be retained).
CO-9	Mouthparts of cockroach.
CO-10	Female reproductive system of cockroach
CO-11	Nerve ring of earthworm
CO-12	Septal nephridia of earthworm
CO-13	Brain & pituitary gland of Rohu
<b>COURSE-II</b>	<b>Computer Application</b>
CO-1	Use of Windows based software: manipulation of files (in MS Office) file creation & deletion,
CO-2	Use of Windows based software: manipulation of files (in MS Office) Protection; renaming; editing);
CO-3	handling database (in MS Access / MS Excel or any other) –making tables
CO-4	handling database (in MS Access / MS Excel or any other) –making charts (Pie, Bar, Polygon etc.).
CO-5	Use of statistical formulas in Excel.
<b>COURSE-III</b>	<b>Cytology</b>
CO-1	Study of meiosis from grasshopper
CO-2	Pedigree analysis –Autosomal
CO-3	Pedigree analysis- sex linked
CO-4	Biostatistics- chi square test
<b>COURSE-IV</b>	<b>Histology</b>
CO-1	Section cutting, staining of histological tissues and mounting of liver, lungs
CO-2	Section cutting, staining of histological tissues and mounting of stomach, pancreas
CO-3	Section cutting, staining of histological tissues and mounting of thyroid, kidney
CO-4	Section cutting, staining of histological tissues and mounting of ovary & testis
<b>COURSE-V</b>	<b>Histochemistry</b>
CO-1	Histochemical detection of carbohydrate by PAS
CO-2	Histochemical detection of protein & lipid by Millon's test
CO-3	Histochemical detection of lipid by Sudan Black B techniques
CO-4	Identification of T. S. of liver, pancreas, thyroid
CO-5	Identification of T. S. of kidney, ovary & testis
CO-6	Identification of T. S. of lungs, adrenal, stomach
<b>COURSE-VI</b>	<b>Developmental Biology</b>
CO-1	Identification of whole mount of chick embryo (24h; 48h).
CO-2	Identification of whole mount of chick embryo (72h, 96h).
CO-3	Identification of cleavage stage (blastula & gastrula of frog).
	<b>Paper – VI Theory</b>
<b>COURSE-I:</b>	<b>Molecular Biology</b>

CO-1	Genetics of cell cycle,
CO-2	checkpoints of cell cycle
CO-3	enzymes and proteins associated with replication in prokaryotes
CO-4	process of replication in prokaryotes
CO-5	enzymes and proteins associated with transcription in prokaryotes
CO-6	process of transcription in prokaryotes
CO-7	enzymes and proteins associated with translation in prokaryotes
CO-8	process of translation in prokaryotes
CO-9	Post transcriptional modifications
CO-10	Splicing
CO-11	types of Splicing
CO-12	basic steps of Splicing
CO-13	Molecular basis of Mutation
CO-14	Molecular basis of Mutation-origin
CO-15	Molecular basis of Mutation- types
CO-16	Elementary idea of mitochondrial and chloroplast DNA
CO-17	Elementary idea of Centromeric, telomeric
CO-18	Elementary idea of selfish DNA, C value paradox
CO-19	Regulation of gene expression: Lac operon
CO-20	Regulation of gene expression: Tryp operon
CO-21	Concept of Oncogene
CO-22	Concept of Oncogene regulation
<b>COURSE- II:</b>	<b>Biotechnology</b>
CO-1	Elementary idea of animal biotechnology
CO-2	basic steps of gene cloning
CO-3	cDNA and genomic library
CO-4	restriction endonuclease-action
CO-5	restriction endonuclease- types
CO-6	restriction endonuclease- steps
CO-7	use of PCR
CO-8	Vermitechnology- basic steps
CO-9	Principle of animal cell culture
CO-10	Media and its types of animal cell culture
<b>COURSE- III:</b>	<b>Biophysics</b>
CO-1	Osmosis; diffusion
CO-2	Donnan membrane equilibrium; pH
CO-3	buffers.Importance Physiological buffer system
CO-4	Laws of thermodynamics; fundamentals of energy concepts
CO-5	Calculation of $G^0$
<b>COURSE- IV</b>	<b>Biochemistry</b>
CO-1	Classification, structure and biological role of carbohydrate
CO-2	Classification, structure and biological role of protein (upto quaternary structure)
CO-3	Classification, structure and biological role of lipid
CO-4	Carbohydrate metabolism - glycogenolysis;

CO-5	Carbohydrate metabolism -gluconeogenesis.
CO-6	Elementary idea of biological oxidation
CO-7	Oxidative phosphorylation
CO-8	electron transport chain.
CO-9	Protein metabolism-Transamination
CO-10	Protein metabolism- deamination
CO-11	urea cycle
CO-12	Lipid metabolism
CO-13	oxidation of fatty acid
CO-14	Enzymes, properties, types
CO-15	enzyme kinetics;
CO-16	Factors affecting enzyme activity.
<b>COURSE-V</b>	<b>Animal Physiology</b>
CO-1	Ultra structure of muscle
CO-2	chemical basis of skeletal muscle contraction
CO-3	physiological basis of skeletal muscle contraction
CO-4	Structure of mammalian nephron;;
CO-5	physiology of urine formation
CO-6	osmoregulators & osmoconformers
CO-7	Nature of nerve impulse along a neuron;
CO-8	origin and propagation of nerve impulse along a neuron;
CO-9	Synaptic & myoneuronal junctions
CO-10	Transport of O <sub>2</sub> in mammals;
CO-11	Transport of CO <sub>2</sub> in mammals;
CO-12	Bohr and Haldane Effects; Chloride shift.
CO-13	Temperature regulation in polar bear
CO-14	Temperature regulation in desert mammals
CO-15	Oestrous cycle and their regulation
CO-16	menstrous cycle and their regulation
	<b>Paper – VII Practical</b>
<b>COURSE-I:</b>	<b>Parasitology</b>
CO-1	preparation of gut content of cockroach,
CO-2	preparation of gut content of fowl
CO-3	seminal vesicle smear from earthworm for observation on endoparasites.
<b>COURSE-II:</b>	<b>Immunobiology</b>
CO-1	isolation of lymphocyte from blood;
CO-2	isolation of lymphocyte from spleen
CO-3	identification of lymphoid cells from prepared slides (spleen, lymph gland)
CO-4	identification of lymphoid cells from prepared slides (bursafabriceous)
CO-5	determination of blood group (ABO & Rh)
CO-6	Demonstration of ELISA
CO-7	Immunofluorescence technique/blotting.
<b>COURSE-III</b>	<b>Microbiology</b>
CO-1	Preparation of culture media



CO-2	culture of microorganisms
CO-3	staining of microbes (Gramstain).
<b>COURSE-IV</b>	<b>Biochemistry</b>
CO-1	Qualitative tests for carbohydrate (glucose, fructose, Lactose/Maltose,)
CO-2	Qualitative tests for carbohydrate (Sucrose, Starch, Dextrin), Protein
CO-3	Protein (albumin/globulin, gelatine, peptone).
CO-4	Quantitative test- colorimetric analysis (Lowry's method) of protein
<b>COURSE-V</b>	<b>Animal Physiology</b>
CO-1	Estimation of Hb
CO-2	differential count; total count;
CO-3	determination of CT, BT & ESR (for white rat);
<b>COURSE-VI</b>	<b>Biochemistry,</b>
CO-1	Tests of ammonia in the urine Of fish (aquarium water) / toad, bird guano and cow respectively);
CO-2	Tests of uric acid in the urine Of fish (aquarium water) / toad, bird guano and cow);
CO-3	Tests of urea in the urine offish (aquarium water) / toad, bird guano and cow);
CO-4	Tests of ammonia in the urine Of toad, bird guano and cow respectively);
CO-5	Tests of uric acid in the urine Of toad, bird guano and cow respectively);
CO-6	Tests of urea in the urine of bird guano and cow respectively);
<b>COURSE-VII</b>	<b>Biophysics</b>
CO-1	use of pH meter
CO-2	estimation of pH of solutions
CO-3	Demonstration to students on the use of digital balance
CO-4	Demonstration to students on the use of homogeniser
CO-5	Demonstration to students on the use of spectrophotometer
CO-6	Demonstration to students on the use of Electrophoresis
CO-7	Demonstration to students on the use of centrifuge machine
	<b>Paper – VIII Practical</b>
<b>COURSE-I:</b>	<b>Ecology and Environmental Management</b>
CO-1	Determination of dissolved O <sub>2</sub> ,
CO-2	Determination of: free CO <sub>2</sub> ,
CO-3	Determination of alkalinity
CO-4	Determination of salinity
CO-5	Determination of hardness.
CO-6	Determination of LC <sub>50</sub>
CO-7	Determination of LD <sub>50</sub> of a pollutant.
CO-8	Qualitative Study of Zooplankton
CO-9	Quantitative Study of Zooplankton
<b>COURSE-II</b>	<b>Identification OF Non-chordates</b>
CO-1	Identification of <i>Elphidium</i> , <i>Scypha</i> (= <i>Sycon</i> ), <i>Neptune's cup</i> , <i>Aurelia</i> , <i>Pennatula</i> , <i>Physalia</i> ,

CO-2	Identification of <i>Sea-anemone, Madripora, Beroe, Nereis, Patella, Aplysia</i>
CO-3	Identification of <i>Chaetopterus, Aphrodite, Squilla, Hippa, Eupagurus,</i>
CO-4	Identification of <i>Carcinoscorpius, Peripatus, Belostoma, Chiton, , Mytilus,</i>
CO-5	Identification of <i>Sepia, Loligo, Octopus, Asterias, Astropecten, Sea-urchin, sea-lily, Hemichordate.</i>
<b>COURSE-III</b>	<b>Identification of Chordates;</b>
CO-1	Identification of <i>Branchiostoma, Ascidia, Petromyzon, Myxine, Torpedo,</i>
CO-2	Identification of <i>Sphyrnma, Exocoetus, Hippocampus, Echinus, Ichthyophis, Trilototriton,</i>
CO-3	Identification of <i>Axolotl larva, Cryptobranchus, Hyla, Chameleon, Gekko, Vipera, Naja,</i>
CO-4	<b>Identification of Bones:</b>
CO1	Identification of appendicular bones of <i>Columba</i>
CO-2	Identification of <i>Appendicular bone of Cavia;</i>
CO-3	Identification of <i>vertebrae of snake, Columba and Cavia;</i>
CO-4	Identification of <i>skull of Bufo, Rana, Chelonia, venomous snake,</i>
CO-5	Identification of <i>Skull of Columba, Cavia and Canis.</i>
<b>COURSE-V</b>	<b>Applied Zoology</b>
CO-1	Identification of <i>Entamoeba, Giardia, Trypanosoma, Plasmodium,</i>
CO-2	Identification of <i>Leishmania, Ascaris (male &amp; female), Wuchereria bancrofti, Sitophilus,</i>
CO-3	Identification of <i>Tribolium, Tryporyza, Hispa, Apion, Leucinodes,</i>
CO-4	Identification of <i>Silk worm life history</i>
CO-5	Identification of <i>Life history of honey bee, lac insect,</i>
CO-6	Identification of <i>Culex, Anopheles, Aedes, Phlebotomus,</i>
Co-7	Identification of <i>Paeneus, Macrobrachium, Labeo rohita,</i>
CO-8	Identification of <i>L. bata, Cirhinus mrigala, catla catla</i>
CO-9	Identification of <i>Mugi/parsia, Lates calcarifer, Harpodon neherias.</i>

