



**Scheme of Examination  
and  
Course of Study**

**FACULTY OF SCIENCE**

**B.Sc. (Pass)  
Part-II  
(10+2+3 Pattern)**

# PHYSICS

## Paper-I

### STATISTICAL AND THERMO-DYNAMICAL PHYSICS

Teaching : 2 hrs./week

Max. Marks : 33

**Note :**

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit

#### UNIT - I

**Introduction of Macroscopic Systems :** Thermal interaction (Also thermal insulation) Adiabatic interaction, general interaction (first Law of thermodynamics) and infinitesimal general interaction. Concept of temperature and quantitative idea of temperature scale (thermodynamical parameter ) distribution of energy, small heat transfer. (Second law of thermodynamics) and system in contact with a heat reservoir, partition function ( $z$ ), mean energy of an ideal gas and mean pressure. Heat engine and efficiency of the engine, Carnot's cycle (different statements). Thermodynamical scale as an absolute scale.

#### UNIT - II

**General thermodynamical Interaction :** Dependence of the number of state on the external parameters, General relations in equilibrium, equilibrium condition. Infinitesimal quasistatic process, entropy of a ideal gas, equilibrium of an isolated system, equilibrium of system in contact with a reservoir (Gibb's free energy). Equilibrium between phases Clausius Clapeyron equation. Triple point, vapor pressure in equilibrium with a liquid or solid, equilibrium conditions for a system of fixed volume in contact with heat reservoir (Helmholtz free energy), Discussion of equilibrium between phases and condition of chemical equilibrium, and equilibrium condition for a system of constant pressure in contact with a heat reservoir (Enthalpy), Maxwell relations.

#### UNIT - III

**Production of Low temperatures and Applications :** Joule Thomson expansion and J.T. coefficients for ideal as well as Vander Wall's gas, porous plug experiment. Temperature inversion, Regenerative cooling and cooling by adiabatic expansion and demagnetisation, liquid He-point, I and He-II Superfluidity, Quest for absolute zero, Nernst heat theorem.

#### UNIT - IV

**The Distribution of Molecular Velocities :** The distribution of molecular velocities, the energy distribution function, effusion, Molecular beam experimental verification of Maxwell velocity distribution, most probable, average and RMS velocities. The principle of equipartition of energy. Transport phenomenon; Mean

free path, distribution of free paths, coefficients of viscosity. Thermal conductivity. Diffusion and their interrelation.

#### UNIT -V

**Classical Statistics :** Validity of classical approximation phase space, Micro and Macro State, Thermodynamics probability, Entropy and probability, The monoatomic ideal gas, the barometric equation, specific heat capacity of diatomic gas, specific heat capacity of solids.

**Quantum Statistics :** Black body radiation and failure of classical statistics.

Postulates of quantum statistics, indistinguishability, wave function and exchange degeneracy, a priori-probability. Bose Einstein's Statistics, Planck's distribution law, Fermi-Dirac statistics and their partition function, Contact potential and Thermionic emission, specific heat anomaly of metals, nuclear spin statistics (para and ortho hydrogen).

#### Reference Book

1. Berkely Series Vol-V Statistical Physics.
2. Reif-Thermodynamics and Statistical Physics.
3. Lokanathan & Khandelwal-Thermodynamics and Statistical Physics.
4. Sears- Thermodynamics, Kinetic Theory of Gassed and Statistical Mechanics.

# Paper-II

## OPTICS

Teaching : 2 hrs./week

Max. Marks : 33

### Note :

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit

### UNIT - I

**1. Elements of Geometrical Optics :** Fermat's principle, Laws of reflection and refraction from Fermat's principle. Refraction at a spherical surface, Linear and lateral magnifications, Refraction through a thick lens. Focal lengths of thick and thin lenses. Combination of two lenses. Cardinal points.

### UNIT - II

**2. Interference :** Superposition of waves from two point sources, necessity of coherence, Concept of spatial coherence. Effective size of a point source. Interference of waves from several synchronous sources, Directional transmission and reception of radio signals.

Interference by division of amplitude, Interference in thin films. Colours of thin films in transmission and reflection. Newton's Rings. Michelson's interferometer, Fringes of different shapes with Michelson's interferometer, Determination of  $n$  with Michelson's interferometer. Measurement of refractive index by Newton's rings and Michelson interferometer. The concept of temporal coherence and quasimonochromatic light.

### UNIT - III

**3. Diffraction :** Fraunhofer diffraction by single slit and a circular aperture, Fraunhofer diffraction by  $N$  parallel slits with two slits as an application, Missing order, Plane diffraction grating, Dispersion by a grating, Rayleigh's criterion of resolution, Resolving power of grating Resolving power of a telescope.

Fresnel's diffraction by a circular aperture, straight edge and a thin slit, Zone Plate.

### UNIT - IV

**4. Lasers and holography :** Spontaneous and stimulated emission, density of states, Einstein's A and B coefficients, Ratio of stimulated to spontaneous transitions in a system in thermal equilibrium. Energy density of radiation as a result of stimulated emission and absorption, condition for amplification. Population inversion, Methods of optical pumping, energy level schemes of He-Ne and Ruby lasers, working of a laser sources, Special feature of laser source and their origin. Tunable Lasers (Qualitative discussion only).

Basic concepts of Holography, construction of hologram and reconstruction of the image.

#### UNIT - V

**5. Polarization :** Plane electromagnetic waves E and B of linearly, circularly and elliptically polarized electromagnetic waves. Polarization by reflection.

EM Wave Propagation in an anisotropic media, Huygen's Theory of Double Refraction using Fresnel Ellipsoidal Surfaces (no mathematical derivation), Production and Analysis of Plane Polarized, Circularly and elliptically polarized light, Quarter and half wave plates. Bi-quartz Optical activity, Specific Rotation and half shade polarimeters.

#### Reference Book

1. Principle of Optics by B.K. Mathur
2. Optics by D.P. Khandelwal
3. Introduction to Modern optics by A.K. Ghatak (Tata McGraw Hill)
4. Optics by Brij Lal and Subramaniam
5. An introduction to Modern Optics by G.R. Fowels.
6. Optical Physics by Lipson and Lipson
7. Essential of Laser by Allen

**Paper-III**  
**ELECTRONICS AND SOLID STATE DEVICES**

Teaching : 2 hrs./week

Max. Marks : 33

**Note :**

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit

**UNIT - I**

**Circuit Analysis :** Networks - some important definition, loop and nodal equations (Kirchhof's Laws). Four terminal network superposition. Thevenin, Norton and reciprocity, compensation, Maximum power transfer.

**UNIT - II**

**Semiconductor and Rectification :** Charge densities in N and P materials, conduction by drift diffusion of charge, PN diode equation, capacitance effects. Half-wave and full wave rectifiers, calculation, of ripple factor, efficiency and regulation. Filters shunt capacitor hall effect and Hall coefficients L and \* filters, Bridge rectifier, Voltage regulation and voltage stabilization by Zener diode. Voltage multiplier.

**UNIT - III**

**Transistor and Transistor Amplifiers :** Notations and volt ampere relations for bipolar junctions transistors. Concept and load line and operating point, Hybrid parameters, CG, CE, CC configuration and their equivalent, circuits. Analysis for transistor amplifiers using hybrid parameters and its frequency response. Bias : Fixed and emitter bias, Bias stability.

**UNIT - IV**

**Amplifier with Feed Back :** Concept of feed back, Stabilization of gain by negative Feed back, effect of feed back on output and input resistance, reduction of nonlinear distortion by negative feed back. Voltage and current feed back circuits, frequency response.

**Oscillators :** Feed back requirements for oscillations, circuit requirement for oscillation, Basic oscillator analysis, Colpitt's and Hartely oscillators, R.C. Oscillators, Piezoelectric frequency control.

**UNIT - V**

**Field Effect transistor and logic circuits :** Differential amplifier, DC level shifter, Field effect transistors : JFET volt-

ampere curves, biasing JEFT, as operation of JFET, Source follower, Depletion and enhancement mode, MOSFET, biasing MOSFET, FET as variable voltage resistor, digital MOSFET circuits. Logic fundamental AND, OR, NOT, NOR, NAND, XOR, transistor as a switch, Logic gates circuit relation of logic functions.

#### **Reference Book**

1. John D. Ryder, Electronic Fundamentals and Applications : Prentice Hall of India Pvt. Ltd. (1983), New Delhi
2. John D. Ryder, Engineering Electronics; Mc Graw Hill book Co.
3. Jacob Millman and Christors Hailkias, Integrated Electronics, Analog and Digital Circuits and Systems; Mc Graw Hill Ltd. (1972)
4. Albert Paul Malvino, Digital Computer Electronics Tata McGraw Hill Pub. Co. Ltd New Delhi (1983)
5. Kumar & Gupta, Hand Book of Electronic.
6. G.K. Mithal, Hand Book of Electronics
7. G.K. Mithal, Electronics and Electronic Applieances.

## PRACTICAL

Teaching : 4 hrs/week

Practical One paper

Min. Pass Marks : 18

5 Hrs. duration

Max. Marks : 50

**Note :** Total number of experiments to be performed by the students during the session should be 16 selecting any 8 from each section.

### Section-A

1. Study of dependence of velocity of wave propagation on line parameter using torsional wave apparatus.
2. Study of variation of reflection coefficient on nature of termination using torsional wave apparatus.
3. Using Platinum resistance thermometer find the melting point of a given substance.
4. Using Newton's rings method find out the wave length of a monochromatic source and find the refractive index of liquid
5. Using Michelson's interferometer find out the wavelength of given monochromatic source (Sodium light)
6. To determine dispersive power of prism
7. To determine wave length by grating
8. To determine wave length by Biprism
9. Determine the thermodynamic constant \* using Clements & Desorme's method
10. To determine thermal conductivity of a bad conductor by Lee's method
11. Determination of ballistic constant of a ballistic galvanometer
12. Study of variation of total thermal radiation with temperature

### Section-B

1. Plot thermo emf versus temperature graph and find the neutral temperature (Use sand bath)
2. Study of power supply using two diodes/bridge rectifier with various filter circuits.
3. Study of half wave rectifier using single diode and application of L and \* section filters.
4. To study characteristics of a given transistor PNP/NPN (Common emitter, common base and common collector configurations)
5. Determination of band gap using a junction diode.
6. Determination of power factor ( $\cos \phi$ ) of a given coil using CRO.
7. Study of single stage transistor audio amplifier (Variation of gain with frequency).
8. To determine e/m by Thomson's method.
9. Determination of velocity of sound in air by standing wave method using speaker, microphone and CRO
10. Measurement of inductance of a coil by Anderson's bridge.
11. Measurement of capacitance and dielectric constant of aliquid and gang condenser by de-Sauty bridge.

**CHEMISTRY**  
**Paper I**  
**Inorganic Chemistry**  
**(2 Hrs. or 3 periods week)**

**Note :**

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2. Two questions will be given from each unit. One essay type and one of short answer type having two parts.
3. Students are required to attempt either essay type or short answer type question from each unit

**UNIT-I**

**Chemistry of Elements of First Transition Series**

Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

**UNIT-II**

**Chemistry of Elements of Second and Third Transition Series**

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

**UNIT-III**

**Coordination Compounds**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

**Oxidation and Reduction**

Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, Latimer and Pourbaix diagrams, Principles involved in the extraction of the elements.

**UNIT-IV**

**Chemistry of Lanthanide and Actinide Elements**

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolating, lanthanide compounds.

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanide's.

**UNIT-V**

**Acid and Bases**

Arrhenius, Bronsted-Lowry the Lux-Flood, solvent system and Lewis concepts of acids and bases.

**Non-aqueous Solvents**

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH<sub>3</sub> and liquid SO<sub>2</sub>.

# Paper II

## Organic Chemistry

(2 Hrs. or 3 period/week)

### UNIT-I

#### **Electromagnetic Spectrum : An introduction Absorption Spectra :**

Ultraviolet (UV) absorption spectroscopy - absorption laws (Beer Lambert law) molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of solvent on transitions, effect of conjugation, concept of chromophore and auxochrome Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. Infrared (IR) absorption spectroscopy - molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

### Unit-II

**Alcohols** : Classification and nomenclature. Monhydric Alcohols : Methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding Acidic nature, Reactions of alcohols.

Dihydric Alcohols : Methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $\text{HIO}_4$ ] and pinacol pinacolne rearrangement.

Trihydric alcohols : Methods of formation, chemicals reactions of glycerol.

#### **Phenols**

Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion reactions of phenols electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement. Gatterman synthesis, Hauben-Hoesch reaction, Lederer manasse reaction and Reimer Tiemann reaction.

#### **Ethers and Epoxides**

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions , cleavage and autoxidation, Ziesels' method.

Synthesis of epoxides. Acid and base-catalyed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithim reagents with epoxides.

### UNIT-III

#### **Aldehydes and Ketones**

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the syntheses of aldehydes from acid chlorides, synthesis of aldehydes and

ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolf-Kishner,  $\text{LiAlH}_4$  and  $\text{NaBH}_4$  reductions, Halogenation of enolizable ketones.

#### UNIT-IV

##### **Carboxylic Acid**

Nomenclature, structure and bonding, Physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, reduction of carboxylic acids, Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids. Hydroxy acid; malic, tartaric and citric acids. Methods of formation and chemical reactions of , unsaturated monocarboxylic acid.

Dicarboxylic acid : Methods of formation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids.)

##### **Carboxylic Acid Derivatives**

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides, Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions, Mechanisms of esterification and hydrolysis (acidic and basic).

#### UNIT-V

##### **Organic Compounds of Nitrogen**

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkenes, Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid.

**Halonitroarenes** : Reactivity, structure and nomenclature of amines, physical properties, stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl, and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydeic and ketonic compounds. Gabriel phthalimide reaction, Hofmann bromide reaction.

Reaction of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Diazotisation, mechanism. Synthetic transformation of aryl diazonium salts, azo coupling.

**Paper III**  
**Physical Chemistry**  
(2Hrs. or 3 Periods/week)

**UNIT-I**

**Thermodynamics-I**

Definition of thermodynamic terms : System, surroundings etc.  
Types of systems intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work.

First Law of Thermodynamics : Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law- Joule - Thomson coefficient and inversion temperature, calculation of  $w$ ,  $q$ ,  $dU$  &  $dH$  for the expansion of ideal gases under isothermal and adiabatic condition for reversible process.

Thermochemistry : Standard state, standard enthalpy of formation Hess's law of heat summation and its application. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

**UNIT-II**

**Thermodynamics-II**

Second Law of Thermodynamics : Need for the law, different statements of the law, Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature.

Concept of Entropy : Entropy as a state function, entropy as a function of  $V$  &  $T$ , entropy as a function of  $P$  &  $T$ , entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium, Entropy change in ideal gases and mixing of gases.

Third law of thermodynamics : Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions : Gibbs function ( $G$ ) and Helmholtz function ( $A$ ) as thermodynamic quantities,  $A$  &  $G$  as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of  $G$  and  $A$  with  $P$ ,  $V$  and  $T$ .

**UNIT-III**

**Chemical Equilibrium**

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation and Clausius. Clapeyron equation, applications.

**Phase Equilibrium**

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system- water,  $CO_2$  and S systems phase equilibria

of two component system - solid - liquid equilibria, simple eutectic Bi - Cd, Pb-Ag systems, desilverisation of lead. solid solution - compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H<sub>2</sub>O), (FeCl<sub>3</sub> - H<sub>2</sub>O) and CuSO<sub>4</sub>-H<sub>2</sub>O system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures - Ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes - HCl-H<sub>2</sub>O and ethanol water systems.

Partially miscible liquids - Phenol- water, trimethylamine -water nicotine water systems, Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids steam distillation. Nernst distribution law-thermodynamic derivation, applications.

#### UNIT-IV

##### Electrochemistry-I

Electrical transport - conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements : Determination of degree of dissociation, determination of K<sub>a</sub> of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

#### UNIT-V

##### Electro Chemistry-II

Types of reversible electrodes - gas - metal ion, metal -metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells - reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements, computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (\*G \*H and K), polarization, over potential and hydrogen overvoltage. concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pK<sub>a</sub> determination of pH using hydrogen quinhydrone and glass electrodes, by potentiometric methods. Buffers - mechanism of buffer action, Henderson-Hassel equation, Hydrolysis of salts.

# PRACTICAL

## Laboratory Course -II

(4 Hrs. on 6 period/week)

### Inorganic Chemistry

Calibration of fractional weights, pipetters and burettes.  
Preparation of standard solution.

Dilution - 0.1 M to 0.001 M solutions.

### Quantitative Analysis

#### Volumetric Analysis

- a. Determination of acetic acid in commercial vinegar using NaOH
- b. Determination of Alkali content - antacid tablet using HCl
- c. Estimation of calcium content in chalk as calcium oxalate by permanganometer.
- d. Estimation of hardness of water by EDTA
- e. Estimation of ferrous and ferric by dichromate method
- f. Estimation of copper using thiosulphate

#### Gravimetric Analysis

Analysis of Cu as CuSCN and Ni as Ni (dimethylglyoxime)

### Organic Chemistry

#### Laboratory Techniques

#### A. Thin Layer Chromatography

Determination of R<sub>f</sub> values and identification of organic compounds.

- a. Separation of green leaf pigments (spinach leaves may be used.).
- b. Preparation and separation of 2,4,-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2-one using toluene and light petroleum (40-60)
- c. Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5 : 1.5)

#### B. Paper Chromatography : Ascending and Circular

Determination of R<sub>f</sub> values and identification of organic compounds.

- a. Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid, leucine and glutamic acid. Spray reagent-ninhydrin.
- b. Separation of a mixture of DL - alanine, glycine and L-Leucine using n-butanol : acetic acid : water (4. : 1 : 5), Spray reagent-aniline hydrogen phthalate
- c. Separation of monosaccharides - a mixture of D-galactose and D-fructose using n-butanol : acetone : water ( 4 : 5 : 1) Spray reagent - aniline hydrogen phthalate.

### Qualitative Analysis

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

### Physical Chemistry

### **Inorganic Chemistry**

Volumetric Analysis

OR

Gravimetric Analysis as mentioned in the syllabus

16

### **Transition Temperature**

1. Determination of the transition temperature of the given

### **Organic Chemistry**

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

OR

Perform one experiment out of 6 experiments on thin layer and paper chromatography.

12

substance by thermometric/dilatometric method (e.g.

$\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$  /  $\text{SrBr}_2 \cdot 2\text{H}_2\text{O}$ )

### **Phase Equilibrium**

1. To construct the phase diagram of two components (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.
2. To construct the phase diagram of two components (e.g. diphenylamine - benzophenone) system by cooling curve method.

### **Thermochemistry**

1. To determine the solubility of benzoic acid at different temperatures and to determine  $\Delta H$  of the dissolution process.
2. To determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born-Haber cycle.

### **(Instruction to Examiners)**

### **B.Sc. Part II Chemistry Practical (Pass course)**

Max. Marks. : 50    Duration of Exam. : 5 Hrs.    Minimum Marks : 18

### **Physical Chemistry**

Perform one of the 6 physical chemistry experiments as mentioned in the syllabus. 12

Viva-voce

5

Record

5

Total

50

**MATHEMATICS**  
**Paper-I**  
**Real Analysis and Metric Space**

Note:

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit.

**Unit - I**

Real numbers as a complete ordered field, limit point. Bolzano-Weierstrass theorem, closed and open sets, union and intersection of such sets, concept of compactness. Heine-Borel theorem, connected sets, Real sequences, Limit and convergence of a sequence, monotonic sequences, Cauchy's sequences, Subsequences

**Unit - II**

Cauchy's general principle of convergence, properties of continuous functions on closed intervals. Properties of derivable functions, Darboux's and Rolle's theorms. Notion of limit and continuity for functions of two variables.

**Unit - III**

Fundamental theorem of integral calculus. Uniform convergence, Sequence and series of functions pointwise and uniform convergence, Weierstrass M-test, Abel's test and Dirchlet's test for uniform convergence of series of functions

**Unit - IV**

Definitions and examples of metric spaces, open and closed sets, sub-space, continuous mappings, Cauchy sequences and complete metric spaces, Baire's theorem, compact spaces and compact sets, connected spaces, product spaces.

**Unit - V**

Riemann integration. Lower and upper Riemann integrals. Riemann integrability, Mean value theorem of Integral Calculus. continuity of the sum functions of limit functions, term-wise differentiation and integration.

## **Paper-II**

### **Differential Equations**

Note:

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit.

#### **Unit - I**

Degree and order of a differential equation. Equations of first order and first degree. Equations in which the variables are separable. Homogeneous equations and equations reducible to homogeneous form.

#### **Unit - II**

Linear equations and equations reducible to linear form. Exact differential equations and equations which can be made exact. First order but higher degree equations solvable for  $x, y, p$ . Clairaut's form and singular solutions with Extraneous Loci.

#### **Unit - III**

Linear differential equations with constant coefficients, complimentary function and particular integral. Homogeneous linear differential equations with variable coefficient, simultaneous differential equations.

#### **Unit - IV**

Exact linear differential equations of  $n$ th order. Existence and uniqueness theorem. Linear differential equations of second order. Linear independence of solutions, Solution by transformation of the equation by changing the dependent variable/the independent variable, factorization of operators, method of variation of parameters. method of undetermined coefficients.

#### **Unit - V**

Partial differential equations of the first order. Lagrange's linear equation. Charpit's general method of solution. Homogeneous and non-homogeneous linear partial differential equations with constant coefficients, Equations reducible to equations with constant coefficients.

# **Paper-III**

## **Numerical Analysis And Vector Calculus**

Note:

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit.

### **Unit - I**

Differences, Relation between differences and derivatives. Difference of polynomial. Newton's formulae for forward and backward interpolation. Divided differences. Newton's divided difference, interpolation formula. Lagrange's interpolation formula.

### **Unit - II**

Central differences. Gauss's Stirling's and Bessel's interpolation formulae. Numerical Differentiations, Derivatives from interpolation formulae. Numerical integration, Newton-Cote's formulae,

### **Unit - III**

Trapezoidal rule, Simpson's one-third, Simpson's three-eighth and Gauss's quadrature formulae. Numerical solution of algebraic and transcendental equations; Bisection method, Regula-Falsi method, method of iteration,

### **Unit - IV**

Newton- Raphson method. Gauss elimination and Iterative methods (Jacobi and Gauss Seidal) for solving system of linear equations. Solutions of ordinary differential equations with initial and boundary conditions using Picard's and modified Euler's method.

### **Unit - V**

Scalar point function, vector point function. Differentiation and integration of vector point functions, directional derivative, differential operators, gradient, divergence and curl. Theorems of Gauss, Green, Stokes (without proof) and problems based on these theorms.

**BOTANY**  
**Paper-I**  
**DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS**

**Note :**

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3. Students are required to attempt either essay type or short answer type question from each unit

**Unit - I**

Angiosperms taxonomy : Brief history, aims and fundamental components (alpha and omega taxonomy). Botanical Garden of India Botanical nomenclature : Principles and rules : taxonomy ranks; type concept; principle of priority, Flora and Icones .

**Unit - II**

Classification of angiosperms : salient features of the system proposed by Bentham and Hooker and Engler and Prantl and Hutchison, Diversity of flowering plants as illustrated by members of the families Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae.

**Unit - III**

Diversity of flowering plants as illustrated by members of the families, Apiaceae, Apocynaceae, Asclepidaceae, Solanaceae, Lamiaceae, Euphorbiaceae, Poaceae.

**Unit - IV**

General characters, economic, importance and broad classification of Gymnosperms. Occurrence, Structure and life history of Cycas.

**Unit - V**

Occurrence, Morphology, Anatomy and life history of pinus and Ephedra. Study of Gymnosperms in India.

**Note to teachers**

The students should be made familiar with the families listed at Serial No. 9 only in the practical classes with representative species of any other that may be available locally. See the list for practical classes. However, questions pertaining to this may be asked in the theory examination.

**Suggested Reading**

1. Bhatnagar, S.P. and Moitra, A. 1996, Gymnosperms, New Age International Limited, New Delhi.
2. Davis, P.H. and Heywood, V.H. 1963, Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
3. Gifford, I.M. and Foster, A.S. 1988 Morphology and Evolution of Vascular Plants. W.H. Freeman & company, New York
4. Heywood, V.H, and Moore, D.M. (eds) 1984, Current concepts in Plant taxonomy, Academic Press, London.

5. Jefferey, C. 1982, An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
6. Jones, S.B., and Luchsinger, A.F. 1986, Plant Systematics (2nd edition) McGraw-Hill Book Co., New York.
7. Maheshwari, J.K. 1963 Flora of Delhi, CSIR, New Delhi.
8. Radford, A.E. 1986, Fundamentals of Plant Systematics, Harper and Row, New York.
9. Singh, G. 1999, Plant Systematics; Theory and Practice, Oxford and IBH Pvt. Ltd. New Delhi.
10. Sporne, K.R. 1965, The Morphology of Gymnosperms. Hutchinson & Co. (Publishers) Ltd., London.
11. State, C.A. 1989, Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold, London.
12. Steward, W.M. 1983, Paleobotany and the Evolution of Plants, Cambridge University Press, Cambridge.

### **Suggested Laboratory Exercises :**

**Angiosperms** The following species are suitable for study. This list is only indicative, Teachers may select plants available in their locality.

1. Ranunculaceae : Ranunculus, Delphinium.
2. Brassicaceae : Brassica, Alyssum, Iberis, Coronopus
3. Malvaceae : Hibiscus, Abutilon
4. Rutaceae : Murraya, Citrus
5. Fabaceae : Faboideae : Lathyrus, Cajanus, Melilotus, Trigonella, Caesalpinioideae : Cassia, Case alphinia : Mimosodieae : Prosopis, Mimosa, Acacia.
6. Apiaceae : Coriandrum, Foeniculum, Anethum
7. Apocyanaceae : Vinca, Thevetia, Nerium.
8. Asclepiadaceae : Calotropis
9. Solanaceae : Solanum, Vithania, Datura.
10. Euphorbiaceae : Euphorbia, Phyllanthus.
11. Lamiaceae : Ocimum, Salvia.
12. Poaceae : Avena, Triticum, Hordeum, Poa, Sorghum.

### **Gymnosperms**

#### **Cycas**

- i. male cone (Specimen); microsporophyll, Megasporophyll, mature seed.
- ii. Study through permanent slides-normal root (T.S.) stem (T.S.) (if sections are not available show photographs); ovule (L.S.)
- iii. Study through and sections or dissections coralloid root (T.S.) rachis (T.S.) leaflet (V.S.), microsporophyll (V.S.) Pollen grains (W.M.)

#### **Pinus**

- i. Study through permanent slides - root (T.S.), female cone (L.S.) ovule (L.S.), embryo (W.M.)
- ii. Study through hand sections or dissections - young stem (T.S.), old stem (wood) (T.L.S.) and R.L.S.) needle (T.S.) male cone (L.S.)

## **Ephedra**

- i. Habit and structure of whole male and female cones
- ii. Permanent slides-female cone (L.S.)
- iii. Hand section of node (L.S.), internode (T.S.), macerated steam to see vessel structure, male cone (T.S. and L.S.),

**Embryology** : Slides/Specimens. Placentation: Axile, free central, Parietal and Marginal , Ovules:-Anatropus and Orthotropus

Ovary:- Different type

T.S. of anther L.S. of Mature Seed

Inflorescence: Cyathium, hypanthidium, Capitulum.

## **Economic Botany :**

Drugs: Cinchona , Rauwolfia, Papaver, Withania.

Fibers: Cotton, Jute.

Oil Seeds: Groundnuts, Coconut.

Timber: Heartwood, Sap-wood/ annual rings.

Spices And Condiments: Capsicum, Coriander, Zinger, Ferula, Curcuma.

Beverages: Tea, Coffee.

Plant pathology, Green in ear disease of bajara, Loose and Covered smut of wheat/Black rust of wheat, Citrus canker, Little leaf of Brinjal, Yellow vein of Bhindi.

## **Marking Scheme -**

**Max Marks - 50**

**Time ; 4 hrs**

- |  |    |
|--|----|
| 1. Description in Semi - technical language of given flower  |    |
| a. diagrams, b. description, c. identification and systematic position with characters, d. F.F. & F.D.   | 8  |
| 2. Material for anatomical study of Angiosperms and Gymnosperms  |    |
| a. Double stained T.S. preparation   |    |
| b. Labeled cellular diagram  |    |
| c. Identification with characters  |    |
| d. Special anatomical/ecological   | 7  |
| 3. Economic Botany   | 6  |
| 4. Embryology  | 3  |
| 5. Plant pathology   | 4  |
| 6. Spots 6 ( One each form Anatomy, Taxonomy, Economic botany, Embryology Gymnosperms, Plant pathology ) | 12 |
| 7. Viva-voce   | 5  |
| 8. Records   | 5  |

## **Paper-II**

### **Anatomy & Embryology of Angiosperm**

**Note :**

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit

#### **Unit - I**

Meristems and various theories related to organization of apical meristems (root and stem). Primary internal structure of root, stem and leaves, structure of leaf epidermis, trichomes and stomata, origin of lateral roots.

#### **Unit - II**

Simple and complex permanent tissues, secretory tissues, tissue system, periderm, commercial cork and abscission of leaves.

#### **Unit - III**

Secondary growth in dicot root and stem. Primary anomalous internal structure & secondary anomalous growth in roots and stem.

#### **Unit - IV**

Megasporogenesis Structure and germination of pollen-grains. Megasporogenesis - types of ovules. Development and types of embryosacs ( mono, bi and tetrasporic embryosacs ), Fertilization.

#### **Unit - V**

Endosperm- Structure, types and development. Types of endosperm haustoria, nature of endosperm. Structure and types. Apomixis, polyembryony and parthenogenesis. Experimental embryology - culture of anther and embryo.

**Note to Teachers :**

Wherever required role of environment and hormones in plant development and reproduction should be emphasized.

**Suggested Readings**

1. Bhojwani S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, 4th revised and enlarged edition, Vikas Publishing House, Delhi.
2. Cutter, E.G. 1969, Part, I Cells and Tissues, Edward Arnold. London
3. Cutter, E.G. 1971, Plant Anatomy : Experiment and Interpretation. Part II, Organs, Edward Arnold, London
4. Esau, K . 1977, Anatomy of Seed Plants, 2nd edition John Wiley & Sons, New York.
5. Fageri, K. and Van der Pij 1979. The Principles of Pollination ecology. Pergamon Press, Oxford.
6. Hartmann, H.T. and Kestler D.E. 1976. Plant propagation : Principles and Practices, 3rd edition Prentice-Hall of India Pvt. Ltd. New Delhi.
7. King, J. 1997, Reaching for the Sun : How Plants Work. Cambridge University Press, Cambridge, U.K.

8. Mauseth, J.D. 1988, Plant Anatomy. The Benjamin/Cyummings Publishing Company Inc., Menlo Park, California, USA.
9. Proctor, M and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
10. Raven, P.H. Evert, R.F. and Eichhorn, Se. E. 1999. biology of Plants, 5th edition. W.H. Freeman and Co., Worth Publishers, New York.
11. Thomas, P. 2000, Trees : Their Natural Histroy, Cambridge Unviersity Press, Cambridge.
12. Trivedi, P.C. N. Sharma and J.L. Sharma 2003 structure, development and reproduction in blowering plants, Ramesh Book Depot, Jaipur.

### **Suggested Laboratory Exercises**

1. Study of any commonly occurring dicotyledonous plant (for example *Solanum nigrum* or *Kalanchoe*) to understand the body plan and modular type of growth.
2. Life forms exhibited for flowering plants (by a visit to a forest or a study garden). Study of tree-like habit in cycads, bamboos, banana, traveler's tree (*Ravenala madagascariensis*) of yucca and comparison with true trees as exemplified by conifers and dicotyledons.
3. L.S. Shoot tip to study the cytohistological zonation and origin of leaf primordia.
4. Monopodial and sympodial types of branching in stem (especially rhizomes).
5. Anatomy of primary and secondary growth in monocots and dicots using hand sections (or prepared slides), structure of secondary phloem and xylem, growth rings in wood, microscopic study of wood in T.S. and R.L.S.
6. Field study of diversity in leaf shape, size, thickness, surface properties, internal structure of leaf, structure and development of stomata (using epidermal peels of leaf).
7. Anatomy of the root, primary and secondary structure.
8. Examination of a wide range of flowers available in the locality and methods of their pollination.
9. Structure of anther, microsporogenesis (using slides) and pollen grains (using whole mounts) pollen viability using in vitro pollen germination.
10. Structure of ovule and embryo sac development (using serial sections)
11. Test of self-incompatibility (using petunia auxiliaries, *Brassica campestris*, *B. oleracea* or a suitable available material) using field pollinations.
12. Nuclear and cellular endosperm, Embryo development in monocots and dicots (using slide/dissections).
13. Simple experiments to show vegetative propagation (leaf cutting in *Bryophyllum*, *Sansevieria*, *Begonia*, stem cutting in rose, *Salix*, money plant, sugarcane and *Bougainvillea*).
14. Germination of non-dormant and dormant seeds.

**Suggested Readings (For Laboratory Exercises)**

1. Steeves, T.A., and Sussex, I.M. 1989, Patterns in Plant Development (2nd Edition). Cambridge University Press Cambridge.
2. Raven, P.H., Evert, R.F. and Eichhorn, S.E. 1992, Biology of Plants (5th Edition). Worth Publisher, New York
3. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angio

**Paper III**  
**Economic Botany, Ethano botany, Evolution,**  
**Biostatics and Plant Pathology**

**Note :**

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit

**Unit I**

Origin, cultivation and improvement of Wheat, Rice , Maize, and Su grance, study of economic botany of Following group of plants:-

Fibre yielding- Cotton, Jute, Oil yielding- Groundnut, Sunflower and Coconut. Timber yielding- Tectona, Dalbergia , Tecomella.

**Unit II**

Economic importance of following group of plants:- General account of medicinal plants with special reference to Cinchona, Rauwolfia, Papaver and Withania. General account of spices and condiments with special reference to Capsicum, Coriander, Ginger , Ferula and Curcuma.

**Unit III**

General account Rubber plants plant. Beverages- Tea, Coffee. Ethnobotany: Definition, important, method of study, major tribes ot Rajasthan and their living style ( Bhil, Garasia, Meena, Saharia )

**Unit IV**

Lamarckism and neo-Lamarckism. Darwinism and neo-Darwinism. De Vries concept, origin of species. Elementary Study of biostatistics-mean, mode, median. Standard error, chi-square test, standard deviation.

**Unit V**

Principles of plant pathology : Symptoms and control measures of following plant diseases; Green ear disease of bajra. Loose and Covered smut of wheat/Black rust of wheat, Citrus canker, Little leaf of Brinjal, Yellow vein mosaic of Bhindi, Study of plant pathology in India.

# ZOOLOGY

## Paper-I

### Structure and Functions of Invertebrate Types

#### Note :

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit.

#### Unit - I

Structure and functional organization of vital systems of nonchoradates as exemplified by Amoeba, Paramecium, Euglena, Obelia, Sycon, Fasciola, Taenia, Nereis, Hirudinaria, Palaemon lamellidens, Pila and Aseterias :

1. Locomotion : Pseudopodial (Amoeba), ciliary (Paramecium) and flagellar (Euglen) : Parapodial (Nereis) : Pedal-Muscular foot (Pila) and tube-feet (Asterias).
2. Skeleton : Endoskeleton (Spicules of Sycon), Exoskeleton, chitinous (Palaemon) calcareous (Corals, Pila, Lamellidens, Asterias), siliceous (Radiolaria)

#### Unit - II

1. Food, Feeding, Digestive Structures and Digestion : Autotrophic (Euglena) : heterotrophic : through food vacuole (paramecium) and in hydroid and medusoid zooids (Obelia) : Parastitic (Fasciola, Taenia, Hirudinaria) : Predatory (Nereis, Palaemon, Asterias) : Filter-feeding (Lamellidens).
2. Excretion : General body surface (Protozoa, Sycon, Obelia) : protonephridial system and flame cells (Fasciola, Taenia); nephridia (Nereis, Hirudinaria): malpighian tubules (Insect) : organ of Bojanus (Lamellidens, Pila).

#### Unit - III

3. Respiration : aquatic general body surface (Euglena, Nereis, Hirudinaria); dermal branchiae (Asterias), Parapodia (Nereis), gills (Palaemon, Lemellidens, Pila): aerial, Pulmonary sac pila), trachea (Insect) : anaerobic (Fasiola, Taenia).  
Circulation : Cyclosis (Euglena, Paramecium) : diffusion (Sycon, Obelia, Fasciola, Taenia) : Open circulatory system (Hirudinaria, Palaemon, Lamellidens, Pila, Asteria) : Closed circulatory system (Nereis).

#### Unit - IV

4. Nervous System : Sensory and nerve cells (Obelia) : brain ring and longitudinal nerves (Fasciola and taenia) : brain and ventral nerve cord (Nereis, Palemon) : Nervous system of Pila and Lamellidens.
5. Sense-organs : Statocyst and ospharadium (Lamellidens and Pila), compound eye (Palaemone) and simple eye (Nereis, Pila) : tactile and olfactory organs (Palaelmon) : nuchal organs (Nereis).

#### Unit - V

6. Reproduction : Asexual (paramecium, Euglena, Sycon); alternation of generation (Obelia) : sexual (Fasciola, Taenia, Nereis, Lamellidens, Pila, Hirudinaria, Asterias).
7. Invertebrate Adaptations Salient Features of Hemichordata. Evolution of canal system of sponges. Parasitic adaptations in Helminths. Social organization in termites and bees. Direct and indirect development in insects. Water vascular system of starfish.

**Paper-II**  
**Animal Physiology and Biochemistry**  
**Animal Physiology with special reference to**  
**mammals**

**Note :**

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit.

**Unit - I**

1. Osmoregulation, membrane permeability : active and passive transport across membrane.
2. Physiology of Digestion : Nature of food-stuff, various types of digestive enzymes and their digestive action in the alimentary canal.
3. Physiology of Excretion : Kinds of nitrogenous excretory endproducts (ammonotelic uricotelic and ureotelic) : role of liver in the formation of these end products. Functional architecture of mammalian kidney tubule and formation of urine : hormonal regulation of water and electrolyte balance

**Unit - II**

4. Physiology of Circulation : Composition : Composition and function of blood : mechanism of blood clotting : heart beat : cardiac cycle : blood pressure: body temperature regulation
5. Physiology of respiration : Mechanism of breathing : exchanges of gases : transportation of oxygen and carbon dioxide in blood: regulation of respiration.

**Unit - III**

1. Physiology of Nerve Impulse and Reflex Action : Functional architecture of a neuron, origin and propagation of nerve impulse, synaptic transmission : spinal reflex arc : central control of reflex action.
2. Physiology of Muscle contraction : Functional architecture of skeletal muscle; chemical and biophysical events during contraction and relaxation of muscle fibres.

**Unit - IV**

3. Types of Endocrine Glands. Their secretions and Functions : Pituitary, adrenal, thyroid, islets of Langerhans, testis and ovary.
4. Hormonal control of male and female reproduction and implantation, parturition and lactations in mammals.
5. Preliminary idea of neurosecretion : Hypothalamic control of pituitary function, neuroendocrine and endocrine mechanism of Insects.

**Unit - V**

**Biochemistry**

1. Carbohydrate : Structure, function and significance.
2. Carbohydrates : Oxidation of glucose through glycolysis. Krebs cycle and oxidative phosphorylation; elementary

knowledge of interconversion of glycogen and glucose in liver. Role of insulin.

3. Protein : Structure, function and significance.
4. Proteins : Essential and non-essential amino acids, transformation of amino acids, deamination, transamination, decarboxylation synthesis of enzymatic protein and urea, fate of ammonia (Ornithine cycle) : fate of carbon skeleton.
5. Lipids : Structure, function and significance. : beta-oxidative pathway of fatty acid; brief account of biosynthesis of triglycerides. Cholesterol and its metabolism.
6. Catabolism and Biosynthesis of nucleic acid.
7. Mineral Metabolism : Iodine, Iron, Calcium and Zinc

## Paper-III

### Immunology, Microbiology & Biotechnology

**Note :**

1. Paper will be divided into five units
2. Two questions will be given from each unit . One essay type and one of short answer type having two parts
3. Students are required to attempt either essay type or short answer type question from each unit.

#### Unit - I

**Immunology**

1. Immunology : Definition, types of immunity : innate and acquired : humoral and cell mediated.
2. Antigen : Antigenicity of molecules, haptens.
3. Antigen-antibody reactions : Precipitation reaction, agglutination reaction, neutralizing reaction, complement and lytic reactions and phagocytosis.
4. Cells of Immunity : Macrophages, Lymphocytes (B- and T- types) T- Helper cells. T-Killer cells, plasma cells and memory cells.
5. Mechanism of humoral or antibody mediated immunity.

#### Unit - II

**Microbiology**

1. Brief introduction to the history of Microbiology : work of Anton Van Leeuwenhoek : theory of spontaneous generation : Germ theory of fermentation and disease : Work of Louis Pasteur, John Tyndall, Robert Koch and Jenner.
2. The Prokaryota (Bacteria) :  
Structural organization :
  - i. Size shapes and patterns of arrangement
  - ii. Structural organization :  
Slime layer (capsule) : cell envelopes : cytoplasmic membrane (inner membrane). cell wall (outer membrane) of Gram negative and Gram-positive bacteria : mesosomes : cytoplasmic organization : Cell projection : flagella and pili.
3. Genetic material of bacteria : (i) Chromosome (ii) Replication of bacterial DNA
4. Reproduction in Bacteria : Asexual reproduction binary fission, budding endospore formation, exospore and cyst formation: Sexual reproduction, conjugation.

#### Unit - III

5. Microbial nutrition culture of bacteria
  - a. Carbon and energy source
  - b. Nitrogen and minerals
  - c. organic growth factors
  - d. Environmental factors : Temperature, hydrogen-ion concentration
6. Bacteria of medical importance :
  - . Gram-Positive :
    - a. Cocci : Staphylococci , Streptococci
    - b. Bacilli : Diphtheria : Tetanus.

- i. Gram-Negative :
    - a. Cocci : Gonorrhoea, Meningitis
    - b. Bacilli : Diphtheria
  - ii. Mycobacteria : Tuberculosis, Leprosy
7. AIDS and hepatitis (with emphasis on B type). The causative agents. Transmission, Pathogenicity, Laboratory diagnosis, treatment and prevention.

#### Unit - IV

#### Biotechnology

1. History, scope and significance of biotechnology, Major areas of biotechnology.
2. Concept of gene : Mutation, recombination and cis-acting : gene expression, lac operon and gene mutation.
3. Vectors for gene transfer (plasmids and phages). Basic concepts of cell and tissue culture.
4. Eugenics and genetic counselling.
5. Basic concepts of animal cell and tissue culture and hybridoma technology.
6. Monoclonal antibodies and their applications.
7. Protoplast fusion in prokaryotes and eukaryotes.

#### Unit - V

8. Recombinant DNA technology and its application.
9. Bacteria and genetic engineering (outline idea only) : benefits of genetic engineering : potential hazards and regulations of genetic engineering.
10. Transgenic animals, their uses in biotechnology
11. Brief account of cloning, Genomic research its advantages and disadvantages.
12. Biotechnology in Medicine (outline idea only) : P.C.R. (Gene machine) Antibiotics. Vaccines, Enzymes, Vitamins., Steroids. Artificial Blood.
13. Environmental Biotechnology (outline idea only) : Metal and petroleum recovery pest control waste-water treatment.
14. Food, drink and dairy Biotechnology (outline idea only) : Fermented food production : dairy products, alcoholic beverages and vinegar microbial spoilage and food preservation.

# Practical

(Examination : 50 Marks : 4 Hours)

## 1. Study of Museum Specimens :

Platyhelminthes : Taenia, Fasciola

Aschelminthes : Ascaris

Annelida : Nereis, Heronereis, Aphrodite, Chaetopterus,  
: Arenicola, Glossiphonia, Pontobdella,  
Polygordius.

Onychophora : Peripatus

Arthropoda : Limulus, Spider, Scorpion, Centipede, Millipede,  
: Lepas, Balanus, Squilla. Eupagurus, Crab,  
Mantis, honeybee, Locusts, Silkworm, moth,  
Beetle, White grub

Mollusca : Chiton, Aplysia, Cypraea, Mytilus, Perloyster,  
Dentalium, Loligo, Nautilus, Octopus, Sepia.

Echinodermata : Pentaceros, Echinus, Ophiothrix, Cucumaria,  
Antedon

Hemichordata : : Balanoglossus.

## II. Study of Microscopic Slides

Platyhelminthes : Planaria, Fasciola, T.S. body, Miracidium,  
: Sporocyst, Redia and cercaria larva of  
Fasciola : Scolex, mature proglottid of Taenia,  
Cysticercus.

Aschelminthes : Wuchereria, Dracunculus

Annelida : T.S. body of Nereis, T.S. Body of leech

Arthropoda : V.S. of integument (cuticle) : pediculus,

: bedbug, termite and its various types, Cyclops,  
Daphnia, crustacean larvae.

Mollusca : V.S. shell, T.S. gill of Unio : Glochidium.

## III : Permanent Preparation and Study of the following :

Hastate plate and statocyst of prawn : gill-lamella, radula  
and T.S. osphradium of pila

## IV : Dissection :

Prawn/Squilla : External features appendages, alimentary  
canal and nervous system.

Pila : External anatomy. Pallial organs and nervous system.

## V : Microbiology :

1. Preparation and use of culture media for microbes.
2. Study of microbes in food materials (like curd ).
3. Educational tour to any Microbiology Laboratory, Dairy, Food processing factory, Distillery, Museum of natural science for first hand study, Collection of material may also be encouraged wherever possible. Candidates are expected to submit a report on such visit.

## VI : Animal Physiology

1. Counting of red and white blood cells in a blood sample.
2. Estimation of haemoglobin in a blood sample.
3. Estimation of haematocrit value in a blood sample.
4. Demonstrations of enzyme activity (Catalase) in liver.
5. Study of salivary digestion of starch and the effect of heat and alcohol.

## VII : Biochemistry

1. Detection of proteins, carbohydrates and lipids in animal tissue.
2. Identification of different kinds of mono-di-and polysaccharides in the given samples.
3. Demonstration of the principle of paper chromatography.

### Scheme of Practical Examination

Time : 4 Hrs.

Min. Pass Marks : 18

Max. Marks : 50

	Regular	Ex-students
1. Dissection	8	10
2. Permanent Preparation	5	7
3. Microbiological Preparation	5	6
4. Exercise in Animal Physiology / Exercise in Biochemistry	6	6
5. Identification and Comments on & spots ( 1-8 )	16	16
6. Viva-voce	5	5
7. Class record	5	
Total	50	50

### Note :

1. With reference to dissection the candidates must be well versed with the techniques of flag labeling and black paper insertion, as the case may be for a clear illustration.
2. With reference to whole mounts and museum specimens in case of unavailability, the animal types should be substituted with diagrams, photographs, models, etc.
3. Candidates will keep a record of all work-done in the practical class and it will be submitted for inspection at the time of practical examination.
4. Emphasis should also be given on writing part, allocating separate marks.

### Recommended Books :

1. Barnes, R.D. : Invertebrate Zoology, W.G. Saunders, Philadelphia.
2. Bell, J.N. and Davidson, Gh.H. : Text Book of Physiology and Biochemistry ELBS London.