

# L\_6\_General\_Ed\_Science\_Stream

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## I MATHEMATICS

### Paper-I : ADVANCED CALCULUS

#### SECTION-A

- Definition of a sequence. Theorems on limits of sequences. Bounded and monotonic sequences. Cauchy's convergence criterion. Series of non-negative terms. Comparison Tests. Cauchy's Integral Test. Ratio Tests. Cauchy's Root Test. Raabe's and Logarithmic. De Morgan and Bertrand's tests. Gauss Test. Alternating series. Leibnitz's theorem. Absolute and conditional convergence.
- Vector differentiation, Gradient, divergence and curl. Vector integration, Theorems of Gauss, Green, Stokes and problems based on these.
- Continuity. Sequential continuity. Uniform continuity, Proof of chain rule of Differentiability.

#### SECTION-B

- Limit and continuity of functions of two and three variables. Partial differentiation. Change of variables. Partial derivation and differentiability of real-valued functions of two and three variables. Schwarz and Young's theorem. Statements of Inverse and implicit function theorems and applications.
- Euler's theorem on homogeneous functions. Taylor's theorem for functions of two and three variables. Jacobians. Envelopes. Evolutes. Maxima, minima and saddle points of functions of two and three variables. Lagrange's multiplier method.

### Paper-II : DIFFERENTIAL EQUATIONS

#### SECTION-A

- Exact differential equations. First order higher degree equations solvable for  $x$ ,  $y$ ,  $p$ . Clairaut's form and singular solutions. Geometrical meaning of a differential equation. Orthogonal trajectories. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Linear differential equations of second order. Transformation of the equation by changing the dependent variable/the independent variable. Method of variation of parameters.
- Series solutions of differential equations—Power series method, Bessel, Legendre, Hermite and Hypergeometric equations.

#### SECTION-B

- Bessel, Legendre, Hermite and Hypergeometric functions and their properties—convergence, recurrence and generating relations. Orthogonality of functions. Orthogonality of Bessel, Legendre and Hermite functions.

- Laplace Transformation—Linearity of the Laplace transformation. Existence theorem for Laplace transforms of derivatives and integrals. Shifting theorems.
- Differentiation and integration of transforms. Convolution theorem. Solution of integral equations and systems of differential equations using the Laplace transformations.

### Paper-III : MECHANICS

#### SECTION-A

##### Statics :

- Basic notion, Newton's laws of motion, system of two forces, parallelogram law of forces, resultant of two collinear forces, resolution of forces, moment of a force, couple, theorems on moment of a couple, coplanar forces, resultant of three coplanar forces acting at a point, algebraic method of finding the resultant of any number of coplanar concurrent forces, theorem of resolved parts, resultant of two forces acting on a rigid body, Varignon's theorem, generalized theorem of moments.
- Equilibrium of two concurrent forces, equilibrium conditions for any number of coplanar concurrent forces, Lami's theorem.  $\mu$  theorem, theorems of moments, resultant of a force and a couple.
- Equilibrium conditions for coplanar non-concurrent forces.
- Friction : Definition and nature of friction, laws of friction, equilibrium of a particle on a rough plane. Centre of gravity.

#### SECTION-B

##### Dynamics :

- Motion of a particle with constant acceleration, acceleration of falling bodies, motion under gravity, motion of a body projected vertically upwards: Motion of two particles connected by a string, motion along a smooth inclined plane, constrained motion along a smooth inclined plane. Variable acceleration: Simple harmonic motion, elastic string.
  - Curvilinear motion of a particle in a plane: Definition of velocity and acceleration, projectiles, motion in a circle, motion under constraint, central force motion.
  - Work, power, conservative fields and the potential energy, work done against gravity, potential energy of a gravitational field.
  - Relative motion, relative displacement, velocity and acceleration, motion relative to a rotating frame of reference.
  - Linear momentum, angular momentum, conservation of angular momentum, impulsive forces, principle of impulse and momentum, motion with respect to centre of mass of a system of particles, collisions of elastic bodies, loss of energy during impact.
  - Free vibrations, the simple pendulum, the conical pendulum. Central Orbits. Kepler's laws of motion.
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## II PHYSICS

### Paper A : STATISTICAL PHYSICS AND THERMODYNAMICS

#### UNIT-I

Basic ideas of Statistical Physics, Scope of Statistical Physics, basic ideas about probability, distribution of four distinguishable particles in two compartments of equal size. Concept of macrostates, microstates, thermodynamic probability, effects of constraints on the system, distribution of  $n$  particles in two compartments, deviation from the state of maximum probability, equilibrium state of dynamic system, distribution of distinguishable  $n$  particles in  $k$  compartments of unequal sizes.

#### UNIT-II

Phase space and its division into elementary cells, three kinds of statistics. The basic approach in the three statistics. Maxwell-Boltzmann statistics applied to an ideal gas in equilibrium, experimental verification of Maxwell-Boltzmann's law of distribution of molecular speeds. Need of quantum statistics--B.E. statistics, derivation of Planck's law of radiation, deduction of Wien's displacement law and Stefan's law from Planck's law, F.D. statistics, Comparison of M.B., B.E. and F.D. statistics.

#### UNIT-III

Statistical definition of entropy, change of entropy of a system, additive nature of entropy, law of increase of entropy, reversible and irreversible processes with examples. Work done in a reversible process. Examples of increase of entropy in natural processes. Entropy and disorder. Brief review of the terms and Laws of Thermodynamics, Carnot's Cycle. Entropy changes in Carnot's Cycle. Applications of thermodynamics to thermoelectric effect, change of entropy along a reversible path in a P.V. diagram, entropy of a perfect gas. Equation of state of ideal gas from simple statistical consideration. Heat death of the universe.

#### UNIT-IV

Derivation of Maxwell's thermodynamical relations, cooling produced by adiabatic stretching, adiabatic compression, change of internal energy with volume. Expression for  $(C_p - C_v)$ , change of state and Clayperon Equation. Thermodynamical treatment of Joule-Thomson effect. Use of Joule-Thomson effect for liquification of helium. Production of very low temperature by adiabatic demagnetisation.

#### UNIT-V

Spread over the entire syllabi of all the four units above.

### Paper-B : OPTICS AND LASERS

#### UNIT-I

Interference : Concept of coherence, spatial and temporal coherence, coherence time, coherence length, area of coherence. Conditions for observing interference fringes. Interference by wavefront division and amplitude division. Young's double slit experiment. Michelson interferometer—working, principle and nature of fringes. Interference in thin films, Role of interference in anti-reflection and high reflection dielectric coatings. Multiple

beam interference, Fabry-Perot interferometer, nature of fringes, finesse.

#### UNIT-II

Diffraction : Huygen-Fresnel theory half period zones, zone plates. Distinction between Fresnel and Fraunhofer diffraction. Fraunhofer diffraction at rectangular and circular apertures. Effects of diffraction in optical imaging, resolving power of optical instruments. The diffraction grating, its use as a spectroscopic element, resolving power. Polarization : Concept and analytical treatment of unpolarised, plane polarized and elliptically polarized light. Double refraction, Nicol prism, sheet polarisers, retardation plates. Production and analysis of polarized light (quarter and half wave plates).

#### UNIT-III

Laser Fundamentals : Derivation of Einstein relations, concept of stimulated emission and population inversion. Broadening of spectral lines, natural, collision and doppler broadening. Line width, line profile. Absorption and amplification of a parallel beam of light passing through a medium. Threshold condition. Three level and four level laser schemes. Elementary theory of optical cavity, longitudinal and transverse modes.

#### UNIT-IV

Laser Systems and Fiber Optics : Types of lasers, Ruby and Nd : YAG lasers. He-Ne and CO<sub>2</sub> lasers – construction, mode of creating population inversion and output characteristics. Semiconductor lasers, Applications of lasers—a general outline, Holography. Fiber fundamentals, wave propagation and dissipation of energy applications.

#### UNIT-V

Spread over the entire syllabi of all the four units above.

### Paper-C : QUANTUM PHYSICS

#### UNIT-I

Formalism of Wave Mechanics :

- (i) Brief introduction to need and development of quantum mechanics, wave-particle duality (photon as particle, de-Broglie hypothesis, particle diffraction, particle interference), wave packet, indeterminacy, complementarity.
- (ii) Schrödinger equation for a free particle, operator correspondence and equation for a particle subject to forces. Normalization and probability interpretation of wave function, superposition principle, expectation value, probability current and conservation of probability, admissibility conditions on the wave function, Ehrenfest theorem.
- (iii) Fundamental postulates of wave mechanics. Eigenfunctions and eigenvalues, operator formalism, orthogonal systems, expansion in eigenfunctions, Hermitian operators, simultaneous eigenfunctions, equation of motion.
- (iv) Uncertainty of position and momentum, monochromatic waves, Gaussian wave packet.

#### UNIT-II

### Problems in One and Three Dimensions :

- (i) Time dependent Schrödinger equation, Application to stationary states for one dimension, Potential step, potential barrier, rectangular potential well, degeneracy, orthogonality, linear harmonic oscillator.
- (ii) Schrödinger equation for spherically symmetric potential, spherical harmonics, hydrogen atom energy levels and eigenfunctions, degeneracy, angular momentum.

### UNIT-III

#### One Electron Atomic Spectra :

- (i) Interaction with radiation, transition probability, spontaneous transition, selection rules and life times.
- (ii) Spectrum of hydrogen atom, fine structure, normal Zeeman effect, electron spin, Stern-Gerlach experiment, spin orbit coupling, electron magnetic moment, total angular momentum, Hyperfine structure, examples of one electron systems, Anomalous Zeeman effect, Lande-g factor (sodium D- lines).

### UNIT-IV

#### Many Electron System Spectra :

- (i) Exchange symmetry of wave functions, exclusion principle, shells, subshells in atoms, atomic spectra (Helium), LS coupling, JJ coupling, selection rules, regularities in atomic spectra.
- (ii) X-ray spectra, Mosley law, absorption spectra, Auger effect.
- (iii) Molecular bonding, molecular spectra, selection rules, symmetric structures, rotational, vibrational electronic level and spectra of molecules, magnetic resonance experiments, Raman spectra.

### UNIT-V

Spread over the entire syllabi of all the four units above.

### PRACTICALS

#### List of Experiments :

#### I Statistical Physics and Thermodynamics :

##### Activities :

- (i) Adiabatic expansion of a gas.
- (ii) Thermal expansion of crystal using interference fringes.
- (iii) Thermal conduction in poor conductor (variation with geometry) by Lee's method.
- (iv) Thermo emf calibration, comparison.
- (v) Total radiation law, temperature dependence of radiation.
- (vi) Probability distribution using coloured dice, coins.

#### II Optics and Lasers :

##### Activities :

- (vii) To determine the refractive index of a liquid using spectrometer.
- (viii) To determine the Cauchy's constants.

- (ix) To study the refractive index of a doubly refracting prism.
- (x) Study of rotation of plane of polarization with a polarimeter.
- (xi) Set up Newton's rings to determine wave length of sodium light.
- (xii) To determine the wave length of a given light using biprism.
- (xiii) To determine the wave length and dispersive power using plane diffraction grating (use Hg source).
- (xiv) To determine the resolving power of a telescope.
- (xv) To determine the resolving power of a grating.
- (xvi) To measure an inaccessible height using sextant.
- (xvii) To determine the principal points of a lens system.
- (xviii) To determine the divergence and wave length of a given laser source.

### III Quantum Physics :

#### Activities :

- (xix) Study the Photoelectric effect and determine the value of Planck's constant.
  - xx) To study the gas discharge spectrum of hydrogen.
  - (xxi) To study the absorption spectra of iodine vapours.
  - (xxii) To determine the ionization potential of mercury.
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### III CHEMISTRY

#### Paper- V : INORGANIC CHEMISTRY

##### UNIT-I

- (A) Chemistry of Elements of First Transition Series :
- Characteristic properties of d-block elements.
  - Properties of the elements of the first transition series, their simple compounds and complexes, illustrating relative stability of their oxidation states, coordination number and geometry.
- (B) 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 behaviour, spectral properties and stereochemistry.

##### UNIT-II

- (A) Chemistry of 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. Properties of Coordination compounds i.e. magnetic properties, colours (Qualitative approach only), use of coordination compounds.

##### UNIT-III

- (A) Chemistry of Lanthanide Elements :
- Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.
- (B) Chemistry of Actinides :
- General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.
- (C) Acids and Bases :
- Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

##### UNIT-IV

- (A) 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.
- (B) 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-VI : ORGANIC CHEMISTRY

##### UNIT-I

###### Alcohols :

- Classification and nomenclature Monohydric alcohols - Nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen

bonding. Acidic nature. Reactions of alcohols.

- Dihydric alcohols - Nomenclature, methods of formation, chemical reactions of vicinal glycols. Oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $\text{HIO}_4$ ] and pinacol-pinacolone rearrangement. Trihydric alcohols - Nomenclature and methods of formation, Chemical reactions of glycerol.

Phenols :

- Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character.
- Comparative acidic strengths 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.

UNIT-II

Aldehydes and Ketones :

- Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis 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, Wolff-Kishner,  $\text{LiAlH}_4$  and  $\text{NaBH}_4$  reductions.

UNIT-III

Carboxylic Acids :

- Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparations 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. Hydroxyl acids : Malic, tartaric and citric acid (structural features only).
- Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic Acids: Methods of formation and effect of heat and dehydrating agents.

Carboxylic Acid Derivatives :

- Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides. Relative stability & reactivity 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).



Ethers and Epoxides :

- Nomenclature of ether and methods of their formation, physical properties. Chemical reactions – cleavage and autoxidation, Ziesel's method.
- Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

#### UNIT-IV

Fats, Oils and Detergents :

- Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents; alkyl and aryl sulphonates.

Organic Compounds of Nitrogen :

- Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.
- 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 catalysis. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.

#### Paper-VII : PHYSICAL CHEMISTRY

##### UNIT-I

Liquid State :

- Intermolecular forces, structure of liquids (a qualitative description).
- Structural differences between solids, liquids and gases.

Liquid Crystals : Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholestric phases. Thermography and seven segment cell.

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.

##### UNIT-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.

### Thermodynamics-III :

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 functions (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

#### 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<sub>2</sub> and S systems.
- Phase equilibria of two component system – solid–liquid equilibria, simple eutectic – Bi-Cd system, desilverisation of lead.
- Solid solutions—Compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H<sub>2</sub>O) system. Freezing mixtures, acetone-dry ice.
- 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.

#### 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.

### UNIT-IV

#### Electrochemistry-II :

- Types of reversible electrodes – gas metal – ion, metal –insoluble salt – anion and redox electrodes.
- Electrode reactions, Nernst equation, derivation of cell E.M.F. 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.
- E.M.F. of a cell and its measurements, Computation of cell E.M.F., Calculation of thermodynamic quantities of cell reactions ( $\Delta G$ ,  $\Delta H$  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.

#### Paper-VIII : LABORATORY PRACTICALS

Inorganic Chemistry

Quantitative Analysis

Volumetric Analysis:

- Estimation of calcium content in chalk as calcium oxalate by permanganometry.
- Estimation of hardness of water by EDTA.
- Estimation of ferrous and ferric by dichromate method.
- Estimation of copper using sodium thiosulphate.

Gravimetric Analysis :

Analysis of Cu as CuSCN and Ni as Ni (dimethylglyoxime)<sub>2</sub>.

Organic Chemistry

Laboratory Techniques :

- Determination of R<sub>f</sub> values and identification of organic compounds. Separation of isomeric mixture of ortho and para–nitroaniline using hexane and ethyl acetate (8.5 : 1.5) by thin layer chromatography.
- Extraction of caffeine from tea leaves.

Qualitative Analysis :

Detection of elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide), in simple organic compounds.

Physical Chemistry

Thermochemistry :

- To determine the solubility of benzoic acid at different temperatures and to determine  $\Delta H$  of the dissolution process.
  - To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base. pH of a Buffer solution; Determination of ionization constant of a weak acid.
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## IV COMPUTER SCIENCE

Paper-A : COMPUTER ORGANIZATION AND ARCHITECTURE

SECTION-A

- Representation of Information : Number system, integer and floating point representation, character codes (ASCII, EBCDIC), error detection and correction codes.

## SECTION-B

2. Basic Building Blocks : Boolean algebra, combinatorial logic design, flip-flops, registers, counters, ALU : arithmetic and logic unit operations, organization of control units, memory : types and organization, peripheral devices : I/O devices (video terminals and printers) and controllers, storage devices (tapes and disks), Programmed and interrupt control mechanism, I/O controllers, bus bandwidths.

## SECTION-C

3. Assembly Language Programming for INTEL 8086/8088 Machine : Programmers model of a machine, example of a typical 16 or 32 bit processor, registers, addressing modes, instruction set, use of assembly language for specific programs for typical problems like : Table search, subroutines, symbolic and numeric manipulations and I/O.

## SECTION-D

4. System Maintenance : Introduction to various physical components of a computer, physical inspection of IBM-PC and internal cards, Diagnostics on IBM-PC, Functional description of various modules and cards. Various types of displays and other peripherals used in IBM-PC, Installing software, and detection of viruses and protection on IBM-PC.

Paper-B : OBJECT ORIENTED PROGRAMMING (USING C++) Objective :

## SECTION-A

1. Concepts of Object Oriented Programming : Object, Class, Encapsulation, Data Hiding, Inheritance, Polymorphism. Analysis and design of system using Object Oriented Approach.
2. Structure of a C++ Program : Include files, Declaration of an object, Main function, I/O streams.
3. Classes : Class Declaration : Data Members, Member Functions, Private and Public members, data hiding and encapsulation, arrays within a class.

Class Function Definition : Member function definition inside the class declaration and outside the class declaration, scope resolution operator, Private and Public member function, Nesting of member functions.

## SECTION-B

4. Objects : Creating Objects, Accessing class data members, Accessing member functions, Arrays of Objects, Objects as function arguments : Pass by value, Pass by Reference, Pointers to Objects.
5. Constructors and Destructors : Constructors : Declaration and Definition, Default Constructors, Parameterized Constructors, Copy Constructors. Destructors : Definition and use.

## SECTION-C

6. Function Overloading : Function Overloading : Declaration and definition.
7. Inheritance – Extending Classes : Concept of inheritance, base class, derived class, defining derived classes, visibility modes, private, public, protected; single inheritance : privately derived, publicly derived; making a protected member inheritable, access control to private and protected members by member functions of a derived class, multilevel inheritance, nesting of classes.

#### SECTION-D

8. Data Structures : Linked Lists, Queues, Stacks, Trees and Sorting algorithms.

Paper-C : PRACTICAL : Practicals based on Paper-A and Paper-B.

#### STATISTICAL INFERENCE

##### SECTION-I

Concept of a statistic and its sampling distribution. Point estimate of a parameter, concept of unbiasedness, consistency, efficiency and sufficiency (only the definitions and examples). Maximum likelihood estimation (standard distributions). Standard errors of sample mean and sample proportion. Sampling distribution of sum of independent binomial and Poisson random variables. Independence of sample mean and variance in random sampling from a normal distribution (without derivation).

Statements and sampling distributions of chi-square, t & F distributions and their relationships.

##### SECTION-II

Statistical Tests and Interval Estimation : Null and alternative hypothesis, two types of errors and p-value. Testing for the mean and variance of a normal distribution, testing of equality of means and variances of two univariate normal distributions, and their related confidence intervals. Testing the significance of sample correlation coefficient.

Large Sample Tests : Use of central limit theorem for testing and interval estimation of a single mean and a single proportion, difference of two means and two proportions. Fisher's Z-transformation and its uses. Chi-square test for goodness of fit and testing of independence of attributes, Yate's correction.

#### SAMPLE SURVEYS, DESIGN AND ANALYSIS OF EXPERIMENTS

##### SECTION-I

Concepts of population and sample, need for sampling, census and sample surveys, basic concepts in sampling. Sample selection and sample size. Sampling and non-sampling errors.

Some basic sampling methods for estimation of population mean, variance and standard error of estimates : simple random sampling (SRS) with and without replacement, stratified random sampling under various allocations and systematic sampling.

##### SECTION-II

Linear Models : Concepts of fixed effect, random effect and mixed effect models. Analysis of

variance for one-way, two-way (with one observation per cell and with multiple but equal observations per cell) classifications under the fixed effect models.

Need for design of experiment, fundamental principles of design, basic designs—CRD, RBD, LSD and their analysis.

PRACTICAL

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## **V APPLIED STATISTICS**

Paper-A : MATHEMATICAL METHODS-II

### SECTION-I

Coordinate Geometry of 3 dimensions : Cartesian, spherical coordinates, equations of line, plane, sphere and ellipsoid.

Matrices and Linear Algebra : Determinants, algebra of matrices, rank of a matrix, inverse of a matrix, symmetric matrices (upto  $4 \times 4$  matrices only).

### SECTION-II

Matrices and Linear Algebra : Systems of Linear equations and their solutions.

Calculus of Several Variables : Functions of two variables, Partial derivatives and double integrals.

Applications to evaluation of area.

Paper-B : STATISTICAL METHODS

### SECTION-I

Compilation, classification, tabulation and diagrammatic representation of statistical data. Concepts of Statistical population, random sample and frequency curve, measures of location, dispersion, skewness and kurtosis.

Two dimensional random variable, joint probability distributions, marginal and conditional probability distributions, conditional expectation, covariance and correlation coefficient.

### SECTION-II

Measures of association and contingency, correlation and linear-regression involving two variables. Bivariate normal distributions.

Statement of weak law of large numbers and central limit theorem for independent and identical random variables. Sampling distributions of means, chi-square, t and F in sampling from normal populations (without proof).

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## **VI BOTANY**

Paper A : DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS

SECTION-I :  
GYMNOSPERMS

UNIT-I

1. General characteristics, basis of classification and economic importance of gymnosperms.
2. Fossil gymnosperms : Lyginopteris : Introduction, external structure of stem; internal structure of primary stem, root and leaf; reproduction.

Williamsonia : Introduction, external morphology; internal structure; reproductive organs, male and female flowers.

UNIT-II

Structure, reproduction (male and female strobilus; structure of ovule; development of male and female gametophytes; pollination, fertilization, development of embryo and structure of seed) and life cycle of :

(a) Cycas (b) Pinus (c) Ephedra

SECTION-II : ANGIOSPERMS

UNIT-III

1. General characters of Angiosperms.
2. Plant nomenclature and International Code of Botanical Nomenclature : Principles and rules; taxonomic ranks; type concept; principle of priority, aims and objectives of plant taxonomy; a brief introduction to taxonomy as synthetic discipline.
3. Salient features of Bentham and Hooker's, Hutchinson's and Engler & Prantl's system of classification (Details of Bentham and Hooker's system only).
4. Terminology pertaining to floral description.
5. Criteria for determining primitive and advanced nature of flower.
6. General account and diagnostic features of the following families (excluding economic importance) :

Liliaceae	:	Asphodelus/Asparagus
Orchidaceae	:	Zeuxine
Gramineae (Poaceae)	:	Triticum

UNIT-IV

General account and diagnostic features of the following families (excluding economic importance) :

Ranunculaceae	:	Ranunculus, Delphinium
Brassicaceae	:	Brassica
Rutaceae	:	Citrus, Murraya
Malvaceae	:	Hibiscus
Fabaceae	:	Lathyrus, Cassia, Acacia
Cucurbitaceae	:	Luffa
Umbelliferae (Apiaceae)	:	Coriandrum
Compositae (Asteraceae)	:	Helianthus, Ageratum/Parthenium
Asclepiadaceae	:	Calotropis
Solanaceae	:	Solanum, Petunia

Labiatae (Lamiaceae) :	Ocimum
Chenopodiaceae	: Chenopodium
Euphorbiaceae	: Euphorbia

Paper B : STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS

UNIT-I

1. The basic body plan of a flowering plant.
2. Diversity in plant form in annuals, biennials and perennials.
3. Leaf : Origin, development, arrangement and diversity in size and shape, and modifications; internal structure (dicot and monocot leaves).
4. Root System : Structural modifications for storage, respiration and reproduction.

UNIT-II

1. Tissue Systems : Meristematic, shoot apex, root apex; simple and complex permanent tissues, special tissues; internal structure of primary dicot stem & root (Helianthus); secondary growth in dicot stem & root (Helianthus); internal structure of monocot stem & root (Maize).
2. Anomalous stem structure in Boerhaavia, Nyctanthes, Mirabilis and Dracaena.
3. Various methods of vegetative propagation.

UNIT-III

Flower : As a modified shoot, functions; Structure of anther and pistil; Male and female gametophytes; Double fertilization and its significance; Different types of ovules and embryo-sacs.

UNIT-IV

Types of pollination, Advantages and disadvantages of self and cross-pollination, Contrivances for self and cross-pollination, various agencies to bring about cross-pollination, characters of flowers pollinated by different agencies; Seed formation : development of endosperm and embryo; Fruit development and maturation. Significance of Seed : Suspended animation; Ecological adaptation; Dispersal strategies.

Suggested Laboratory Exercises :

1. Cycas :
  - i. Habit, armour of leaf bases on the stem, young and old foliage leaves, scale leaves, male cone, megasporophyll, seed.
  - ii. Preparation of permanent stained slides of Cycas (T.S. leaflet, rachis and coralloid root).
2. Pinus :
  - (i) Dwarf shoot; Male cone; Female cones (first year, second year and third year); Seed.
  - (ii) Preparation of permanent slide of T.S. needle and Pollen grains.
  - (iii) Study through permanent slides :



- (a) L.S. male cone.
  - (b) L.S. female cone.
  - (c) L.S. Ovule.
3. Ephedra :
- (i) Habit and structure of male and female cones.
  - (ii) Preparation of permanent slide of T.S. stem (young and old).
  - (iii) Study through permanent slides :
    - (a) L.S. female cone.
    - (b) L.S. male cone.
4. Preparation of permanent stained slides to show :
- (i) Anomalous internal structure of stem in Boerhaavia, Nyctanthes, Mirabilis and Dracaena.
  - (ii) T.S. Dicot stem & root (Helianthus).
  - (iii) T.S. Monocot stem & root (Maize).
5. Description of flowers in technical terms, drawing F.D., V.S., T.S. ovary, writing F.F. and reference to their respective families of the genera mentioned in different families in theory syllabus.

**Guidelines for Botany Practical Examination:**

1. Cut T.S. of specimen A. Make its permanent stained slide. Draw its well Labelled diagram and show it to the examiner. Identify the slide giving at least two reasons.
  2. Describe specimen B or C in technical terms and proper sequence. Draw F.D. and V.S. of flower B or C. Cut T.S. of ovary and V.S. of flower and show them to the examiner. Write F.F. also. Refer specimen B or C to its respective family giving at least two reasons (The specimen B or C is to be given to the alternately seated students).
  3. Write illustrated morphological note on specimen D & E (from Gymnosperms).
  4. Identify slides F, G & H giving at least two reasons.
  5. Practical note book.
  6. Plant album.
  7. Viva-Voce.
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## **VII ZOOLOGY**

### **PAPER-A : BIODIVERSITY III (CHORDATES) & EVOLUTION**

#### **UNIT-I**

Chordates – Origin, Parental care and migration.

Protochordates – Urochordata – Type Study – Herdmania except development. Cephalochordata - Type Study - Amphioxus.

Cyclostomata – External Characters of Petromyzon & affinities of Cyclostomata. Pisces-Type study - Labeo, Scales & fins.

Classification of the animals up to orders relating to the following groups along with brief ecological notes of the following :

Protochordates : Herdmania, Molgula, Pyrosoma, Doliolum, Salpa, Oikopleura, & Amphioxus (excluding development).  
Cyclostomata : Myxine, Petromyzon & Ammocoetes larva.  
Chondrichthyes : Zygaena (Hammer headed shark), Pristis (saw fish), Narcine (electric ray), Trygon, Rhinobatus and Chimaera (rabbit fish).

Actinopterygii : Polypterus, Acipenser, Lepisosteus, Muraena, Mystus, Catla, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echeineis and Solea.  
Dipneusti (Dipnoi) : Protopterus (lung fish)

#### UNIT-II

- Amphibia – Origin, Type study-Frog.
- Reptilia-Type study-Uromastix, Origin, Extinct reptiles, Poisonous and non-poisonous snakes, Poison apparatus.

Classification of the animals up to orders relating to the following groups along with brief ecological notes of the following :

Amphibia : Uraeotyphlus, Necturus, Ambhiuma, Amblystoma and its Axolotl Larva, Triton, Salamandra, Hyla, Rhacophorus.

Reptilia : Chelone (turtle) and Testudo (Tortoise), Hemidactylus (wall lizard), Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python, Eryx, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis and Alligator.

#### UNIT-III

- Aves-Type study-Pigeon, Flight adaptations.
- Mammals - Type study-Rat, Adaptive radiations, Dentition.

Classification of the animals up to orders relating to the following groups along with brief ecological notes of the following :

Aves : Ardea, Milvus, Pavo, Tyto, Alcedo, Eudynamis and Casuarius.  
Mammalia : Ornithorhynchus, Echidna, Didelphis, Macropus (Kangaroo), Loris, Macaca, Manis (Scaly ant eater), Hystrix (porcupine), Funambulus (Squirrel) Panthera, Canis, Herpestes (Mongoose), Capra, Pteropus.

#### UNIT-IV

Concept and evidences of organic evolution. Theories of organic evolution.

Origin of life.

Concept of micro, macro and mega-evolution. Concept of species.

Fossils and evolutionary rate. Evolution of man.

PAPER B : BIOCHEMISTRY & ANIMAL PHYSIOLOGY (ZOO 202)

#### UNIT-I

- Biochemistry and its scope; Carbohydrates, proteins, lipids and nucleic acids: their classifications and functions.
- Carbohydrate metabolism: The Embden Meyerhoff, Parnas pathway, (glycolysis), the tricarboxylic acid cycle, the hexose monophosphate shunt, glycogenesis and glycogenolysis.

#### UNIT-II

- Enzymes: Nature, their classification and coenzymes.
- Lipid metabolism : $\beta$ -oxidation of fatty acids, rate of glycerol and gluconeogenesis, interaction of carbohydrates and lipids, lipogenesis in tissues, ketosis.
- Protein metabolism :Protein metabolism of amino acids (Oxidative deamination, transamination and decarboxylation; hydrolysis of proteins and Ornithine cycle).

#### UNIT-III

- Digestion:Digestion of dietary constituents, regulation of digestive processes and absorption.
- Types of nutrition, feeding mechanisms, extra and intra cellular digestion, enzymatic digestion and symbiotic digestion.
- Blood: Composition and functions of blood and lymph. Molecular structure and function of haemoglobin, blood clotting. Blood groups including Rh. factor, haemopoiesis.
- Heart : Origin and regulation of heart beat, cardiac cycle, electrocardiogram, cardiac output, fluid pressure and flow pressure in closed and open circulatory systems, blood pressure and micro- circulation.
- Respiration:Transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen dissociation curve of haemoglobin, Bohr effect, chloride (-) shift, Haldane effect and control of breathing.

#### UNIT-IV

- Excretion:Urine formation and osmoregulation
- Muscles:Ultrastructure, chemical and physiological basis of skeletal muscle contraction.
- Neural Integration:Structure of neuron, resting membrane potential, origin and propagation of impulse along the axon, synapse and myoneural function.
- Physiology of behavior:Taxes and reflexes, instinctive and motivative, learning and reasoning.
- Endocrine:Structure, hormones and functions of thyroid, parathyroid, adrenal, hypothalamus, pituitary, pancreas and gonads.

PRACTICALS : Practical based on Theory Papers ZOO (ZOO 251)

1. Classification up to orders habits, habitats, distinctive characters and economic importance (if any) of the following animals :

- Urochordata : Herdmania, Molgula, Pyrosoma, Doliolum, Salpa & Oikopleura.
- Cephalochordata : Amphioxus.
- Cyclostomata : Myxine, Petromyzon & Ammocoetes larva.
- Chondrichthyes : Zygaena (Hammer headed shark), Pristis (Saw fish), Narcine (Electric ray), Trygon, Rhinobatus, and Chimaera (Rabbit fish).
- Actinoptergii :Polypterus, Acipenser, Lepidosteus, Muraena, Mystus, Catla,Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echeineis and Solea.
- Dipneusti (Dipnoi) :Protopterus.
- Amphibia:Uraeotyphlus, Necturus, Amphiuma, Amblystoma and its Axolotl larva, Triton, Salamandra, Hyla, Rhacophorus.
- Reptilia:Chelone (Turtle) and Testudo (Tortoise), Hemidactylus, Calotes, Draco, Varanus,Phrynosoma, Chamaeleon, Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis.
- Aves :Casuarius, Ardea, Anas, Milvus, Pavo, Eudynamis, Tyto and Alcedo.
- Mammalia:Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaca, Manis, Hystrix, Funambulus, Panthera, Canis, Herpestes, Capra, Pteropus.

2. Examine and dissect the following animals :

Herdmania	:	General anatomy
Labeo	:	Digestive, reproductive systems, heart, afferent and efferent branchial arteries and cranial nerves.
Chick	:	Digestive, arterial, venous and urinogenital systems.:
White Rat	:	Digestive, arterial, venous and urinogenital systems.

3.Study of the skeleton of Labeo, Rana (Frog), Varanus, Gallus and Rat/Oryctolagus (Rabbit).

4. Study of the following prepared slides : T.S. Amphioxus through various regions.

Spicules & pharynx of Herdmania & pharynx of Amphioxus.

Histology of rat/rabbit (compound tissues).

5. Make temporary preparations of the following : Temporary preparation of spicules of .

Permanent preparation of whole mount of pharynx of Herdmania and Amphioxus.

Blood smear of a mammal.

6. Identification of food stuffs : Starch, glucose, proteins and fats in solution.

7. Demonstration of osmosis and diffusion.

8. Demonstrate the presence of amylase in saliva, denaturation by pH and temperature.

9. Determination of coagulation and bleeding time of blood in man/rat/rabbit.

10. Determination of blood groups of human blood sample.

11. Recording of blood pressure of man.
  12. Analysis of urine for urea, chloride, glucose and uric acid.
  13. Estimation of haemoglobin content.
- Field study : Visit to a fossil Park/Museum. Familiarity with the local vertebrate fauna.
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## VIII BIOCHEMISTRY

### Paper-A : METABOLISM

#### SECTION-I

Digestion & Absorption of Carbohydrates :

Metabolic Pathways of Carbohydrates, Glycolysis and alcoholic fermentation, The Pentose Phosphate Pathway, Glucuronate and glyoxylate pathway, TCA cycle, Glycogenolysis & Glycogenesis, Gluconeogenesis, Biosynthesis of starch, Biosynthesis of Ascorbic acid.

#### SECTION-II

Digestion & Transport of Lipids :

$\beta$ -Oxidation of fatty acids including odd chain fatty acids.  $\alpha$  and  $\omega$  oxidation of fatty acids. Degradation of triglycerides and phospholipids. Formation and utilization of ketone bodies. Biosynthesis of saturated and unsaturated fatty acids. Biosynthesis of triglycerides and phospholipids, biosynthesis of cerebrosides; sulfatides and gangliosides. Biosynthesis of Cholesterol. Biosynthesis of Prostaglandins, Thromboxanes, Leukotrienes, Lipoxins and Prostacyclins.

#### SECTION-III

Digestion of Proteins :

General Reactions of Amino Acids : Deamination, transamination and decarboxylation. Urea cycle.

Catabolism of Carbon Skeletons of Amino Acids :

Glycine and Alanine, Serine and threonine, Phenylalanine and Tyrosine, Tryptophan, Histidine, Leucine, Valine and Isoleucine, Cysteine and Methionine, Lysine, Glutamic acid and Glutamine, Aspartic acid and Asparagine.

Biosynthesis of Nutritionally Non-Essential Amino Acids :

Glutamate and Glutamine, Aspartate and Asparagine, Proline, Alanine, Cysteine & Selenocysteine, Tyrosine, Serine, Glycine.

#### SECTION-IV

Nucleic Acids :

Degradation of purines and pyrimidines. Biosynthesis of purines, pyrimidines and nucleotides. Catabolism of Heme & Formation of Bile pigments. Biosynthesis of porphyrins and heme. Conjugation of bilirubin and its clinical significance.

### Paper- B : BIOCHEMICAL TECHNIQUES

## SECTION-I

### Spectroscopic Techniques :

Beer-Lambert's Law. Light absorption and its transmittance. Determination and application of extinction coefficient. Applications of following spectroscopic techniques in elucidating structure of Biomolecules- Visible, U.V., infra-red and fluorescence spectroscopy. ORD, C.D. and N.M.R.

## SECTION-II

### Electrophoretic Techniques :

Principles and applications of the following electrophoresis techniques. Paper and gel electrophoresis, high voltage electrophoresis, SDS-PAGE : Discontinuous electrophoresis, isotachopheresis, isoelectric focussing and immunoelectrophoresis.

### Centrifugation Techniques :

Various centrifugation techniques and their applications in Biochemistry. Preparative and analytical ultra- centrifugation procedures. Application of partial specific volume, diffusion coefficient and viscosity measurements in the study of macromolecules of biochemical importance.

## SECTION-III

### Chromatographic Techniques :

General principles of chromatography and the application of following chromatographic procedures in isolation and purification of biomolecules : Absorption, partition, paper and thin layer chromatography. Gas liquid chromatography. High performance liquid chromatography (HPLC), Ion exchange and Exclusion chromatography. Affinity chromatography.

## SECTION-IV

### Radio Isotopic Techniques :

Nature of isotopes and radioisotopes. Radioactive decay. Properties of radioactive emissions. Units of radioactivity. Techniques used to measure radioactivity; GM counter and liquid scintillation counting and gamma counter. Labelling of Biochemical compounds and autoradiography. Use of radioactive tracers in the study of enzyme reaction mechanisms and metabolic pathways. Radioimmuno assay. Biological hazards of radiation and safety measures in handling radioisotopes.

## PRACTICALS :

1. Estimation of blood glucose by the methods of (i) Folin Wu (ii) Nelson Somogyi.
2. Isolation and assay of glycogen from rat liver.
3. Separation and identification of amino acids by  
(i) Paper chromatography (ii) Thin layer chromatography.

4. Estimation of  $\text{Ca}^+$  in serum.
  5. Estimation of total and free cholesterol in serum.
  6. Estimation of total lipids in serum by Vanillin method.
  7. Estimation of proteins by Lowry's method.
  8. Estimation of Lipoproteins in plasma.
  9. Colorimetric estimation of inorganic phosphate.
  10. Separation of phospholipids by thin layer chromatography.
  11. Estimation of lactic acid in blood before and after exercise.
  12. Preparation of starch from potato and its hydrolysis by salivary amylase.
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## **IX MICROBIOLOGY**

### **SECTION-A**

Brief introduction to terminology of Infections diseases, Frequency of disease, Recognition of Infectious disease, Infections, Disease cycle, Virulence and mode of transmission, Emerging and reemerging Infectious diseases, Global travel & Health considerations, Nosocomial Infections.

### **SECTION-B**

Nomenclature and classification of microbes of medical importance. Origin of the Normal Flora, Germfree and Gnotobiotic Life, Distribution and occurrence of Normal Flora of Skin, Eye, Respiratory Tract, Mouth, Intestinal Tract & Genitourinary Tract.

### **SECTION-C**

Microbial adherence, Passive Penetration into body, Active Penetration into body, Events in Infection following penetration, Microbial virulence factors.

### **SECTION-D**

Development of chemotherapy, General characteristics of antimicrobial drugs, Determining level of antimicrobial activity, Mechanism of action of antimicrobial agents, factors influencing the effectiveness of antimicrobial drugs, Antibacterial drugs viz sulfonamides, Quinolones, Penicillins, Cephalosporins, Tetracyclines, Erythromycin, Chloramphenicol, Drug Resistance, Antifungal and Antiviral drugs.

## **IMMUNOLOG**

### **SECTION-A**

Introduction and history of Immunology, Non-specific Defense; Physical Barriers, Chemical Barriers, Phagocytosis, Inflammation, Fever, Types of Immunity, Active & Passive Immunity, Immunological memory, Primary & Secondary Lymphoid organs, Mucosa Associated Lymphoid tissue (MALT), Cutaneous Associated Lymphoid Tissue (CALT), Lymphocyte Traffic, Cells of immune system, Antigens; factors affecting Immunogenicity, epitopes, haptens.

### **SECTION-B**

Humoral Immune Response, Antibodies/Immunoglobulins, Structure, function and type of antibodies, Antigenic-combining regions of antibodies, factors influencing antibody production, Genetic model, Multigene Organisation, generation of antibody diversity.

#### SECTION-C

Cell Mediated Immune System, Mechanism of CMI, Types of effector T Cells, Helper T-cells, Suppressor, T-cells, cytotoxic T cells, Killer T cells, Cytokines, Lymphokines, Colony Stimulating factors, Tumour Necrosis factor, Interferons, Accessory cells (Macrophages), the Complement System, Classical and Alternate pathway, HLA, Monoclonal antibody technology and its applications, Interactions between B and T lymphocytes.

#### SECTION-D

Antigen-Antibody Interactions : Precipitation reaction, Immuno-diffusion test, counter current Immuno electrophoresis, complement fixation tests, Widal test, Wasserman's test, Weil Felix reaction, Western Blotting, Types of vaccines.

#### PRACTICALS

1. Stainings – Gram's, Alberts, ZNCF.
2. Isolation and Maintenance of Pure Cultures.
3. Physiological characteristics of bacteria and its use for their identification.
4. Assay of antimicrobials.
5. Preparation of serum/plasma.
6. Sterilization – Introduction to autoclave, hot air oven, filter sterilization.
7. Demonstration of Immune organs in dissected animal.
8. Demonstration of Immune cells in the smears prepared from Immune organs.
9. Complement fixation.
10. Antigen-antibody interactions :
  - Agglutination
  - Precipitation
  - Blood grouping
  - Immunodiffusion

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## X ELECTRONICS

UNIT-I : There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry fifteen marks.

UNIT-II : There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry fifteen marks.

UNIT-III : There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry fifteen marks.

UNIT-IV : There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry fifteen marks.



UNIT-V :There will be eight questions of small answer type covering the syllabi of all the four units (I-IV). Five questions are to be attempted. Each question will carry three marks.

Paper-A : PRINCIPLES OF COMMUNICATIONS SYSTEMS UNIT-

Communication Principles :

Communication bands, basic principles of propagation of e.m. waves through atmosphere and ionosphere: ground wave, sky wave, space waves, Dead Zones, Concept of modulation and its advantages, qualitative treatment of FM, AM (DBS, SSB), PM.

Superhetrodyne Receivers :

Principles, advantages, RF input and AE coupling arrangement, RF amplifier, mixers, local oscillator, IF amplifier, detector, audio amplifier, loud speaker, tuning/alignment of receivers, trouble shooting of radio receiver.

UNIT-II

Tape Recorders :

Principles of magnetic recording, playback principles, need for biasing, tape speed, magnetic tape, head care, head alignment, high frequency response, record replay equalization, noise, noise reduction, tape transport, tape recorder electronics, playback amplifier, record amplifier.

Digital Audio :

Sampling and Quantizing the input signal, recording system, playback, compact disc, CD player (block diagram).

UNIT-III

Elements of T.V. Systems :

Overview of picture transmission, sound transmission, picture reception, sound reception, synchronization.

Composite Video Signal :

Scanning sequence details, sync details of 625 line system, channel band width, vestigial side band transmission, reception of vestigial side band signals, frequency modulation, FM channel band width, allocation of frequency bands for television, signal transmission, television standards.

Picture Tube- Monochromatic :

Beam deflection, screen phosphor, face plate, picture tube characteristics, picture tube circuit controls.

UNIT-IV

Television Receivers :

Block diagram of black and white T.V. receivers, functions of various sections i.e. Balun, RF amplifier, mixer local oscillator, IF amplifier, video detector, video amplifier, sound IF, sound detector and amplifier, sync separators, horizontal and vertical oscillator and their

synchronization, EHT section, AGC, DC power supply.

Fundamentals of Colour T.V.:

Concept of primary and complementary colours, colour mixing, beam splitting in camera, colour difference signals (U and V signals), luminance (Y) and chrominance (C) signals, compatibility with black and white signals, colour signal subcarrier, concept of colour picture tube (PIL).

Paper- B : MICROPROCESSOR BASED SYSTEMS

UNIT-I

Microcomputer Fundamentals :

Introduction, microcomputer architecture, memory organization, Memory classification, CPU organization, Microcomputer operation.

8085 Microprocessor Fundamentals :

Introduction, The 8085 pin diagram and functions, The 8085 microprocessor architecture, 8085 Bus system, Demultiplexing of 8085 bus system, The 8085 machine cycles.

UNIT-II

Interfacing the Microprocessor :

Introduction to basic interfacing concepts, Interfacing of 8085 microprocessor with ROM and RAM, Interfacing of 8085 microprocessor with input/output devices, Synchronizing I/O data transfer using interrupts, Address decoding, Memory mapping, The 8155 multipurpose programmable device.

UNIT-III

Instruction Set :

Machine and assembly language, Instruction set : data transfer instructions, arithmetic instructions, logical instructions, branch instructions, stack, I/O machine control instructions, addressing modes, Subroutine, CALL and RETURN instructions, Idea of counters, Time delays, Miscellaneous instructions.

UNIT-IV

Programming 8085 Microprocessor :

Straight line programs, Program branching, Program looping, Program indexing, Mathematical programs addition with and without carry, subtraction, multiplication of two 8 bit numbers.

Applications of 8085 Microprocessor :

- (i) Traffic Control
- (ii) Temperature Control
- (iii) Digital Clock

## ELECTRONICS PRACTICALS

### I Guidelines for Electronics Practical Examinations :

- (i) One full experiment requiring the student to take data, Analyse it and draw conclusions
- (ii) Brief Theory
- (iii) One exercise based on experiment (to be allotted by the examiner)
- (iv) Viva-Voce
- (v) Record (Practical file)

II There will be one session of 4 hours duration. The paper will consist of 8 experiments out of which an examinee will mark 6 and one of them will be allotted by the examiner.

III Number of candidates in a group for practical examination should not exceed 12.

IV In a single group, same experiment will not be allotted to more than three examinees in any group.

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