



**Scheme of Examination  
and  
Course of Study**

**FACULTY OF SCIENCE**

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

## SCHEME FOR B.Sc. Pass - PART III

Name of the subject		Duration of Exam.	Max.Marks		Min.Marks	
			Th.	Prac.	Th.	Prac.
<b>Physics</b>						
Paper – I	Solid State Physics	3 Hrs.	50	-	18	-
Paper – II	Nuclear Physics	3 Hrs.	50	-	18	-
Paper – III	Relativity and Mathematical Physics	3 Hrs.	50	-	18	-
Paper – IV	Practical	5 Hrs.	-	75	-	27
			<b>150</b>	<b>75</b>	<b>54</b>	<b>27</b>
<b>Chemistry</b>						
Paper – I	Inorganic Chemistry	3 Hrs.	50	-	18	-
Paper – II	Organic Chemistry	3 Hrs.	50	-	18	-
Paper – III	Physical Chemistry	3 Hrs.	50	-	18	-
Paper – IV	Practical	5 Hrs.	-	75	-	27
			<b>150</b>	<b>75</b>	<b>54</b>	<b>27</b>
<b>Mathematics</b>						
Paper – I	Real Analysis	3 Hrs.	75	-	27	-
Paper – II	Linear Programming and Operations Research	3 Hrs.	75	-	27	-
Paper – III	Numerical Analysis and Difference Equations	3 Hrs.	75	-	27	-
			<b>225</b>	<b>-</b>	<b>81</b>	
<b>Botany</b>						
Paper – I	Ecology and Phytogeography	3 Hrs.	50	-	18	-
Paper – II	Plant Physiology and Biochemistry	3 Hrs.	50	-	18	-
Paper – III	Molecular Biology and Biotechnology	3 Hrs.	50	-	18	-
Paper – IV	Practical	5 Hrs.	-	75	-	27
			<b>150</b>	<b>75</b>	<b>54</b>	<b>27</b>
<b>Zoology</b>						
Paper – I	Mammalian Neuroendocrinology and Behaviour	3 Hrs.	50	-	18	-
Paper – II	Genetics and Biotechnology	3 Hrs.	50	-	18	-
Paper – III	Animal Ecology and Biostatistics	3 Hrs.	50	-	18	-
Paper – IV	Practical	5 Hrs.	-	75	-	27
			<b>150</b>	<b>75</b>	<b>54</b>	<b>27</b>

**PHYSICS**  
**Paper - I**  
**Solid State Physics**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

**UNIT - I**

**Crystal Binding and Crystal Structure:-** Crystal Bonding, Ionic Bond, Binding Energy of Ionic Crystal, Determination of the Repulsive Exponent, Covalent Bonding, Metallic Bonding, Molecular or Vander Waal's Bonding, Hydrogen Bonding, Space Lattice and Crystal Structure, Bravis Lattice, Miller Indices and Crystal Structure, Spacing of Planes in Crystal Lattice, Atomic Packing, Simple cubic lattice Structure, Face Centered Cubic Lattice Structure, Hexagonal Closed Packed Structure, Pervoskite Structure, X-ray Diffraction and Bragg's Law, Laue Pattern.

**UNIT - II**

**Thermal Properties of the Solids:-** Concepts of Thermal Energy and Phonons, Internal Energy and Specific Heat, The Various theories of Lattice Specific Heat of Solids, The Einstein Model, Vibrational Modes of Continuous medium, Debye Model, Electronic Contribution of the internal Energy hence to the Specific Heat of Metals, Thermal Conductivity of the Lattice.

**UNIT - III**

**Band Theory of Solids :-** Formation of Bands, Periodic Potential of a Solid Wave Function in a Periodic Lattice and Bloch Theorem, Number of States in the Band, Kronig Penny Model, Velocity of the Bloch electrons and Dynamical Effective Mass, Momentum, Crystal Momentum and Physical Origin of the Effective Mass, Negative Effective Mass and Holes, The distinction between metals, insulators and intrinsic semiconductors.

**UNIT - IV**

**Electrical Conductivity :-** Drude-Logentz Theory of Electrical conductivity, Boltzmann Transport Equation, Sommerfield Theory of Electrical Conductivity Mathiessen's Rule, Thermal Conductivity and Wiedemann-Franz's Law, The Hall Effect.

**Superconductivity :-** Introduction, Experimental Features of Superconductivity, The Isotope Effect and Electron-Phonon Interaction, The Effect of the Superconductivity Transition on Properties, Special Features of Superconducting Materials, Theoretical Survey (Basic Ideas), Flux Quantisation BCS Theory of Superconductivity : Cooper Pairs, High Temperature, Superconductors (Basic Ideas), Main Properties of Copper Oxide Superconductors, Electron Superconductors, Copper free high T-

Oxide superconductors (Bismuth Oxide Sub Organic and Fullerenes), Alkali Metal Doped  $C_{60}$  Fullerenes Superconductors (Basic Ideas), Mechanics of High T, Superconductors (Basic Ideas), Use of Superconductors.

#### UNIT - V

**Magnetic Properties** - Classification of Magnetic Materials, Review of Basic Materials, Origin of Atomic Magnetism, Dynamics of Classical Dipole in Magnetic Field, Magnetic Susceptibility, Phenomenon of Diamagnetism, Paramagnetism, Paramagnetism of Ionic Crystal, Ferromagnetism, Temperature Dependence of Saturation of Spontaneous Magnetisation, The Paramagnetic Region, The Nature of Ferromagnetism, Nature and Origin of Weiss Molecular Field, Heisenberg's Exchange Interaction, Quantum Theory of Ferromagnetism, Relation Between  $J_0$  (Exchange Integral) and  $1$  (Weiss Constant) Ferromagnetism Domains, Magnetostriction.

**PHYSICS**  
**Paper - II**  
**Nuclear Physics**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

**UNIT - I**

**Nuclear Properties** - Rutherford's theory of a Particle Scattering, Properties of Nuclei : Quadrupole Moment and Nuclear Ellipticity, Quadrupole Moment and Nuclear Spin, Parity and Orbital Angular Momentum, Parity and Its Conservation, Nuclear mass and Mass Spectroscopy, Nuclear Energy, Explanation of the fact that Electrons Cannot Exist within a Nucleus, Discovery of Neutron and Proton-Neutron Hypothesis, Neutron to Proton Ratio (N/Z), The Nuclear Potential, Nuclear Mass, Atomic Mass Unit (amu), Mass Defect and Binding Energy, Nuclear Forces, Theory of Nuclear Forces, The Liquid Drop Model.

**UNIT - II**

**Nuclear Fission** - The Discovery of Nuclear Fission, The energy Release in Fission, The Fission Products, Charge distribution of Fission products, Ionic Charge of Fission products, Fission Cross Section and Threshold, Neutron Emission in Fission, The Prompt Neutron and Delayed Neutrons, Mechanism for the emission of Delayed Neutrons, Energy of Fissions Neutrons, Theory of Nuclear Fission and Liquid Drop Model, Barrier Penetration-Theory of Spontaneous Fission, Nuclear Energy sources, Nuclear Energy Sources, Nuclear Fission as a source of Energy, The Nuclear Chain Reaction, Condition of Controlled Chain Reaction, The Principle of Nuclear Reactors, Classification of Reactors, Typical Reactors, Power of Nuclear Reactor, Critical Size of Thermal Reactors, The Breeder Reactor, Reprocessing of the Spent Fuel, Radiation Damages and Fission Product Poisoning, Uses of Atomic Energy.

**UNIT - III**

**Nuclear Fusion** - The Source of Stellar Energy, The Plasma : The Fourth State of the Matter, Fusion Reaction, energy Balance and Lawson Criterion, Magnetic Confinement of Plasma, Classical Plasma Losses from the Magnetic Container, Anomalous Losses, Turbulence and Plasma Instabilities, The Laser Fusion Problem, Fusion Reactor.

**Elementary Particles:** Classification of Elementary Particles, Fundamental Interactions, Unified Approach (basic Ideas), The Conservation Laws, Quarks (basic Ideas), Charmed and Colour Quarks.

**UNIT - IV**

**Accelerators** : Ion Sources, Cock-Craft-Walton High Voltage Generators, Van-De-Graff Generators, Drift Tube Linear Accelerators, Wave Guide

Accelerator, Magnetic Focussing in Cyclotron, Synchro Cyclotron, Betatron : The Electromagnetic Induction Accelerator, electron Synchrotron, Proton Synchrotron.

#### UNIT - V

**Particle and Radiation Detectors** : Ionisation Chamber, Region of Multiplicative Operation, Proportional Counter, Geiger - Muller Counter, Cloud chamber.

**Cosmic Rays** : Discovery of Cosmic Rays, Nature of Cosmic Rays soft and hard components variation in cosmic rays-

- (1) Latitude Effect
- (2) East-West Assymetry Directional Effect
- (3) Altitude Effect

Detection of Cosmic Ray Particles, Origin of Cosmic Rays

**PHYSICS**  
**Paper - III**  
**Relativity and Mathematical Physics**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

**UNIT - I**

Orthogonal curvilinear coordinate system, scale factors, expression for gradient, divergence and curl and their applications to cartesian, cylindrical and spherical polar coordinate systems.

Coordinate transformation and Jacobian, transformation of covariant, contravariant and mixed tensor. Addition, multiplication and contraction of tensors, quotient law, pseudotensors. Metric tensor, its use in transformation of Tensors.

**UNIT - II**

Dirac-Delta Function and its properties. Fourier series, computation of Fourier coefficients, applications to simple periodic functions like square wave, sawtooth wave and rectifier output.

Postulates of special theory of relativity and observational evidence, Lorentz transformation and rotation in space time, time like and space like vectors, worldline, macro causality.

**UNIT - III**

Four vector formulation, energy-momentum four vector, relativistic equation of motion, in-variance of rest mass, orthogonality of four force and four velocity, Lorentz force as an example of four force, transformation of four frequency vector, longitudinal and transverse Doppler's effect.

Transformation between laboratory and center of mass systems, four momentum conservation. Kinematics of decay products of an unstable particle and reaction thresholds, pair productions, inelastic collision of two particles, Compton effect.

**UNIT - IV**

Electromagnetic field tensor, transformation of four potentials, four currents, electric and magnetic field between two inertial frames of reference, equation of continuity, conservation of charge, tensor description of Maxwell's equations.

The second order linear differential equation with variable coefficient and singular points, series solution method and its application in the

Bessel's Hermite's Legendre's and Laguerre's differential equations. Basic properties (without proof) like orthogonality, recurrence relations, graphical representation and generating function of Bessel, Hermite, Legendre, Laguerre and Associated Legendre functions (very simple applications).

#### UNIT - V

Technique of separation of variables and its application to following boundary value problems (i) Laplace equation in three dimension cartesian coordinate system - line charge between two earthed parallel plates. (ii) Wave equation in spherical polar coordinates the vibration of circular membrane (iii) Diffusion equation in two dimensional cartesian coordinate system-heat conduction in a thin rectangular plate. (iv) Laplace equation in spherical coordinate system-Electric potential about a spherical surface.

## PHYSICS Practical

**Duration : 5 Hrs.**

**Max. Marks - 75**

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

### SECTION - A

1. Determination of Planck's constant by photo-cell (retarding potential method using optical filters, preferably five filters).
2. Determination of Planck's constant using solar cell.
3. Determination of Stefan's constant.
4. Study of the temperature dependence of resistance of semi-conductor (Four probe method)
5. Study of Iodine spectrum with the help of grating and spectrometer using ordinary bulb light.
6. Study of the characteristic of a GM counter and verification of inverse square law for the same strength of a radioactive source.
7. Study of  $\beta$ -absorption in a foil using GM counter.
8. To find the magnetic susceptibility of paramagnetic solution using Quinck's method. Also find the ionic molecular susceptibility of the ion and magnetic moment of the ion in terms of Bohr magneton.
9. Determination of coefficient of rigidity as a function of temperature using torsional oscillators (Resonance method)
10. Study of polarization by reflection from a glass plate with the help of Nicol prism and photo cell and verification of Brewsters law and law of Malus.
11.  $e/m$  measurement by Helical method.
12. Measurement of magnetic field using ballistic galvanometer and search coil study of variation of magnetic field of an electromagnet with current.
13. Measurement of electronic charge by Millikan's oil drop method.

### SECTION - B

1. Study of a R-C transmission line at 50 Hz.
2. Study of a L-C transmission line
  - a. at fixed frequency
  - b. at variable frequency
3. Study of resonance in an LCR circuit (using air core inductance and damping by metal plate)
  - a. at fixed frequency by varying C, and
  - b. by varying frequency
4. (a) Recovery time of junction diode and point contact diode.  
(b) Recovery time as a function of frequency or operation & switching.
5. Design a Zener regulated power supply and study the regulation with various loads.

6. Study the characteristics of field effect transistor (FET) and design and study amplifier of finite gain.
7. Study the frequency response of transistor amplifier and measure the input and output impedances (frequency response with change of values of R and C components)
8. Design and study of an R-C phase shift oscillator.
9. Study voltage multiplier circuit to generate high voltage D.C. from A.C.
10. Using discrete components, study OR, AND, NOT logic gates, compare with TTL integrated circuits IC's.
11. Application of operational amplifier (OP-AMP) as : (Minimum Two of the following exercise) :0-
  - (i) Inverter
  - (ii) Non-Inverter
  - (ii) Differentiator
  - (iv) Integrator

**CHEMISTRY**  
**Paper - I**  
**Inorganic Chemistry**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

**UNIT - I**

**Coordination Compounds** : Werner's theory, nomenclature, chelates, stereochemistry of different coordination numbers, isomerism in coordination complexes. Elementary idea of valence bond and crystal field theories to explain bonding in transition metal complexes, Explanation of magnetism, geometry and spectral behaviour and colour of coordination complexes on the basis of the above theories. Spin paired and spin free complexes.

**UNIT - II**

**Organometallic Compounds** : Definition and classification, synthesis, Properties, structure and application of organometallic compounds of lithium, magnesium and tin.

Preparation, Properties and nature of bond in metal carbonyls (simple approach with reference to mononuclear compounds).

**Inorganic polymers and other Materials** : Type of inorganic polymer, comparison with organic polymers, structural aspects and applications of silicates, phosphonitric halides, clays and clay materials, zeolites. Ceramics and ceramic glasses.

**UNIT - III**

**Nuclear chemistry** - Fundamental principles of nucleus (nucleons) concept of nuclides, representation of nuclides, Isotopes, Isobars and Isotones with specific examples. The size concept of nucleus and atom. Force operating between nucleons (n-n, p-p and n-p) and the magnitude of nuclear forces (short range), qualitative idea of stability of nucleus (n/p ratio). Liquid drop and shell models of nucleus (qualitative idea) Natural and artificial radioactivity, half life period, average life, nuclear binding energy, mass defect, artificial transmutation nuclear reactions. Spallation, nuclear fission and fusion.

**UNIT - IV**

Structure of Inorganic compounds of the type (i) AB (NaCl, ZnS, CsCl), AB<sub>2</sub> (CaF<sub>2</sub>, TiO<sub>2</sub>, CdI<sub>2</sub>, AB<sub>3</sub> (CrCl<sub>3</sub>) and A<sub>2</sub>B<sub>2</sub> (Al<sub>2</sub>O<sub>3</sub>) Factors which influence the structure's of compound of type AB and AB<sub>2</sub> Nonaqueous solvents: Classification, general study of ionizing solvent with special reference to liquid NH<sub>3</sub>, liquid SO<sub>2</sub>, and liquid HF.

## UNIT - V

**Separation methods : solvent Extraction :** Principle and process of solvent extraction, the distribution law and the partition coefficient, batch extraction, continuous extraction and counter current distribution.

**Chromatography :** Classification of chromatographic methods, principle of differential migration, adsorption phenomenon, nature of the adsorbent solvent systems, values.

**CHEMISTRY**  
**Paper - II**  
**Organic Chemistry**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

**UNIT - I**

**Heterocyclic Compounds (I)** - Five and six membered heterocyclic compounds, Aromatic character, resonance and orbital picture, preparation and chemical reactions of furan, pyrrole, thiophene. Preparation, basicity and chemical reactivity of pyridine. Condensed five and six membered heterocyclic compounds, preparation, structure and reactions of Indole, quinoline and isoquinoline.

**UNIT - II**

**Heterocyclic Compounds (II)** - Introduction to five and six membered heterocyclic compounds containing two hetero atoms (N, O and S) thiozole, pyrimidine and pyrazine, nomenclature, preparation, reaction and structures of imidazoles, pyrazole, oxazole.

**Applications of UV and IR spectroscopy** - Application of UV spectroscopy in structural determination of alkenes, conjugated dienes, carbonyl compounds, acids and aromatic compounds. Application of IR spectroscopy in structural determination of alcohols, carbonyl compounds, acids, amides, esters, amines and ethers.

**UNIT - III**

**Carbohydrates** - Classification and nomenclature of monosaccharides. Ascent and descent in sugars, Muta-rotation and its mechanism, interconversion of glucose and fructose, cyclic structure and configuration of  $\alpha$  and  $\beta$ -D(+) glucose and  $\alpha$ - and  $\beta$ -D(-) fructose.

**Disaccharides** - Structure of Lactose and Sucrose.

**Polysaccharides** - Starch and cellulose (excluding determination of)

**UNIT - IV**

Alicyclic and polynuclear aromatic hydrocarbons. Nomenclature, Methods of preparation and properties of alicyclic compounds, Baeyer's strain theory, theory of strainless rings, conformations of cyclohexane, axial and equatorial bonds, stereoisomers of decalin.

Structure of naphthalene, mechanism and orientation of electrophilic substitution in naphthalene. preparation and properties of naphthalene and anthracene phenanthrene, naphthols and naphthyl amines.

#### UNIT - V

**Amino acids, Proteins and nucleic acids** - Synthesis, physical and chemical properties of amino acids, Zwitter-ions and isoelectric point, synthesis of polypeptide, components of nucleic acids, methods of synthesis of nucleotides general characteristic and structure of proteins.

**CHEMISTRY**  
**Paper - III**  
**Physical Chemistry**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

**UNIT - I**

**Chemical Dynamics** - Differential and integrated forms of Zero order, first order and second order rate equations, Pseudo order reactions, Determination of order of reactions, isolation method, initial rate and pseudo order method. Opposing first order, consecutive reactions of first order & parallel reaction of first order, Chain reactions -  $H_2 + Br_2$  reaction, Chemical relaxation, temperature jump, Dependence of reaction rates on temperature Activation energy, simplified treatment of collision and Absolute Rate theories.

**UNIT - II**

**Catalysis** - The simple catalysis mechanism ( $S + C \rightarrow Sc \rightarrow P + C$ ) its mathematical treatment and its consequences, Specified and general acid base catalysis, Enzyme catalysis, surface catalysis and Langmuir adsorption isotherms. Mechanism of surface catalysis.

**Phase Equilibria** - Phase rule, Explanations of terms : phase, component and degree of freedom, one component systems - water and sulphur, restricted phase rule, Condensed systems, two component systems, Lead - silver system, K<sub>1</sub>- water system and aniline - hexane system.

**UNIT - III**

Electrochemical cells, Cell Diagrams, The Daniel Cell Gibb's energy and cell potential the Nernst Eqn. The hydrogen electrodes, Equilibrium constant from standard half cell potentials, significance of half cell potential The measurement of cell potential, The determination of a half cell potential. Determination of activity coefficient from cell potentials, concentration cells, classification of electrochemical cells, Requirements of a power source, lead storage cell and fuel cell.

**UNIT - IV**

**Spontaneity and equilibrium** - General conditions for spontaneity and equilibrium the condition of thermal equilibrium, transformation of a system at constant temp, Helmholtz energy, Transformation of a system at constant temperature pressure, Gibbs energy, criteria of spontaneity and equilibrium, Driving force natural changes, Fundamental thermodynamic equations, Thermo dynamic equations of state and its application in calculating Joule Thomson coefficient. The variation of G with temp, and

pressure and Gibb's Helmholtz equation, chemical-potential and its properties, Gibb's energy of mixing chemical potential of a pure ideal gas chemical potential of an ideal gas in a mixture of ideal gases, conditions for chemical equilibrium in a mixture, chemical equilibrium in mixture of ideal gases and mixture of real gases.

#### UNIT - V

**Spectroscopy** - Survey of molecular spectra - emission and absorption of light and quantum mechanical condition, pure rotation spectra and microwaves spectroscopy, Vibrational modes, vibration rotational spectra, Outlines of an absorption spectrometer. Infrared spectroscopy and its applications. Electronics spectra, Electronic transition in different chromophores, Auxochromes.

Electronic spectra of conjugated molecules - primary and secondary bands application of U.V. Visible spectroscopy, Lambert Beer's law and quantitative estimations Identification of molecules etc.

## CHEMISTRY Practical

Duration : 5 Hrs.

Max. Marks - 75

### 1. Organic Chemistry -

- a. Estimation of carboxyl group in a given organic acid by Volumetric method.
- b. Sorenson's titration method for estimation of glycine.
- c. Estimation of reducing sugars by Volumetric methods.

### 2. Preparation of the following inorganic compounds ( Student should prepare at least four compounds) -

- a. Cuprous chloride
- b. Chrome Alum
- c. Sodium Thiosulphate
- d. Ferrous Sulphate from Kipp's waste
- e. Ferrous Ammonium Sulphate
- f. Tetramine Copper Sulphate

### 3. Physical Experiments -

- a. To study the kinetics of acid hydrolysis of an ester.
- b. To study the kinetics of saponification of an ester by Sodium hydroxide.
- c. To study the kinetics of acetone Iodine reaction.
- d. To determine the composition of a binary solution by viscosity measurement.
- e. Potentiometric/PH meter titrations (acid-base)
- f. Determination of concentration of Copper/Manganese/Iron or any other substance in the solution using colorimetric.
- g. Conductrometric titration (acid base)
- h. To study the adsorption of acetic acid by activated charcoal.

To distribution of marks shall be as follows -

(i)	Organic estimation	20 Marks
(ii)	Inorganic preparation	15 Marks
(iii)	Physical experiment	20 Marks
(iv)	Viva-Voce	10 Marks
(v)	Sessional and record	10 Marks

**Total            75 Marks**

**MATHEMATICS**  
**Paper - I**  
**Real Analysis**

**Duration : 3 Hrs.**

**Max. Marks - 75**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

**UNIT - I**

Real Number System as a complete ordered field, Limit points, Bolzano, Weirestrass theorem, Derived sets, Open and Closed sets.

**UNIT - II**

Real sequence and its convergences, Infinite series and its convergence, Different tests of convergence of infinite series (Without proof), alternating series.

**UNIT - III**

Limits, Continuity and elementary properties of continuous functions, defined on closed intervals, Differentiability, Rolle's theorem, Lagrange Mean value theorem, Cauchy's Mean Value theorem, general Mean Value theorem. Taylor's theorem, Power series, Expansion of  $e^x$ ,  $\sin x$ ,  $\cos x$ ,  $(1+x)^n$ ,  $\log(1+x)$ .

**UNIT - IV**

Theory of Riemann integration, Darboux theorem, Fundamental theorem of integral calculus, Mean value theorem of integral calculus, Improper integrals.

**UNIT - V**

Fourier series, Uniform convergence of series of functions, Weirestrass M-test, Abel's test and Dirichlet's test for uniform convergence.

**Book Recommended-**

- |                        |   |
|------------------------|---|
| 1. Real Analysis       | : Shanti Narayan                        |
| 2. Real Analysis       | : G.N.Purohit                           |
| 3. Real Analysis       | : Bhargava & Goyal                      |
| 4. Real Analysis       | : Gokhroo, Saini and Ojha (Hindi, Edn.) |
| 5. Elementary Analysis | : Gokhroo, Saini and Ojha (Hindi, Edn.) |

# MATHEMATICS

## Paper - II

### Linear Programming and Operations Research

Duration : 3 Hrs.

Max. Marks - 75

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical.

#### UNIT - I

Introduction to Linear Programming Problems, Mathematical formulation, Graphical method of solution of linear programming problems (problems for two variables only), Theory of convex sets, Theory of simplex method.

#### UNIT - II

The simplex algorithm and its application to simple linear programming problems, Concept of Duality in linear programming, Formulation of dual problems, Elementary theorems of duality.

#### UNIT - III

Assignment Problems, Transportation problem.

#### UNIT - IV

Game Theory - Two persons zero sum game, The maximum and minimum principle, Game without saddle points, Mixed strategies, Graphical solution of  $2 \times n$  and  $m \times 2$  games, Dominance property, Reduction of the game problem to L.P.P., Fundamental theorem of games, Inventory models, Deterministic and Stochastic models.

#### UNIT - V

Queue theory - Queuing system and characteristic, Poisson process and Exponential distribution, Classification of queues, Transient and steady states, M/M/I and M/M/C queuing systems and their simple models.

#### Book recommended -

1. Linear Programming : Mittal and Sethi
2. Operations Research : S.D.Sharma
3. Linear Programming : Gokhroo, Saini and Jain (Hindi Edn.)  
Navkar Prakashan, AJMER

# MATHEMATICS

## Paper - III

### Numerical Analysis and Difference Equations

Duration : 3 Hrs.

Max. Marks - 75

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. 40% weightage will be given to problems and numerical. Use of non programmable scientific calculator is permissible. A note to this effect be mentioned in the question paper also.

#### UNIT - I

Difference operators and factorial notation, Difference, Relation between difference and derivatives, Difference of polynomial, Newton's formulae for forward and backward interpolation for equal intervals.

#### UNIT - II

Divided difference, Relation between divided difference and simple differences, Newton's general interpolation formula, Lagrange's interpolation formula, Gauss central difference formula, Stirling and Bessel interpolation formulae, Inverse interpolation.

#### UNIT - III

Numerical differentiation and integration, Trapezoidal, Simpson's 1/3, 3/8 rules, Weddle's rule, Solution of algebraic and Transcendental equations, Bisection method, Regula-Falsi Method, Newton Raphson method.

#### UNIT - IV

Difference equations - Definition and Order of a difference equations, First and higher order homogeneous form, Non-homogeneous linear difference equation reducible to homogeneous form, Non-homogeneous linear difference equation, Generating function of a sequence and its use in the solution of difference equation.

#### UNIT - V

Eigen value and Eigen vectors, Summation of series, Boudery value problems.

#### Book Recommended-

1. Saxena and H.C. : Numerical Analysis
2. Goyal and Mittal : Numerical Analysis
3. Gokhroo, Saini and Yadav : Numerical Analysis (Hindi Edn.)
4. Bansal and Ojha : Numerical Analysis (Hindi Edn.)
5. Gokhroo, Saini and Yadav : Difference Equations (Hindi Edn.),  
Navkar Prakashan, Ajmer

**BOTANY**  
**Paper - I**  
**Ecology and Phytogeography**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

**UNIT - I**

Plant Ecology - Definition, scope, branches, Ecological factors affecting the vegetation, Ecosystems : Structure, its biotic and abiotic components food chain and food web, ecological pyramids, energy flow, biochemical cycles.

**UNIT - II**

Productivity - Primary and secondary productivity, their measurements in terrestrial and aquatic environments. Plant succession : causes, process, types : Hydrosere, Xerosere (Lithosere and Psammosere), Community: Structure and development.

**UNIT - III**

Pollution of air, water, their causes, consequences and control, Resources : Renewable and non-renewable, management problem of depletion of natural vegetation, endangered plants, Red data book, National parks and sanctuaries.

**UNIT - IV**

Plant adaptations : Hydrophytes, Xerophytes and Halophytes (morphological, anatomical and physiological adaptations). An idea of desert climate and common vegetation of Rajasthan deser.

**UNIT - V**

Phytogeography - Introduction, continuous and disjunct distribution, Phytogeography of India. Vegetational regions of India, Plant Indicators.

**BOTANY**  
**Paper - II**  
**Plant Physiology and Biochemistry**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

**UNIT - I**

Osmosis, plasmolysis, deplasmolysis, Absorption of water, Ascent of sap. Concept of water potential. Mechanism and factors affecting transpiration. Role of macro and micro elements.

**UNIT - II**

Photosynthesis - Photosynthetic pigments (Chlorophylls carotenoids and phycobilins) - structure and function, light reactions and mechanism of carbon fixation in C<sub>3</sub> and C<sub>4</sub> plants. Brief description of C.A.M. plant. Photorespiration, compensation point. Factors affecting photosynthesis. Enzymes - General characteristics, classification, mode of action inhibitors.

**UNIT - III**

Respiration - Glycolysis, Krebs cycle, electron transport system and oxidative phosphorylation, factors affecting respiration. Fats - synthesis and degradation.

**UNIT - IV**

Plant growth regulators - Auxins, gibberellins, cytokinins, ethylene and abscissic acid, their discovery, structure, physiological effect and applications. Seed dormancy, senescence, photoperiodism and vernalization.

**UNIT - V**

Principles and uses of following instruments, techniques - p metry, centrifugation, colorimetry, chromatography (PC, TLC)

**BOTANY**  
**Paper - III**  
**Molecular Biology and Biotechnology**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

**UNIT - I**

Gene concept from Mendel to molecular level. Genetic code, DNA types, DNA replication and transcription in prokaryotic system. *Nif* gene and nitrogen fixation.

**UNIT - II**

Plasmids, kinds and their uses as vectors, Principle of genetic engineering and recombinant DNA technology and their general application in prokaryotes. Tools of genetic engineering (PCR, gene sequencing restriction enzymes, genomic library)

**UNIT - III**

Interaction and expression of trans genes, Bt-toxin. Methods of gene transfer in higher plants, vector mediated gene transfer. Brief account of vectorless gene (particle gun, liposomes, chemical methods).

**UNIT - IV**

History and scope of plant tissue culture. Basic techniques and tools of plant tissue culture. Brief amount of protoplast culture and fusion. Plant tissue culture in agriculture and forestry. Micropropagation and somatic embryogenesis.

**UNIT - V**

Plant tissue culture in industry, secondary plant product, definition types and uses of alkaloids, factors affecting production of secondary products in culture, cell cultures grown in bioreactors (fermentors)

## BOTANY Practical

Duration : 5 Hrs.

Max. Marks - 75

### Paper - I Ecology and Phytogeography

1. Find out frequency of herbaceous species by quadrat method.
2. Find out density of herbaceous species by quadrat method. Minimum size of quadrat 1x1 mt.
3. To find out the minimum size of the quadrat.
4. Plant adaptive modifications, Specimens/slides.  
*Opuntia, Euphorbia, Capparis, Leptadenia, Hydrilla, Eichhornia and Typha.*
5. Soil analysis : Field test
  - a. Soil temperature
  - b. Soil moisture
  - c. Soil pH
6. Water analysis
  - a. Hardness of water
  - b. Water temperature
  - c. Carbonate, bicarbonate and chloride tests
7. Ecological instruments and their working
  - a. Maximum and minimum thermometer
  - b. Oven

### Paper - II Plant Physiology and Biochemistry

1. Demonstration of following colloidal system.  
*Suspension, Emulsion, Brownian movement.*
2. To observe streaming movement of protoplasm (Hydrilla)
3. Demonstration of phenomenon of plasmolysis using Rhoeo discolor leaves.
4. Demonstration of phenomenon of osmosis by potato osmoscope.
5. Demonstration of unequal transpiration in dorsiventral leaf using cobalt chloride paper.
6. Effect of various wavelengths of light on the process of photosynthesis.
7. Demonstration that light, CO<sub>2</sub> and chlorophyll are necessary for photosynthesis.
8. Determine the value of respiratory quotient (RQ) of different respiratory substrates by Ganong's respiroscope.
9. Demonstration of respiratory enzymes (peroxidase, catalase dehydrogenase) in plant tissue samples.
10. Introduction and demonstration of the following instruments/techniques - pH meter, centrifuge, colorimeter, paper chromatography.
11. Phytochemical tests of the following - glucose, starch, proteins, fats tannins, ascorbic acid and anthocyanins.

**Paper - III Molecular Biology and AbND Biotechnology**

1. Principle and application of the following - Laminar air flow/sterile bench, autoclave, ultrafiltration.
2. Preparation of culture media for microbial growth (Nutrient agar and PDA) and solutions of nutrient and growth regulators.
3. Demonstration of inoculation of technique, aseptic transfer of explant and microbial transfer techniques.
4. Demonstration of resistance sensitivity antibiotic discs.
5. Germination of pollen of *Catharanthus roseus* in 10% sucrose solution.

**Marking Scheme -**

Time : 5 Hrs.

Max. Marks. 75

	Student	
	Reg.	Ex.
1. Physiology experiment	10	10
2. Ecological exercise - Morphology & Anatomy	8	10
3. Soil/Water field tests	5	7
4. Experiments in tissue culture	8	8
5. Phytochemical test (two)	8	9
6. Spots (six). Two from each paper	18	18
7. Viva-voce	10	13
8. Records	8	-
<b>Total</b>	<b>75</b>	<b>75</b>

## ZOOLOGY

### Paper - I

#### Mammalian Neuroendocrinology and Behaviour

Duration : 3 Hrs.

Max. Marks - 50

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

#### UNIT - I

Types of endocrine glands : Pituitary, pineal, Adrenal, Thyroid, Islets of Langerhans, Testis and ovary, Nature of Hormones, Hormone action (including role of cyclic AMP in Hormone action), Preliminary idea of neurosecretion, hypothalamic control of pituitary, functions of endocrine glands in insects. Neurotransmitters.

#### UNIT - II

Testicular and ovarian cycles and their neuroendocrine control. Estrous and Menstrual cycle, Endocrinology of ovulation, implantation, parturition and lactation.

#### UNIT - III

Hormonal control of reproduction, using mammalian and insect examples. Pheromones and their role in reproductive functions.

#### UNIT - IV

Introduction and history of Ethology, methods of studying behaviour, neuroanatomical, neurophysiological, neurochemical, focal and scan sampling technique. Human brain and behaviour, Biological clock/circadian rhythms. Social behaviour and social organisation of Black buck and Rhesus monkey. Social communication among animals, acoustic, tactile, olfactory and language of bees.

#### UNIT - V

Migration of fishes, Pheromones and hormones and their role in behaviour, Fixed action pattern, sign stimulus, innate releasing mechanism, Action specific energy, motivation, imprinting and learning, orientation, Taxes and Kinesis, Conservation and Management of wild life of India with special reference to Rajasthan (Wild life of Rajasthan with reference to mammalian fauna). Cryopreservation.

**ZOOLOGY**  
**Paper - II**  
**Genetics and Biotechnology**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

**UNIT - I**

Mendelian Genetics : Mendel's laws of inheritance. Monohybrid and dihybrid cross, dominance, incomplete dominance. Current status of Mendelism. Genetics variation : Variation in chromosome number (Euploidy and Aneuploidy)

**UNIT - II**

Genetic disorders in Human beings (Down's, Turner's Klinefelter's and Edward's syndrome). Types of chromosomal mutations, molecular basis of gene mutation, mutagens, crossing over and linkage.

**UNIT - III**

Sex-determination XX-DY, XO-XY and WZ mechanisms, sex linked inheritance (X- and Y- linked). colour blindness. Haemophilia, Gene interactions, supplementary, complementary, Epistasis and inhibitory. Multiple allele - ABO, Rh and MN blood groups and their inheritance. Polymorphic genes.

**UNIT - IV**

Molecular Genetics : Nucleic acid, Structure function and types of DNA, Structure, function and types of RNA, genetics of RNA, genetic code, Transcription, protein synthesis, Gene structure (Recon, Muton, Cistron) and regulation of gene (lacoperon : inducible and repressible system), Bacterial genetic transformation, transduction and coniugation. Lytic and lysogeny cycle. Elementary idea about eugenics. Elementary idea about genetic engineering, gene cloning and recombinant DNA technology (vectors for gene transfers, plasmids and phages), Restriction enzymes.

**UNIT - V**

Introduction, historical perspective, animal cell hybridoma, major areas and future prospects of biotechnology. Medicines and Biotechnology : Microbes in medicine, antibiotics, Vaccine, Antibodies, Antigens, Environmental biotechnology : Use of micro organisms in metal and petroleum recovery, pest control, waste treatment, processing of industrial waste. Degradation of Xenobiotic compounds including pesticide and Surfactants. Surfactants and oil pollutants, Food and drink biotechnology, ferment food, dairy products, food preservation, microbial spoilage, alcoholic beverages. Vinegar, Monoclonal antibodies and their applications.

**ZOOLOGY**  
**Paper - III**  
**Animal Ecology and Biostatistics**

**Duration : 3 Hrs.**

**Max. Marks - 50**

**Note** - The papers divided into five independent units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

**UNIT - I**

Introduction to ecology, definition, history, subdivisions and scope of ecology. Environmental factors- Physical factors - soil, water, air, temperature. Biotic factors- interspecific and intraspecific relations, neutralism, mutualism, commensalism, antibiosis, parasitism, predation, competition. Concept of limiting factors Liebig's law of minimum, Shelford's law of tolerance, combined concept of limiting factors.

**UNIT - II**

Concept of niches, Population and community ecology. Measurement of population density. Factors affecting population growth, growth curves, dispersal, migration, characteristics of community. Concept of ecosystem.

Trophic levels - food chain and food web. Ecological pyramid. Energy flow in an ecosystem, biogeochemical cycles  $CO_2$ ,  $N_2$ ,  $O_2$ , S and P. Prospects and strategies of sustainable environment.

**UNIT - III**

Aquatic Ecology - Physico-chemical nature of fresh water habitat, lentic habitat (lake and ponds), lotic (stream and river). Fresh water fauna and their adaptations. Characteristic of marine habitat, zonation of marine environment, marine water fauna and their adaptations, deep sea fauna and their adaptations, Estuarine habitat - their fauna and adaptations.

**UNIT - IV**

Terrestrial and Applied Ecology - Characteristic of terrestrial habitat, forest ecosystem (forest types), desert ecosystem - characteristics of desert environment, desert fauna and their adaptations with special reference to Rajasthan. Pollution - types of pollution (water, air and ground, thermal, noise, industrial and chemical), Radiation, nuclear fallout and biological, effect of radiation. Green house effects. Fossil fuels - coal and petroleum, nuclear fuels, Management of environment. Wild life conservation with special reference to Rajasthan.

**UNIT - V**

Introduction and understanding of concepts of descriptive and inferential statistics, frequency distribution, graphical presentation, mean, mode, median, standard deviation, standard error of mean. Probability distribution, correlation and regression, Test of significance - Chi - Square and t-test. Biostatistics analysis of gene distribution in population.

## PRACTICALS

Duration : 5 Hrs.

Max. Marks - 75

### I. Analysis of environment

1. Soil pH
2. Water analysis - pH, alkalinity, acidity, dissolved O<sub>2</sub> and CO<sub>2</sub>
3. salinity (Chloride)
4. Qualitative estimation of Zooplanktons in a given sample of water permanent slide preparation of Zooplanktons)

### II. Ethology

1. Visit to Zoo-identification and general information about Zoo animals. General information about local amphibian fauna (Frogs, toads) Reptiles (Snakes and Lizards), bird fauna (crow, kite, house sparrow, parrot, pigeon, peacock, vultures) and mammalian fauna (Kangaroo, Echidna Hedgehog, Indian Mongoose, Camel, mice, rabbit), Behavioural study of social organization of Black Buck, Monkey and Honey bee.
2. Antennal grooming in cockroach/ wing cleaning by *Musca domestica*
3. Study of phototactic response of *Tribolium*, Housefly, *Paramecium*, response to touch, chemical light Study of lodging collection and examination of microscopic fauna (pond and terrestrial ecosystem)

### III. Biostatistics

1. Construction of frequency tables, histograms, polygon, pie charts.
2. Exercise of mean, mode and median, test of significance.

### IV. Endocrinology

1. Demonstration of major endocrine glands using model, chart/computer.
2. Histological slides of major endocrine glands including gonads in mammalian group, T.S. endocrine glands.

### V. Genetics

*Drosophila* - life cycle and its culture, Identification of wild and mutants (Yellow, ebony body, vestigial wings, white eye and vestigial wings), Prepare slides of sex combs and salivary gland chromosomes of *Drosophila*, body of human chromosomes, Identification of blood group (ABO and Rh factors). Simple problems based on monohybrid/ dihybrid cross.

(Note - use of animals for dissection in subject to the conditions that these are not banned under wild life protection act.)

**Distribution of marks-**

	Regular Student	Ex-student
1. Exercise based on Ecology	10	15
2. Exercise based on Genetics	5	6
3. Exercise based on Biostatistics	5	6
4. Exercise based on Ethology	5	6
5. Permanent Preparation	10	12
6. Spots (10)	20	20
7. Records	10	-
8. Viva-voce	10	10
<b>Total</b>	<b>75</b>	<b>75</b>