

THRID YEAR B.Sc. B.Ed.

COURSE	NOMENCLATURE
GC 3	General Studies I
EL 11	Physics (I)
	Physics (II)
	Physics (III)
	Physics Practical
EL 12	Chemistry I
	Chemistry II
	Chemistry III
	Chemistry Practical
EL 13	Zoology I
	Zoology II
	Zoology III
	Zoology Practical
EL 14	Botany I
	Botany II
	Botany III
	Botany Practical
EL 15	Mathematics I
	Mathematics II
	Mathematics III
PEC 5	Knowledge & Curriculum
PC 1	Pedagogy of General Science
PC 2	Pedagogy of Physics
PC 3	Pedagogy of Chemistry
PC 4	Pedagogy of Biology
PC 5	Pedagogy of Mathematics
TEP 2	Teaching Enhancement Programme Prepory lesson & Integrated lesson Activevity based (Second Pedagogy sub.) only five lesson per activites.
SIP 1	School Internship Programme
	Criticism (Related Two Pedagogy Subject) 10% Technology based lesson is compulsory
SIP 2	Final Lesson (External Assessment)

GENERIC COURSE
GC - 3 GENERAL STUDIES FIRST

तृतीय वर्ष में सामान्य अध्ययन पाठ्यक्रम

सामान्य अध्ययन प्रथम

- नोट : 1. उक्त पाठ्यक्रम में 4 इकाई होगी एवं प्रत्येक इकाई से 25 प्रश्न होंगे।
2. प्रश्न पत्र में 100 प्रश्न होंगे, प्रत्येक प्रश्न 1 अंक का होगा, इस प्रकार प्रश्न पत्र 100 अंको का होगा।
3. प्रश्न पत्र में प्रश्न वस्तुनिष्ठ प्रकार (व्हरमबजपअम जलचम) के होंगे।

इकाई 1	<p>1. राजस्थान का भूगोल</p> <ul style="list-style-type: none">▪ प्रमुख भौतिक विषे"ताएं, मुख्य भू भौतिक विभाग▪ प्राकृतिक संससाधन , खनिज, मृदा,▪ अपवाह प्रणाली, सिचाई परियोजनाएं <p>2. भारत का भूगोल</p> <ul style="list-style-type: none">▪ प्रमुख भौतिक विषे"ताएं, मुख्य भू भौतिक विभाजन▪ भारत के खनिज एवं मृदा लोहा, मैगनीज, कोयला, खनिज तेल व गैस ,आण्विक खनिज
इकाई 2	<p>1. राजस्थान की अर्थव्यवस्था</p> <ul style="list-style-type: none">▪ राजस्थान का औधोगिक परिदृष्य▪ सूतीवस्त्र, चीन, सीमेन्ट, लधु उधोग▪ राजस्थान मे उर्जा परिदृष्य▪ राजस्थान की वृहद् परियोजनाएं▪ राजस्थान मे परिवहन <p>2. भारत की अर्थव्यवस्था</p> <ul style="list-style-type: none">▪ रा"टीय आय▪ मुद्रा स्फीति : अवधारणा,प्रभाव एवं नियंत्रण तंत्र▪ भारतीय रिजर्व बैंक▪ बैंक एवं बीमा▪ सब्सिडी एवं लोक वितरण प्रणाली
इकाई 3	<p>1. राजस्थान का इतिहास</p> <ul style="list-style-type: none">▪ राजस्थान की प्रमुख सभ्यताएं – कालीबंगा, आहड, गणेश्वर, बैराठ

	<ul style="list-style-type: none"> ▪ <u>प्रमुख राजवंश</u> – गुर्जर प्रतिहार, गुहिल, चौहान, राठौड, कुच्छवाह ▪ ऐतिहासिक व्यक्तित्व – पृथ्वीराज चौहान, राणा सांगा, महाराणा प्रताप, महाराणा कुभा, चन्द्रसेन, सूरजमल, मालदेव। ▪ <u>मध्यकालीन प्रशासनिक व राजस्व व्यवस्था</u> ▪ <u>राजस्थान का स्वतंत्रता आंदोलन</u>– किसान एवं जनजातीय आंदोलन, प्रजामण्डल आंदोलन ▪ <u>राजस्थान का एकीकरण</u> <p>2. <u>भारत का इतिहास</u></p> <ul style="list-style-type: none"> ▪ प्राचीन भारत : हड़प्पा सभ्यता, वैदिक संस्कृति, मौर्य काल, गुप्त काल ▪ मध्य भारत: सल्तनत काल, मुगल काल। ▪ आधुनिक भारत : स्वतन्त्रता संघर्ष, धार्मिक एवं सामाजिक सुधार आन्दोलन।
इकाई 4	<p>1. <u>राजस्थान की प्रशासनिक व्यवस्था</u>–</p> <ul style="list-style-type: none"> ▪ राज्यपाल ▪ मुख्यमंत्री ▪ राजस्थान कीविधानसभा ▪ राजस्थान लोक सेवा आयोग ▪ मुख्य सचिव एवं सचिवालय ▪ लोकायुक्त <p><u>भारत की प्रशासनिक व्यवस्था :</u></p> <ul style="list-style-type: none"> ▪ रा'ट्रपति ▪ प्रधानमंत्री ▪ संसद ▪ संघ लोक सेवा आयोग ▪ केबिनेट सचिव एवं सचिवालय ▪ लोकपाल

PHYSICS

Note:

1. Each theory question paper in the annual examination shall have three sections:

Section A shall contain one compulsory question of 5 marks having 10 parts. Two parts shall be set from each unit. The candidate is required to answer each part in one or few words. **(Total: 5 Marks)**

Section B shall contain five compulsory questions of 5 marks each with internal choice. One question with internal choice will be set from each unit. The answer may be given in approximately 250 words. **(Total 25 Marks)**

Section C shall contain four descriptive questions covering all units and candidates have to answer any two questions of ten marks each. The answer may be given in approximately 500 words. There can be two parts in a question from this section. **(Total 20 Marks)**

Paper-I:

Quantum mechanics and Atomic & Molecular Physics

Marks :50

External :40

Internal :10

Unit-I

Introductory Schrodinger theory :

Rise and fall of Plank-Bohr quantum theory Duality of radiation and matter, de Broglie's hypothesis, justification for the relation, experimental confirmation Phase and group velocities of a wave ; formation of a wave packet, illustrations. Uncertainty principle relating to position and momentum, relating to energy and time, application of complementarity principle, photon interpretation of two slit interference, Einstein-de-Broglie relations as a link between particle and wave properties, general equation of wave propagation, propagation of matter waves, time dependent and time independent schrodinger equations, physical meaning of ψ , conditions to be satisfied by schrodinger equation as an operator equation. Postulatory approach to wave mechanics, operators, observable and measurements. Operators, eigen values and eigen functions; linear operators, product of two operators, commuting and non commuting operators, simultaneous eigen functions, orthogonal functions. Hermitian operators, their eigen values, Hermitian adjoint operators, expectation values of an operator.

Unit – II

Simple one dimensional problem ; particle in a box with rigid walls. Concept of a potential well. Wave functions and energies for the ground and excited states ; quantization of energy qualitative discussion of the solutions for a shallow potential well. Application of Operator methods ; Simple harmonic oscillator, step-up and step-down operators, eigen functions and eigen values of the ground state and excited state, zero point energy probability density and its variations with degree of excitation ; orthogonality of wave functions. Other one dimensional problems ; step potential, penetration through rectangular barrier. Transmission coefficients, barriers of special shapes, quantum mechanical tunneling, particle in of three dimensional cubical box, degeneracy.

UNIT-III

Angular momentum and spin

Central force ; orbital angular momentum, operators for its cartesian components, commutation relations, mutual as well as with L^2 , operators L_+ and L_- , their interpretation as step operators eigen values of L^2 , half integral values for quantum numbers. Angular momentum operators in spherical polar coordinates ; evaluation of their eigenfunctions explicitly in terms of the coordinates, their degeneracy. Schrodinger equation for hydrogen atom in spherical polar coordinates ; separations into radial and angular variation, qualitative discussion of spherical harmonics. Angular momentum and magnetic moment of electron due to orbital motion Bohr magneton.

Unit – IV

Mono valent and divalent atoms

Back ground from quantum theory : The four quantum numbers ; spectral terms arising from L-S coupling, s,p,d,f, notation, selection rules. Half life of excited states, width of a spectral line. Spectra of mono and divalent atoms : Doublet fine structures of hydrogen lines ; screening constant for monovalent atoms, series limits, doublet structure for alkali spectrum. Spectra of helium and alkaline earth atoms, singlet and triplet series. Effect of magnetic field on energy levels : Gyromagnetic ratios for orbital and spin motions ; vector model, Lande g factor, strong and weak field effects, illustrative cases of H, Na, Ca and Hg. X-ray spectra : The continuous x-ray spectrum, Duane and Hunt limit. Characteristic x-rays : Mosley's law, doublet fine structure, H-like character of x-ray states, x-ray absorption spectra, absorption edges.

Unit – V

Sharing of electrons : formation of molecular orbitals, H_2^+ ions H_2^- molecule, electronic levels, singlet and triplet characters. Rotational energy levels, internuclear distance.

Vibrational energy levels, force constants, anharmonicity dissociation energy, isotope effects on rotational and vibrational energies. Raman effect (brief study).

Spectra of diatomic molecules : Pure rotation spectra ; selection rules, vibration rotation spectra, selection rules, vibration-rotation spectra ; selection rules, P, Q and R branches.

Electronic band systems, sequences and progressions Frank-Condon principle. (Statement only, no derivation)

Recent developments in Physics including discussion of Nobel prizes in Physics (no questions to be set in the theory examination).

Text books:

1. Quantum mechanics ; S.P. Singh, M.K. Bagde and Kamal Singh (S.Chand and Co)
2. Quantum Mechanics by G.R. Chatwal and Anand SK, Himalaya Publishing Co.

Reference books

1. Quantum Mechanics Alistair I M Rac. ELBS (Low Price edition)
2. Quantum mechanics , S. N. Biswas, Books and Allied, Calcutta (P) Ltd.
3. Atomic and Nuclear Physics ; A.B. Gupta, mew central book agency pvt. Ltd.

PAPER-II:

ELECTRODYNAMICS, ELECTROMAGNETIC WAVES AND RELATIVITY

Marks :50
External :40
Internal :10

UNIT I

Motion of charged particles in \mathbf{E} and \mathbf{B} fields: Case of cathode ray oscillograph, positive ray parabola, velocity selector, magnetic focusing, mass spectrography. Faraday's law for electromagnetic induction: Faraday's law integral and differential forms; self-inductance of a solenoid and of a straight conductor, energy stored in an inductor and in the magnetic field. Displacement current; modified Ampere's law, Maxwell's equation for time-dependent electromagnetic field in vacuum and in material media, boundary conditions.

UNIT II

Electromagnetic potentials: Magnetic vector potential \mathbf{A} and scalar potential ϕ . Poisson's equation for \mathbf{A} in terms of current density, solutions for line surface currents. Coulomb and Lorentz gauge transformations, Lorentz law in terms of potentials. Maxwell's equations and electromagnetic waves: Plane-wave solution for Maxwell's equation; orthogonality of \mathbf{E} , \mathbf{B} and propagation vector. Poynting vector; energy and momentum propagation, reflection and transmission at dielectric boundaries (normal incidence), polarization by reflection, Brewster's angle.

UNIT III

Electromagnetic waves in conductors: Modified field equation; attenuation of the wave, reflection at and transmission through a conducting surface. Total internal reflection Radiation from accelerated charges: Modification (Conceptual only) of Coulomb's law to include velocity and acceleration dependent terms in \mathbf{E} field. Radiation from an oscillating dipole and its polarization. Radial and spherical power of electromagnetic radiation, Radiation pressure equation in free space and medium

UNIT IV

The Lorentz transformations: Galilean transformations; Newtonian relativity, instances of their failure; electromagnetism, aberration of light, Michelson-Morley experiment; Einstein's basic postulates and geometric derivation of Lorentz transformations; invariance of Maxwell's equations, length contraction, simultaneity, synchronization and time dilation, Einstein's velocity addition rule, Doppler effect in light. Relativistic gravitational Red Shift.

UNIT V

Relativistic dynamics: Variation of mass with velocity, mass energy equivalence, relativistic formulae for Momentum and energy. The structure of space-time: Four vectors; invariance of an interval, time-like, spacelike and light-like intervals, Minkowski space. Relativistic electrodynamics: Electric field of a point charge in uniform motion; transverse components, magnetism as a relativistic phenomenon, transformation of \mathbf{E} and \mathbf{B} fields. Recent developments in Physics including discussion of Nobel prizes in Physics (no questions to be set in the theory examination).

Text and Reference books:

1. D.J. Griffiths: Introduction to Electrodynamics, Prentice Hall of India, 1989.
2. Reitz and Milford: Introduction to Electrodynamics, Addison-Wesley.
3. A.M. Portis: Electromagnetic Fields
4. J.B. Marion: Classical Electromagnetic radiation (Academic Press)
5. R.P. Feynmann, R.B. Leighton and M. Sands: The Feynmann lectures in physics, Vol. II (B.I. Publications).
6. B. Saraf et al. : Physics through experiments Vol. I – EMF, constant and varying, Vikas Publishing House.
7. D.R. Corson and P. Lorrain: Introduction to Electromagnetic fields and waves, Freeman-Taraporevala, Bombay,1970.
8. E.C. Jordan and K.G. Balmain: Electromagnetic waves and radiating systems, 2nd Ed., Prentice Hall of India, New Delhi, 1971.
9. Electrodynamics, Electromagnetic Waves and Relativity (In Hindi) Kalra, Kakani and Bhandari

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Paper-III
SOLID STATE, NUCLEAR AND PARTICLE PHYSICS

UNIT – I

Crystal geometry: crystal lattice, crystal planes and Miller indices, unit cells. Typical crystal structures, coordination number, packing fraction, symmetry elements, rotation, inversion and reflection, point groups and crystal classes, space groups.

Crystallography: Bloch functions, Bloch's theorem, diffraction of X-rays by a crystal lattice. Laue's formulation of X-ray diffraction, reciprocal lattice, Brillouin zones, Laue spots, rotating crystal and Debye-Scherrer methods

Introduction to nano particles, Definition, length scales, Importance of nanoscale and Technology.

UNIT – II

Types of binding in solids: covalent binding and its origin, ionic binding, energy of binding, transition between covalent and ionic binding, metallic binding, Van der Waals binding, hydrogen bond.

Conduction in metals : Drude's theory, DC conductivity, AC conductivity, plasma frequency, thermal conductivity of metals, Fermi-Dirac distribution, thermal properties of free-electron gas, Sommerfeld's theory of conduction in metals.

UNIT – III

Conduction in semiconductor: Bands in solids, metals, insulators and semiconductors. Motion of free electrons on a chain of atoms, effective mass, electrons and holes, donor and acceptor impurities, donor impurity levels. Thermal excitation of carriers, electrical conductivity. Elementary ideas of Hall effect in metals and semiconductors and magnetoresistance. Charge transport in semi-conductors: Ionization energy of impurity atoms, carrier concentration in doped semiconductors at high and low temperatures, control of conductivity of semiconductors by impurities and current flow in semi-conductors.

UNIT – IV

Structure of nucleus: discovery of the nucleus, composition. Basic properties: charge, mass, size, spin, magnetic moment, electric quadrupole moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus. Coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve. Liquid drop model of the nucleus.

Nuclear forces: two-nucleon system, deuteron problem, binding energy, nuclear potential well, results of p-p and n-p scattering experiments, meson theory of nuclear forces e.g. Bartlett, Heisenberg, Majorana forces and potentials (No derivations)

Radioactivity: decay constant and half-life, spectra of emitters, Geiger-Nuttall law, Gamow's explanation. Beta decay: elementary Fermi's theory (No derivations). Antineutrino. Nuclear radiation, energy levels.

UNIT – V

Detectors for charged particles: Ion chamber, Geiger counter, resolving time, cloud chamber.

Accelerators: Need for accelerators; cyclic accelerators, cyclotron, betatron, synchrocyclotron, variable energy cyclotron, phase stability. Brief introduction to Accelerator facilities in India. Rutherford scattering formula, different types of nuclear reactions. Artificial radioactivity: Nuclear fission, neutron reactions, Fermi and transuranic elements, chain reaction, criticality, moderators. Brief discussion of Reactor facilities in India. Discovery of cosmic rays: hard and soft components, discovery of muon, pion, heavy mesons and hyperons, mass and life time determination for muon and pion. Primary cosmic rays: Extensive air showers, solar modulation of primary cosmic rays, effect of earth's magnetic field on the cosmic ray trajectories. Elementary particles: Discovery and important properties, Standard Model Strangeness, conservation of strangeness in particle interactions, quark hypothesis, high energy electron scattering from protons, basic interactions of quarks and leptons, interrelation between particle physics and cosmology. Big Bang theory (Brief study. No derivations) Brief introduction to Larger Hadron Collider "Big Bang" experiments at CERN Recent developments in Physics including discussion of Nobel prizes in Physics (no questions to be set in the theory examination).

Text Book

1. Nuclear Physics, Brijlal & Subramannian
2. Solid State Physics, Charles Kittel
3. Solid State Physics, Nuclear Physics and Particle Physics (In Hindi) Kalra, Kakani and Mandot

Reference books:

- 1 D.J. Griffiths: Introduction to Electrodynamics, Prentice Hall of India, 1989.
- 2 Reitz and Milford: Introduction to Electrodynamics, Addison-Wesley.
- 3 A.M. Portis: Electromagnetic Fields
- 4 J.B. Marion: Classical Electromagnetic radiation (Academic Press)
- 5 R.P. Feynmann, R.B. Leighton and M. Sands: The Feynmann lectures in physics, Vol. II (B.I. Publications).
- 6 B. Saraf et al. : Physics through experiments Vol. I – EMF, constant and varying, Vikas Publishing House.
- 7 D.R. Corson and P. Lorrain: Introduction to Electromagnetic fields and waves, Freeman-Taraporevala, Bombay, 1970.
- 8 E.C. Jordan and K.G. Balmain: Electromagnetic waves and radiating systems, 2nd Ed., Prentice Hall of India, New Delhi, 1971.

CHEMISTRY
PAPER I

UNIT I

Hard and Soft Acids and Bases (HSAB) : Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electro-negativity and hardness and softness.

Metal-Ligand Bonding in Transition Metal Complexes : Limitation of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters, John-Teller effect.

UNIT II

Magnetic Properties of Transition Metal Complex : Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of m and m_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

Electronic Spectra of Transition Metal Complexes : Types of electronic transitions, selection rule for d-d transitions, spectroscopic ground states, spectro-chemical series. Orgel-energy level diagram for d. and d9 states, discussion of the electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_3]^3$ complex ion.

UNIT III

Bioinorganic Chemistry: Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+} .

Electro analytical Methods : EMF measurements, pH-determination using hydrogen, glass, quinhydrone, antimony and calomel electrodes, potentiometric titrations.

Volumetric Estimation : Theory of oxidation - reduction titrations. Theory of complexometric titrations.

UNIT IV

Organometallic Chemistry - Definition, nomenclature and classification of organometallic compounds.

Preparation, properties, bonding and applications of alkyl and aryl of Li, Al, Hg, Sn and Ti, a brief account of metal- ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Thermodynamic and Kinetic Aspects of Metal Complexes - A brief outline of thermodynamic stability of metal complexes and factors affecting the, stability, Substitution reactions of square planar complexes.

UNIT V

Molecular Symmetry and Group Theory : Symmetry elements, molecular point groups, group theory and basic properties, similarity transformation and classes, orthogonality theorem, multiplication tables and character tables of C_{2v} and C_{2v} groups.

Mathematical Techniques : Least square treatment applied to linear equation $y = mx + c$, correlation coefficient, S_m and S_c .

Recent Developments in Inorganic Chemistry: Question will not be asked from the recent development section.

BOOKS RECOMMENDED

1. Group theory and its chemical applications : P.K. Bhattacharya.
2. Inorganic chemistry : J.E. Huysse, Principles of Structure and Reactivity, 3rd Ed.
3. Selected topics in inorganic chemistry : W.U. Malik, G.D. Tuli and R. Madan.
4. Principles of Inorganic Chemistry : D. Banerjee.
5. Modern Aspect of Inorganic Chemistry : H.J. Emeleus and A.G. Sharpe.
6. Inorganic Chemistry (Hindi ed.) : Ameta, Sharma and Metha.

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PAPER II

ORGANIC CHEMISTRY

Marks :50
External :40
Internal :10

UNIT I

Electromagnetic Spectrum : Absorption Spectra : Ultraviolet (UV) absorption spectroscopy- absorption laws (Beer-Lambert Law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transition, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated dienes and enones. Infrared (IR) absorption spectroscopy- molecular vibrations, Hooke's, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

Nuclear Magnetic Resonance (NMR) spectroscopy : Proton Magnetic Resonance (PMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1,2 - tribromoethane, ethyl acetate, toluene and acetophenone.

Problem pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

UNIT II

Heterocyclic compounds : Introduction, molecular orbital picture and aromatic characteristics of pyrrole, furane, thiophene and pyridine, method of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives, comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six membered heterocycles, preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer Indole synthesis, Skraup's synthesis and Bischler – Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Photochemistry: Principles: electronic excitation, excited states, modes of dissipation of energy, energy transfer and quantum efficiency, photoreduction and photochemistry of butadienes

UNIT III

Organic synthesis via Enolates - Acidity of alpha hydrogen, alkylation of diethylmalonate and ethylacetoacetate, synthesis of ethyl acetoacetate, Claisen condensation. Keto - Enol tautomerism of ethyl acetoacetate, alkylation of 1,3- dithianes, alkylation and acylation of enamines.

Carbohydrates - Classification and nomenclature, monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses, configuration of glucose and fructose, erythro and threo diastereomers. Conversion of glucose into mannose, formation of glycosides, ether and esters. Determination of ring size of glucose and fructose, Cyclic structure of D (+) - glucose. Mechanism of mutarotation.

An introduction to disaccharide (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

UNIT IV

Amino Acids, Peptides, Proteins and Nucleic Acids - Classification, structure and stereochemistry of aminoacids, acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids.

Structure and nomenclature of peptides and proteins, classification of proteins, peptide structure determination, and group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis.

Structures of peptide and proteins. Levels of protein structure. Protein denaturation! renaturation. Nucleic acids: Introduction, constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

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 sulphates.

UNIT V

Synthetic Polymers - Addition or chain - growth polymerization, free radical vinyl polymerization, ionic - vinyl polymerizations Ziegler-Natta polymerization and vinyl polymers. Condensation or step-growth polymerization, polyesters, polyamides, phenol formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. natural and synthetic rubbers.

Synthetic Dyes - Colour and constitution (electronic concept), classification of dyes. Chemistry and synthesis of methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Recent Developments in Organic Chemistry: Question will not be asked from the recent development section.

BOOKS RECOMMENDED

1. Organic Chemistry, Vol. I and II, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd.
2. A Text Book of Organic Chemistry, Vol. I and II, K.S. Tewari, S.N. Mehrotra and N.K. Vishnoi.
3. Organic Chemistry, M.K. Jain and S. Sharma.
4. A Text Book of Organic Chemistry, Vol. I and II, O.P. Agarwal.
5. A Text Book of Organic Chemistry, Raj. K. Bansal.
6. Organic Chemistry, Vol. I and II, I.L. Finar.
7. Organic Reaction and their Mechanisms, P.S. Kalsi.
8. Introduction of Petrochemicals, Sukumar Maiti.
9. Organic Chemistry (Hindi Ed.) Suresh Ameta, Punjabi and Sharma.
10. Organic Chemistry, Morrison and Boyd, Prentice Hall.
11. Fundamentals of Organic Chemistry, Solomons, John Wiley.
12. Organic Chemistry, P.L. Soni.
13. A Text Book of Organic Chemistry, V.K. Ahluwalia and Maduri Goyal, Narosa Publishing House Pvt. Ltd.

PAPER III PHYSICAL CHEMISTRY

UNIT I

Elementary Quantum Mechanics : Black-body radiation, Planck's radiation law, photo-electric effect, heatcapacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wavefunction, postulates of quantum mechanics, particle in one-dimensional box.

Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance hydrogen like wave functions, radial wave functions, angular wave function. Molecular orbital theory, basic ideas- criteria for forming M. O. from A. O., construction of M. O.s by LCAO- H_2

ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions, concept of s, s, p p^4 . orbitals and their characteristics. Hybrid orbitals- sp , sp^2 , sp^3 , calculation of coefficients of A.O.s used in these hybrid orbitals.

Introduction to valence bond model of H_2 , M.O. and V. B. models.

UNIT II

Spectroscopy - Introduction: electromagnetic radiation, regions of the spectrum basic features of different spectrometers statement of the Born- Oppenheimer approximation degrees of freedom.

Rotational Spectrum - Diatomic molecules. energy levels of a rigid rotator (semi- classical principles) selection rules, spectral intensity, distribution using population distribution (Maxwell - Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Vibrational Spectrum - Infrared spectrum, energy level of simple harmonic oscillator, selection rules, pure vibrational spectrums intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Raman spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Electronic Spectrum - Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck Condon principle.

Qualitative description of s, p and n M.O., their energy levels and the respective transitions.

UNIT III

Photochemistry - Interaction of radiation with matter, difference between thermal and photochemical processes, laws of photochemistry, Grotthus - Drapper law, Stark - Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence non-radiative process (internal conversion, intersystem crossing), high and low quantum yields, photosensitization photochemical equilibrium, photoionization photodimerisation of anthracene, photoinhibition. chemical actinometry.

Solutions, Dilute Solutions and Colligative Properties : Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution:

colligative properties. Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement.

Determination of molecular weight from osmotic pressure, elevation of boiling point and depression of freezing point, thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point, experimental methods for determining various colligative properties, abnormal molar mass, degree of dissociation and association of solute, Vant-Hoff factor.

UNIT IV

Ionic Conductance - Electrical transport, conduction in metal and electrolytes, solutions, specific conductance, equivalent conductance and molecular conductance, effect of dilution on conductance, migration of ions, Kohlrausch's law and its applications, transport numbers and its determination by Hittorf's method and moving boundary methods, ionic mobility, application of conductivity measurement, conductometric titrations.

UNIT V

Chemical Kinetics and Catalysis - Rate of reaction, factors influencing the rate of reaction, concentration, temperature, pressure, solvent, light and catalysis, order of a reaction, zero-order, first order and second order reaction, half life and mean life, conductometric, potentiometric, polarimetric and spectrophotometric methods of determination of order of reactions, method of integration, half life method and isolation method, experimental methods of kinetics, elementary idea about opposing, parallel, consecutive and chain reaction, effect of temperature on reaction rates. Arrhenius equation, concept of activation energy and its measurement, simple collision's theory (hard sphere model), transition state theory (equilibrium hypothesis) limitations.

Theory of unimolecular reactions, catalysis, theory and mechanism, classification of catalysis, enzyme catalysis and its mechanism.

Recent Developments in Physical Chemistry: Question will not be asked from the recent development section.

BOOKS RECOMMENDED

1. Principles of Physical Chemistry : B.R. Puri and L.R. Sharma.
2. A Text Book of Physical Chemistry : A.S. Negi and S.C. Anand.
3. A Text Book of Physical Chemistry : Kundu and Jain.
4. Physical Chemistry (Hindi Ed.) : Suresh Ameta, R.C. Khandelwal, R. Ameta and J. Vardia, Himanshu Pub.

THIRD YEAR CHEMISTRY PRACTICALS

Distribution of Marks

Exercises		Marks
1.	Synthesis of Inorganic complex and organic compound	10
2.	Analysis by Colorimetry/Solvent extraction/Ion exchange method	07
3.	Qualitative analysis : Organic mixture analysis	07
4.	One Physical experiment	10
5.	Vice-voce	08
6.	Records	08

Total 50 marks

LIST OF EXPERIMENTS

1. Synthesis of Inorganic complexes and organic compounds

Any one of the following preparation may be asked in the examination keeping in view that not more than five students are given the same preparation in a batch of 20 students and nature of preparation should be equally distributed both from the organic and inorganic list.

Inorganic Complexes

- (a) Preparation of sodium trisoxalato ferrate (III)
- (b) Preparation of Ni-DMG complex.
- (c) Preparation of cis-and trans-bisoxalato diaquo chromate (III) ion.
- (d) Cuprous chloride
- (e) Sodium thiosulphate
- (f) Ferrous sulphate from Kipp's waste
- (g) Mercury tetrathiocyanate

Organic Synthesis

- (a) Acetylation of salicylic acid, aniline, glucose and hydroquinone, benzylation of aniline and phenol.
- (b) Aliphatic electrophilic substitution : Preparation of iodoform from ethanol and acetone.
- (c) Aromatic electrophilic substitution ;

Nitration -

Preparation of m-dinitrobenzene from nitrobenzene.

Preparation of p-nitroacetanilide from acetanilide.

Halogenation -

Preparation of p-bromoacetanilide from acetanilide.

Preparation of 2,4,6-tribromophenol from phenol.

(d) Diazotization/coupling - Preparation of methyl orange and methyl red.

(e) Oxidation : Preparation of benzoic acid from toluene

(f) Reduction : Preparation of aniline from nitrobenzene.

Preparation of m-nitroaniline from m-dinitrobenzene.

2. (i) Analysis by Colorimetry

(a) Job's method (b) Mole - ratio method

Adulteration - Food stuffs

Effluent analysis, water analysis

(ii) **Solvent Extraction** : Separation and estimation of Mg (II) and Fe (II).

(iii) **Ion Exchange** : Separation and estimation of Mg (II) and Zn (II).

3. Qualitative Analysis : Analysis of an organic mixture containing two solid components separable by water, dil. NaHCO_3 and dil. NaOH .

4. Physical Chemistry Experiment : Any one of the experiments may be given in the examination.

Chemical Kinetics

Study the kinetics of the following reactions.

Initial rate method: Iodide-persulphate reaction

Integrated rate method:

- Acid hydrolysis of methyl acetate with hydrochloric acid.
- Saponification of ethyl acetate.
- Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Conductometry

- To determine the strength of the given acid conductometrically using standard alkali solution.
- To determine the solubility and solubility products of a sparingly soluble electrolyte conductometrically.
- To study the saponification of ethyl acetate conductometrically.
- To determine the ionization constant of a weak acid conductometrically.

Potentiometry

- To titrate potentiometrically the given ferrous ammonium sulphate solution using $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ as titrant and calculate the redox potential of $\text{Fe}^{3+}/\text{Fe}^{2+}$ system on the hydrogen scale.
- To determine the strength of a given solution of $\text{HCl}/\text{CH}_3\text{COOH}$ by titrating with standard NaOH solution potentiometrically/pH metrically.

Refractometry, Polarimetry

- To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
- To determine the specific rotation of a given optically active compound.

Colourimetry

- To verify Beer - Lambert law for $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ and determine the concentration of the given solution of the substances.
- Estimation of iron colorimetrically.
- Estimation of phosphate colorimetrically.

Virtual Experiments: (any two)

- Preparation of inorganic/ organic compounds.
- Kinetic study of acid/base catalyzed hydrolysis of esters.
- Mechanochemical solvent free reactions.
- Determination of optical rotation by Polarimetry.
- Instrumentation Techniques in spectroscopy (UV, IR, NMR etc)
- Water Softening
- Demineralized water

8. Any other virtual experiment related to the content of syllabus and availability of the experimental facilities.

BOOKS RECOMMENDED

1. Practical Chemistry - Giri, Bajpai and Pandey, S. Chand & Co. Ltd., New Delhi.
2. Laboratory Manual in Organic Chemistry, R.K. Bansal, Willey Eastern.
3. Experimental Organic Chemistry, Vol. I and II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
4. Experiments in Physical Chemistry - J.C. Ghose, Bharti Bhawan.
5. Experiments in General Chemistry, N.r. Rado and U.C. Agarwal, Eastern Press.
6. Practical Chemistry - Suresh Ameta and P.b. Punjabi, Himanshu Publication.

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ZOOLOGY

Pattern of question paper in the annual examination and distribution of marks:

Each theory paper in the annual examination shall have three sections i.e. A,B, and C. In section A, total 10 questions will be set in the paper, selecting at least two from each unit. These questions to be answered in a word or so. All questions are compulsory. Each question carries 0.5 mark, total 05 marks.

In section B, there shall be total 10 questions, selecting two questions from each unit, five questions to be answered by the student selecting at least one from each unit. Answer should be given in approximately 250 words. Each question carries 05 marks, total 25 marks.

In section C, 04 descriptive type questions will be set in the examination paper from five units of the syllabus of the paper, selecting not more than one question from a unit. Each question may have two sub divisions. Students are required to answer any two questions approximately in 500 words. Each question is of 10 marks, total 20 marks.

PAPER-I
ANIMAL PHYSIOLOGY, BIOCHEMISTRY AND IMMUNOLOGY

Marks :50
External :40
Internal :10

UNIT-I

- 1 Histology and function of the gastro-intestinal tract, liver, pancreas, lungs, kidney, testis and ovary.
- 2 Histology, functions and disorders of endocrine glands – pituitary, pancreas, adrenal, thyroid and parathyroid.
- 3 Digestion and absorption of food in alimentary canal.

UNIT-II

- 4 Metabolism of carbohydrates: Glycolysis, decarboxylation of pyruvic acid, Krebs cycle, electron transport system and oxidative phosphorylation; glycogenesis and glycogenolysis.
- 5 Metabolism of proteins: Essential and non-essential amino acids, metabolism of amino acids, biosynthesis of glutamic acid..
- 6 Metabolism of lipids : Biosynthesis of saturated fatty acids and β -oxidative pathways of fatty acid,; formation of ketone bodies..

UNIT-III

- 7 Respiration: Mechanism of respiration, vital capacity of lungs, transport of gases, dissociation curve of oxyhaemoglobin and control of respiration, chloride shift.
- 8 Blood: structure and functions of blood cells, ABO blood groups and Rh factor, mechanism of blood clotting.
- 9 Ultrastructure of cardiac and skeletal muscles. Physiology of muscle contraction.

UNIT-IV

- 10 Excretion : Structure and function of nephron, control of renal function.

11 Nerve physiology: Ultrastructure of neuron, synapse, conduction of nerve impulse and neuromuscular junctions.

12 Reproductive physiology: Hormonal control of testicular and ovarian functions with reference to estrous and menstrual cycles.

UNIT-V

13 Immunology: Definition, types of immunity: innate and acquired, humoral and cell mediated.

14 Cell of immunity: macrophages, lymphocytes (B and T types), T-helper cells, T-killer cells, plasma cells and memory cells.

15 Antibody : definition structure and functions of each class of immunoglobulins.

16 Antigen: antigenicity of molecules, haptens. Antigen – antibody reactions, precipitation reaction, agglutination reaction, neutralizing reaction, complementary and lytic reactions and phagocytosis.

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PAPER-II

ECOLOGY AND BIOSTATISTICS

Marks :50
External :40
Internal :10

UNIT-I

- 1 Terminology and scope of Ecology.
- 2 Habitat and niche
- 3 Ecosystem: Components of ecosystem, energy flow and nutrient cycles, food chain, foodweb and ecological pyramids.
- 4 General idea of population and community ecology

UNIT-II

- 5 Freshwater environment: Physico-chemical features and biotic communities, productivity and eutrophication.
- 6 Marine environment: Characteristics, zonation, fauna and their adaptation, deep sea and estuarine fauna.
- 7 Terrestrial environment: General characteristics of desert, grass land and forest ecosystems.

UNIT-III

- 8 Environmental pollution: Biodegradable and non-biodegradable pollutants.
- 9 Air pollution: Source, nature, prevention and control, green house effect, ozone depletion and global warming.
- 10 Water pollution: Source, nature and abatement.
- 11 General account of noise pollution and radioactive pollution.

UNIT-IV

- 12 Conservation of natural resources: Wild life management, brief idea of national parks and wild life sanctuaries of India. Threatened and endangered species of India.
- 13 Environmental planning and environmental impact assessment.
- 14 Brief account of environmental Acts and Legislations (enacted after 1970).

UNIT-V

- 15 Concepts and applications of Biostatistics.
- 16 Frequency distribution, graphical presentation, mean, mode, median, standard deviation and standard error.
- 17 Correlation, T-test, Chi-square test.
- 18 Shanon and Weinner diversity index.

PAPER-III **ETHOLOGY AND EVOLUTION**

UNIT-I

- 1 Introduction and history of Ethology.
- 2 Methods of studying behaviour.
- 3 Neuroanatomical, neurophysiological, neurochemical, focal and scan sampling techniques.
- 4 Evolutionary approach to behaviour, levels of natural selection.
- 5 Human Ethology, general aspects.
- 6 Orientation taxes and kinesis.
- 7 Brief idea of learning.

UNIT-II

- 8 Social organization with reference to dominance, hierarchy, social competition and territoriality.
- 9 Reproductive behaviour with reference to courtship, mating, parental investment and stickle back fish (sexual dimorphism).
- 10 Elementary idea of role of pheromones and hormones in insects and vertebrates in relation to behaviour.
- 11 Adaptation and behaviour of Tiger.

UNIT-III

- 12 Origin of life
- 13 History of evolutionary thought Lamarckism and Neo-Lamarckism
- 14 Darwinism and Neo-Darwinism
- 15 Evidences of organic evolution.
- 16 Concept of micro and mega -evolution

UNIT-IV

- 17 Variation: Kinds and sources, role in evolution.
- 18 Isolation and speciation, definition, isolating mechanism, origin of species and processes of speciation.
- 19 Adaptation: Definition, kinds of adaptations, adaptive radiation, convergence and divergence.
- 20 Geological time scale

UNIT-V

- 21 Brief account of Zoogeographical regions of world
- 22 Fossils and their evolutionary significance.
- 23 Phylogeny of horse.
- 24 Evolution of man.

ZOOLOGY - PRACTICAL

Duration : 5 Hrs. M.M. :50

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S.No	Exercise	
1	Dissection	10
2	Ecology/ Ethology exercise	05
3	Physiological and Biochemical exercise	04
4	Spots	(1-10) 15
5	Viva-voce	08
6	Record	08
		Total :- 50

Major Dissection marks will be given only if virtual dissection is available otherwise marks may be given according to availability of dissection alternate.

ETHOLOGY AND EVOLUTION.

- 1 Habituation in earthworm/mosquito larvae.
- 2 Feeding behaviour of housefly/stored product pest.
- 3 Antennal grooming behaviour of cockroach.
- 4 Trial and error and latent learning in rat /mice.
- 165
- 5 Phototaxis and chemotactic behaviour in *Paramecium*.
- 6 Visit to a zoo/natural habitat of wild animals.
- 7 Demonstration of social behaviour by honey bee colony.
- 8 Adaptive modifications in the feet of birds.
- 9 Adaptive modification in the beak of birds.
- 10 Adaptive modification in the mouth parts of insects.
- 11 To study nests and nesting habits of the birds and social insects.
- 12 To study the phototaxis behavior in insect larvae.
- 13 Study of circadian functions in animals (daily eating, sleep and temperature patterns)

BIOCHEMICAL, PHYSIOLOGICAL AND ECOLOGICAL EXERCISES

- 1 Various biochemical tests of
 - (a) Proteins
 - (b) Carbohydrates
 - (c) Lipids
- 2 Action of salivary amylase.
- 3 RBC and WBC counts.
- 4 Estimation of Haemoglobin.
- 5 Blood groups (ABO and Rh).
- 6 Measurement of blood-pressure.
- 7 Abnormal and normal values of constituents of urine.
- 8 Water analysis: pH, alkalinity, dissolved oxygen, chloride and transparency.
- 9 Soil analysis: texture, moisture, organic and inorganic contents.

DISSECTIONS:

- **Digital animals:** Virtual dissection will be done (if facility of virtual is made available by University).
- Virtual dissection of Scoliodon cranial nerves and brain

MUSEUM SPECIMENS/ SLIDES SHOWING ADAPTATIONS :

Students are required to write about specific adaptations of following animals in relation to habitand habitat only:

Cursorial : *Acinonyx jubatus, Equus caballus, Moschus moschiferous.*

Flight : *Columba livia, Pteropus, Draco, Exocoetus, Papilio.*

Arboreal : *Chamaeleon, Hyla, Preshytis.*

Aquatic : *Physalia, Chiton, Hydrophis, Labeo Anguilla, Notopterus*

Fossorial : *Pheretima, Teredo, Chaetopterus, Talpa, Lepus, Ichthyophis, Naja.*

Parasitic : *Taenia, Fasciola, Enterobius, Ascaris, Schistosoma, Hirudinaria, Pediculus, Ixodes.*

- The teacher concerned will provide e-materials to practical in the form of video or demonstrations or written materials including dissections.

REFERENCE BOOKS (LATEST EDITIONS):

ANIMAL PHYSIOLOGY :

- 1 William S. Hoar, General and Comparative Physiology, Prentice Hall of India Pvt. Ltd.
- 2 Wood, D.W., Principles of Animal Physiology.
- 3 Prosser CL., Comparative Animal Physiology, Satish Book Enterprise.
- 4 Eckert, Animal Physiology. (W.H. Freeman).
- 5 Ganong : Review of Medical Physiology (Lange).

BIOCHEMISTRY :

- 6 Stryer, L : Biochemistry (Freeman)
- 7 Conn et al : Outlines of Biochemistry (Wiley)
- 8 R.K.Murray et al, Harpers Biochemistry, Lang Medical Book.

IMMUNOLOGY

- 9 Roitt I : Essential Immunology (ELBS)
- 10 Kuby : Immunology (W.H. Freeman).

ECOLOGY

- 11 Odum : Ecology (Amerind).
- 12 Odum : Fundamentals of Ecology (Saunders).
- 13 Ricklefy : Ecology (W.H.Freeman).

BIostatISTICS :

- 14 Green, R.H.Sampling design and statistical methods for environmental biologists. JohnWiley and Sons New York.
- 15 Snedecor, G.W. and W.G. Cochran. Statistical methods. Affiliated East-West Press, NewDelhi (Indian Ed.)
- 16 P.N.Arora and P.K.Malhan, Biostastics, Himalaya Publishing House, Bombay.

ETHOLOGY

- 17 Drickamer & Vessey: Animal Behaviour, Concepts, Processes and Methods (Wadsworth).
- 18 Grier : Biology of Animal Behaviour (Mosby College)
- 19 Immelmann : Introduction to Ethology (Plenum Press)
- 20 Lorenz : The Foundation of Ethology (Springer-Verlag)

21 Manning : An Introduction to Animal Behaviour (Addison-Wesley)

22 Reena Mathur : Animal Behaviour, Rastogi Publications, Merrut.

EVOLUTION :

23 Dobzhansky, Ayala, Stebbins & Valentine : Evolution (WH Freeman)

24 Dobzhansky : Genetics and Origin of species (Columbia University Press)

25 Major : Population, Species and Evolution

26 White : Animal Cytology and Evolution.

27 Moody : Introduction to Evolution

28 Savage : Evolution (Holt, Reinhart and Winston).

PRACTICAL :

29 Verma, PS, A manual of practical Zoology Vertebrates S.Chand and Co. Ltd., Ram Nagar, New Delhi(English and Hindi Editions).

30 Lal, SS : Practical Zoology Vertebrates, Rastogi Publication, Meerut (English and Hindi Editions).

31 Verma PS & Srivastava PC, Advanced Practical Zoology, S.Chand & Co.

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Botany

PAPER I
ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY

Marks :50
External :40
Internal :10

Unit-1

Definition, scope and aims of ecological studies, relation with other sciences; factors affecting plant growth and distribution - climatic, edaphic, biotic and topographic. **-10 hours**

Unit-2

Plant population - natality, mortality, age and sex ratio, growth rate, biotic potential. Plant Community – characteristic characters (qualitative and quantitative characters); Plant succession - xerosere, hydrosere. Ecosystem concept- structure and function : food chain, food web, trophic levels, ecological pyramids, energy flow and biogeochemical cycles. **-10 hours**

Unit-3

Pollution : air, water, land, noise and their control. Conservation and management of natural resources, endangered plants and their conservation; biosphere reserves, National Parks and sanctuaries; Chipko movement. **-10 hours**

Unit-4

Biodiversity and its Conservation; Hotspots in India. Morphological, Anatomical and Physiological adaptations of hydrophytes, xerophytes and halophytes; natural vegetation of Rajasthan. Plant indicators. **-10 hours**

Unit-5

Phytogeography - definition, aims, objectives, scope and relation with other disciplines; phytogeographical regions of world and India; continuous and discontinuous distributions, endemism, continental drift theory, land bridges, age and area hypothesis, migration. **-10 hours**

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A**- 10 questions, **Section B**-10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of half mark. All the questions in **Section A** are compulsory.

In **Section B**, 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 5 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 10 marks. In short, pattern of question paper and distribution of marks for UG classes will be as under:

- **Section A:** 10 questions, 2 questions from each unit, short answer, all questions compulsory. Total marks : **05**

- **Section B:** 10 questions, 2 question from each unit, 5 question to be attempted, at least 1 from each unit, answer approximately in 250 words. Total marks : **25**
- **Section C:** 04 questions (question may have sub-division), not more than 1 question from each unit, descriptivetype, answer in about 500 words, 2 questions to be attempted. Total marks : **20**

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PAPER II
PLANT PHYSIOLOGY AND BIOCHEMISTRY

UNIT 1

Different models of cell membrane to explain structure and function; water relations – osmosis, diffusion, diffusion pressure deficit (DPD), turgor pressure, wall pressure; concept of water potential. Mechanism and factors affecting transpiration, role of macro and micro elements, carrier concept of ion absorption. -10 hours

Unit-2

Photosynthesis - photosynthetic pigments; light absorption and mechanism of carbon fixation, C3 and C4 plants.

Brief account of CAM, photorespiration, CO₂ compensation point. Factors affecting photosynthesis. Enzymes :general characteristics, traditional and modern methods of enzyme classification, mode of action. Isozymes. -10hours

Unit-3

Respiration - glycolysis, Krebs cycle, electron transport system and oxidative phosphorylation, factors affecting respiration. Synthesis and degradation of fatty acids. -10 hours

Unit-4

Plant Growth Regulators : auxins, gibberellins, cytokinins, ethylene and abscisic acid, their physiological effects and application in agriculture and horticulture; Seed dormancy, senescence, photoperiodism and vernalization. -10hours

Unit-5

Principles and use of following techniques: pH metry, centrifugation, colorimetry, chromatography. Microscopy:light and compound; scanning electron microscopy. -10 hours

Note: The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A**- 10 questions, **Section B**- 10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of half mark. All the questions in **Section A** are compulsory. In **Section B**, 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 5 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 10 marks. In short, pattern of question paper and distribution of marks for UG classes will be as under:

- **Section A:** 10 questions, 2 questions from each unit, short answer, all questions compulsory. Total marks : **05**
- **Section B:** 10 questions, 2 question from each unit, 5 question to be attempted, at least 1 from each unit, answer approximately in 250 words. Total marks : **25**

- **Section C:** 04 questions (question may have sub-division), not more than 1 question from each unit, descriptivetype, answer in about 500 words, 2 questions to be attempted. Total marks : **20**

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PAPER III

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Marks :50
External :40
Internal :10

Unit-1

Bacterial genome. Methods of genetic recombination in bacteria (Transformation, Transduction and Conjugation).

Principles of recombinant DNA technology. Basic tools and techniques. *Neurospora* genetics. Molecular aspects of biological nitrogen fixation. -10 hours

Unit-2

Structure, chemistry and types of nucleic acids. Replication of DNA. Central dogma, transcription and translation, genetic code. Gene regulation - operon model, two component regulatory system. -10 hours

Unit-3

History of plant tissue culture, contribution made by Haberlandt, White, Nobecourt, Gautheret, Steward, Reinert, Morel and Vasil. Highlights of work done by Indian Scientists. Basic tools and techniques of plant tissue culture, maintenance of aseptic conditions, Laminar Air Flow Bench, Autoclave, Growth Chamber, methods of sterilization, culture media and their preparation. -10 hours

Unit-4

Explant types, initiation of cultures, maintenance of cultures, callus and liquid suspension culture, single cell culture, protoplast isolation, purification, culture and regeneration. Regeneration *in vitro* through organogenesis, somatic embryogenesis, androgenesis and haploid production. -10 hours

Unit-5

Methods of gene transfer in plants - microinjection, electroporation, particle - gun technology, *Agrobacterium* mediated gene transfer. Plant tissue culture in Industry. Secondary plant products with special reference to alkaloids. Prospects of drug production in cell cultures and Bioreactor. -10 hours

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A**- 10 questions, **Section B**-10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of half mark. All the questions in **Section A** are compulsory.

In **Section B**, 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 5 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 10 marks.

In short, pattern of question paper and distribution of marks for UG classes will be as under:

- **Section A:** 10 questions, 2 questions from each unit, short answer, all questions compulsory. Total marks : **05**
- **Section B:** 10 questions, 2 question from each unit, 5 question to be attempted, at least 1 from each unit, answer approximately in 250 words. Total marks : **25**
- **Section C:** 04 questions (question may have sub-division), not more than 1 question from each unit, descriptivetype, answer in about 500 words, 2 questions to be attempted. Total marks : **20**

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**MATHEMATICS
PAPER – I
REAL ANALYSIS**

UNIT - I

Real number system:

(i) Field, ordered field, upper and lower bounds of a set in an ordered field. Supremum and infimum of a set and their properties. Completeness, Archimedean and denseness properties of an ordered field, the set Q of rational numbers as a non-complete dense Archimedean ordered field and the set R of real numbers as a complete dense Archimedean ordered field, (ii) Open interval, closed interval, neighbourhood of a number. Real line R -Interior points and limit points of a set in R , open sets and closed sets in R and their properties, Nested Interval property. Bolzano-Weierstrass theorem, Heine Borel theorem, Compact set and connected set and their properties.

UNIT - II

(i) Sequence, Bounded sequence, monotonic sequence, limit of a sequence, convergent sequence, properties of convergent sequence, Cauchy first and second theorems on limits, subsequence and its properties, Cauchy sequence and its properties, Cauchy general principle of convergence, Examples of convergent sequences.

(ii) Series: Convergence and divergence of an Infinite series of real numbers, the necessary and sufficient conditions, various tests of convergence problems and their illustrations with regard to infinite series of positive terms. Series: Alternating series and Leibnitz test, absolute and semi (or conditional) convergence.

UNIT-III

Riemann Integration: Upper and Lower Darboux sum, Upper and Lower Riemann integrals, Riemann integrability of a bounded function in a closed interval, the necessary and sufficient condition for R integrability in terms of Darboux sums, properties of R -integrable functions, Fundamental theorem of integral Calculus.

UNIT - IV

(i) Uniform convergence of sequences and series of functions, various tests including M_n -test and Weierstrass M -test, relations of uniform convergence with the continuity of the limit and the sum functions and also with term by term differentiation and term by term integration.

(ii) Fourier series representation of periodic functions which are even, odd and none of these in the full interval or half the interval.

UNIT - V

(i) Convergence of improper integrals - various tests and their applications, Evaluation of such integrals.

(ii) Equivalent sets and their examples, nature of the relations of equivalence. Denumerable and non numerable sets, countable and uncountable sets, Nature of subsets of a countable set and that of a denumerable (countable) sets, union of denumerable (countable) sets, Denumerability

of the sets of integers and rational numbers and nondenumerability of the closed unit interval $[0, 1]$ and the sets of real numbers and irrational numbers.

References:

1. T. M. Apostol : Mathematical Analysis.
2. R. R. Goldbeg : Real Analysis
3. Walter Rudin : Principles of Mathematical Analysis
4. P.K. Jain & S. K. Kaushik : An introduction to Real Analysis.
5. D. Somasundaram & B. Chaudhary : A First Course of Mathematical Analysis.
6. G. F. Simmon : Introduction to Topology.
7. Bhargava & Goyal : Real Analysis.
8. Gokhroo & others : Real Analysis.
9. Sharma & Purohit : Elements of Real Analysis.

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**PAPER – II
ABSTRACT ALGEBRA**

Marks :65

UNIT – I

Rings, definition and examples of various kinds of rings, integral domain, division ring, field, characteristic of a ring and integral domain, subring and subfield With examples. Left and right ideals with examples and properties, Principal ideal, principal ideal ring. Maximal, prime and Principal ideals in Commutative rings and their theorems.

UNIT -II

Quotient ring, Homomorphism and isomorphism in rings, kernel of homomorphism, Fundamental theorem of ring homomorphism. The three isomorphism theorems in rings, Embedding of a ring into a ring with unity and also into a ring of endomorphism of some abelian groups, Quotient field of an integral domain.

UNIT - III

Definition and various examples of vector spaces, subspaces and examples, Intersection, sum and direct sum of two subspaces, Linear span, Linear dependence, independence and their basic properties and problems.

UNIT- IV

Basis, Dimension and examples, Finite dimensional vector spaces, Existence theorem for a basis, Extension theorem, Invariance of the number of elements of a basis set, Existence of complementary subspaces of a subspace of a finite dimensional vector space, Dimension of sum (and direct sum) of two subspaces, Quotient space and its dimension.

UNIT - V

Linear transformations, Rank and Nullity of a linear transformation, Sylvester law of nullity, to obtain a matrix from a linear transformation and vice-versa and their problems relating to the same and different bases. The algebra of linear transformations, dual space and dual basis and dimension of dual space, bidual space and natural isomorphism (Reflexivity).

References:

1. Surjeet Singh and Quazi Zarneeruddin : Modern Algebra.
2. I.N.Herstein : Topics in Algebra.
3. R.S.Agrawal : Algebra.
4. Gokhroo, Saini : Advance Abstract Algebra.
5. Shanti Narayan : A Text-Book of Modern Abstract Algebra.
6. Hoffman and Kunze : Linear Algebra, (Second Edition).
7. Purohit, Pareek and Sharma : Linear Algebra.
8. Halmos, Paul R : Finite - Dimensional Vector spaces.

PAPER -III DISCRETE MATHEMATICS

Marks :65

UNIT – I

Sets and propositions – cardinality, Mathematical Induction, Principle of Inclusion and exclusion. Computability and formal language- ordered set. Language phrase structure Grammars. Types of Grammars and languages.
Permutation and combinations: Simple problems.

UNIT –II

Relations and functions:- Binary Relations, Equivalent Relations and Partitions, Partial order relations and lattices, Pigeon Hole principle. Graphs and planar graphs: - Basic Terminology; Multigraphs, weighted graphs, paths and circuits shortest paths. Eulerian paths and circuits. Planar graphs.

UNIT – III

Trees: Rooted trees, Binary tree, Decision or sorting tree, spanning tree, minimal spanning tree. Pumping lemma. Finite state machine: Equivalent machines, Finite state machine as Recognizers. Analysing Algorithms– Time complexity, complexity of problems.

UNIT –IV

Recurrence Relations and Recursive Algorithms: Linear Recurrence Relations with constant coefficients, Homogeneous solutions, Particular solution, Total solution, Solution by the method of generating functions.

UNIT – V

Brief review of groups and Rings. Boolean Algebras – Lattices and Algebraic structures. Duality, Distribution and complemented Lattices, Boolean Lattice and Boolean Algebras, Boolean function and expressions, Propositional calculus, Design and Implementation of Digital network - Switching circuits.

References:

1. C.L. Liu : Elements of Discrete Mathematics
2. K.D. Joshi : Foundation of Discrete Mathematics
3. Mradula Garg & R. Panday : विविक्त गणित
4. Gokhroo et.al :

PAPER- III NUMERICAL ANALYSIS AND OPERATIONS RESEARCH

Marks :65

UNIT - I

Differences, Relation between differences and derivatives, differences of Polynomial, Newton-Gregory formula for forward and backward interpolation, divided differences. Newton's General interpolation formula, Lagrange's interpolation formula.

UNIT - II

Gauss's central difference formula, Stirling's and Bessel's interpolation formula, Inverse interpolation. Numerical differentiation, Derivatives from Interpolation formulae, Method of operators, Numerical Integration: Newton-Cotes Quadrature formula, Trapezoidal, Simpson's one third, Simpson's three-eighths rules.

UNIT-III

Gauss Quadrature formulae, Estimation of errors in quadrature formula, location of roots by Descartes' method of sign, Newton's theorem on multiple roots, Numerical solution of Algebraic and Transcendental equations, Bisection method, Regula-Falsi method, Method of integration .

UNIT-IV

Introduction to linear programming problems, Mathematical formulation Graphical method of solution of linear programming problems (Problems of two variables only), Theory of convex sets, Theory of Simplex method and its applications to simple linear programming problems.

UNIT - V

Concepts of duality in linear programming, formation of dual problems, Elementary theorems of duality.

Assignment and transportation problems and their optimum solutions.

References:

1. C. E. Froberg : Introduction to Numerical Analysis
2. M. K. Jain, S. R. K. Iyenger and R.K. Jain : Numerical methods: Problems & solutions
3. G. Hadley : Linear Programming
4. Kanti Swaroop, P. K. Gupta and Man Mohan : Operation Research
5. H.C. Saxena : Numerical Analysis
6. Goyal, Mittal : Numerical Analysis
7. Goyal, Mittal : Numerical Analysis (Hindi ed.)
8. Goyal, Mittal : Numerical Analysis (Hindi ed.)
9. Goyal, Mittal : Operations Research
10. S.D.Sharma : Operations Research
11. Gokhroo, Saini, Jain : Operations Research (Hindi ed.)
12. Bhargava, Bhati, Sharma : Linear Programming (Hindi ed.)
13. Gokhroo, Saini, Jain : Linear Programming (Hindi ed.)

PAPER- III

MATHEMATICAL STATISTICS

Marks :65
External :50
Internal :10

UNIT -I

Probability: Definitions of Probability, Addition and Multiplication laws, Conditional probability , Independent events, Baye's Theorem.

UNIT II

Random variable, Distribution function, Probability mass & density functions, probability distribution, Joint, marginal and conditional probability functions.

UNIT -III

Mathematical expectation and Moments, Addition & Multiplication law, Covariance, Expectation and Variance of linear combination of two variables, Moment generating, cumulant generating & characteristic functions.

UNIT -IV

Theoretical Probability distributions- Binomial, Poisson and Normal distributions and their properties.

UNIT -V

Curve fitting by the principle of least squares, fitting of straight line and parabola, Bivariate linear correlation and regression.

Books Recommended:

1. Mathematical Statistics, J. N. Kapur & H.C. Saxana, S. Chand & Co., New Delhi.
2. Fundamentals of Mathematical Statistics, V. K. Kapoor & S.C. Gupta, Sultan Chand Sons, New Delhi.
3. Mathematical Statistics by Dr. Gokhroo & Saini.

NOTE:

Candidates who have offered Statistics as an optional subject will not be permitted to offer the paper III (B) and III (C). Candidates who have offered Computer science as an optional subject will not be permitted to offer paper III (B).

PROFESSIONAL EDUCATION COURSE

PEC 5 -KNOWLEDGE & CURRICULUM

OBJECTIVE OF THE COURSE :

- To enable student teachers to understand the meaning of the term knowledge and Curriculum.
- To develop understanding into the epistemological basis of education
- To develop understanding of modern child-centered education
- To develop understanding social & cultural influence on education.
- To examine relationship of Curriculum to education.
- To develop understanding into curriculum its determinates ,process & evaluation.

UNIT :1

Construction of Knowledge

- Meaning & Nature of knowledge
- Information , knowledge ,conception & perception
- Sources of knowledge : Empirical V/s Revealed Knowledge
- Types of knowledge :(1) Disciplinary knowledge
(2) Course Content Knowledge
(3) Indigenous Knowledge
(4) Scientific Knowledge
- Relevance of knowledge construction through dialogue
- Contestations to Knowledge
(a) Dominance
(b) Marginalization (c) Subversion
- Role of curriculum in challenging Marginalization with reference to class ,caste ,gender , & religion .

UNIT :2

Metaphysics

- Meaning of Metaphysics ,aims & objective ,types of Metaphysics – ontology cosmology , theology , Methods , Techniques & Maxims of Teaching , Role of teacher.
- Axiology & Education , Meaning of Axiology ,need ,types of axiology , Value ,methods & techniques , role of teacher .

UNIT :3

Basis of Modern Child – Centered Education

(Concept , basis & educational significance)

1 Activity Method (M.K. Gandhi)

2. Discovery Method (John Dewey)

3. Child Centered (Giju Bhai badheka)

- Education : Meaning (etymological), definitions & characteristics of education
- Epistemological basis of education distinction between knowledge & information ,teaching & training
- Change in education due to industrialization , democracy & individual autonomy
- understanding Education in relation to equity , equality & social Justice (B.R. Ambedkar)
- Interrelationship of education with reference to Nationalism (Krishnamurti) & Secularism (tagore)

UNIT : 4

Curriculum – Concept , Types ,Determinates & Development

1.Curriculum –Meaning & Concept of Curriculum ,Relationship With Curriculum Frame work ,Syllabus & Text books .

2. Determinants of Curriculum (Philosophical , Psychological, Sociological,Political)

3. Types of curriculum (Subject – centered , & Child – Centred ,Hidden Curriculum & enacted Curriculum)

4. Principles of Curriculum Development

5. Process of Curriculum Development

(a) Formulating aims & objectives

(b) Criteria for selecting knowledge & representing knowledge in the form of different subjects .

(c) Selection & organization of Learning Situations .

4. Participatory approach to Curriculum development : Representation of social groups in curriculum construction.

UNIT : 5

Curriculum Implementation and Evaluation

a) Teachers' role in generating dynamic curricular experiences through (i) flexible interpretation of curricular aims, (ii) contextualization of learning, (iii) varied learning experiences (iv) learning resources

b) Need and evaluation of effective curriculum construction with reference to existing pedagogies and Instructional approaches, teacher training, textbooks and instructional materials.

c) Role of MHRD and NCERT in curriculum reform

Practicum:-

- a. Seminar Presentation Critical appraisal of Philosophy & Practice Of Education Advocated by Gandhi, Dewey, Freire
- b. Critical Writing : Critically examine role of hidden curriculum with references to school rituals ,celebrations and rules and discipline .
- c. Report writing choose syllabus for any one school subject, Read text books (of at least 2 Standards from 6 to 9 class) for the same .Deliberate on of modern values like equity ,equality and social Justice Reflected in it and write a report on it.

Reference

1. Schilvest, W.H. (2012), Curriculum: prospective paradigm and possibility.M.C MLLAN publication.
2. Hirst, Paul, H. Knowledge and the curriculum. Routledge publication.
3. Letha ram mohan (2009). Curriculum instrchon and evaluation. Agerwal publication, Agra.
4. Scolt, dand (2003). Curriculum studies: curriculum knowledge. Routledge falmes, m.y.
5. Kelly, AV. (2009). The curriculum: theory and practice sage publication Singapore.
6. श्रीवास्तव, एच.एस.एवं चतुर्वेदी, एम. जी (2010). पाठ्यचर्या और शिक्षण ि
7. यादव, शियाराम, 2011. पाठ्यक्रम विकास अग्र
8. Shulman L. S. (1986) those who understand: knowledge growth in teaching. Educational researcher.
9. Sinha, S. (2000) Acquiring literacy in schools, seminar.
10. Sternberg, R.J. (2013). intelligence, competence, and expertise, in A.J. Elliot & C.S. Dweck (Eds), handbook of competence and motivation .
11. Tagore, R. (2003) Civilization and progress in crisis in civilization and other essays.: rupa &co. New Delhi.
12. Pathak, A (2013) Social implications of schooling: knowledge pedagogy and consciousness. Aakar books, New Delhi.

Curriculum & Pedagogic Studies

PC-1 PEDAGOGY OF BIOLOGICAL SCIENCE

Marks :100
External :80
Internal :20

Paper Objectives-

To enable the pupil teacher to

- Develop a broad understanding of the principles and procedures used in Biological Science & Developing their skills necessary for preparing Biological Science education in modern society.
- To construct different plans according to need.
- To devise the instructional Design of biological science properly.
- Appraise the biological paradigm in understanding of the subject.
- Use different methods to teach different concepts.

UNIT- I

BASICS OF BIOLOGICAL SCIENCE

- Nature of modern science, impact of science on society, globalization and science, Justification of including science as a school subject, socio cultural perspectives of biological science , worlds eminent scientists and their path tracking discoveries.
- Pedagogy of Biological Science – Integration of knowledge about the learner, The subject discipline, social context of learning, and researches related to different aspects of learning.
- Different branches of biological science , relation with other subjects ,
- Constructivism in teaching Biological Science, Vygotskiyan Perspective.

UNIT -II

AIMS AND OBJECTIVES OF TEACHING BIOLOGICAL SCIENCE

- Taxonomy and approaches of educational objectives in biological science.
- Objectives in biological science- Blooms Taxonomy and revised Blooms taxonomy.
- Process and product outcomes.
- Concept of entering and terminal behavior.

UNIT- III

PLANNING FOR INSTRUCTION

- Unit plan, year plan and lesson plan
- Ability to convert an unit plan into lesson plan
- Use of teaching-learning material (Audio-Visual aids)
- Improvised apparatus: significance and preparation
- Use of LCD projector and power point presentation
- Use of Bruner's models as concept attainment and advance organizer models in Teaching of Biological science.
- Planning and Implementation of strategies in Teaching concept – Evaluation Approach

UNIT- IV

TEACHING OF BIOLOGICAL SCIENCE & CURRICULUM ORGANIZATION AND LEARNING RESOURCES

- Inductive-Deductive approach
- Edger Dale's con of experiences.
- Major models & methods for Science Instruction- formal & non-formal and co-curricular approaches Lecture cum demonstration, Heuristic, Discussion, Project, Problem Solving, laboratory and Experimental method.
- Innovative Teaching practices in Biological science.
Principles and approaches for curriculum development, curricular framing according to local needs.
- Text Books, Science journals, handbooks, other resource materials for Teaching Biological science.
- Organization of Biology laboratory.

UNIT VI

EVALUATION IN BIOLOGICAL SCIENCE & PROFESSIONAL DEVELOPMENT OF A BIOLOGY SCIENCE TEACHER

- Measurement and Evaluation- Importance and purpose.
- Types of evaluation
- Achievement Test construction, administration and scoring.

- Characteristics of a good test
- Measuring specific behavioral outcomes- Cognitive, Affective and psychomotor outcomes.
- Diagnostic testing and remedial teaching.
Professional development programmes for a bioscience teacher- Participation in seminar, conferences, online sharing membership of professional organizations, Collaboration of school with colleges, universities and other institutions,

Helpstudentpoint.com

PC-2 PEDAGOGY OF MATHEMATICS

Marks :100
External :80
Internal :20

Objectives

1. To understand the basic concepts associated with academic disciplines
2. To understand place of different disciplines in the school curriculum understand nature, scope & importance of Mathematics at secondary level.
3. To acquaint and formulate aims and instructional objectives in teaching mathematics in Secondary school level as per revised taxonomy.
4. To apply different approaches and methods of teaching mathematics in classroom situations.
5. To set up mathematics club in the school and organize its activities.
6. To use a mathematics laboratory to develop in students an interest in mathematics.
7. To understand the professional competencies, commitments and expectations of mathematics teacher.
8. To develop knowledge of various values of teaching Mathematics
9. To appreciate the role of mathematics in day-to-day life
10. To understand that mathematics is more than formulas and mechanical procedures
11. To channelize, evaluate, explain and reconstruct students' thinking
12. To appreciate the importance of mathematics laboratory in learning mathematics

Unit 1

Basics of Academic Disciplines

- a) Meaning of academic disciplines, Relationship between academic disciplines and Mathematics
- b) Classification of academic disciplines: Belcher -Belgian typology (pure-hard, pure soft, applied-hard, applied-soft types) with emphasis on nature of knowledge in each type.,
- c) Place of Mathematics in the present school curriculum

Unit 2: Introduction to the Teaching of Mathematics & Curriculum

- (a) Meaning, Nature & scope of Mathematics
- (b) Aims and Objectives of teaching Mathematics at Secondary and Higher Secondary Levels (NCF 2009)
- (c) Values of teaching Mathematics (d) Maxims of teaching ,From Known to Unknown ,From Simple to Complex , From Particular to General ,From Concrete to Abstract , From Whole to Part
- (e) Approaches of curriculum construction-Concentric and Topical & Text book .
- (f) Pedagogical Analysis ,Unit Planning & Lesson planning

Unit 3

Methods and Techniques of Teaching Mathematics

- a) Learner Centered methods ---Inductive Deductive (Teaching Generalizations), Analytical Synthetic (Teaching Proofs)
- b) Activity centered methods—Problem solving, Lecture cum Demonstration
- c) Techniques of teaching Mathematics ---Drill and Review, Assignment in Mathematics

Unit 4

Learning Resources

- a) Mathematic Laboratory & Mathematic club (objectives, significance)
- b) Textbook – Characteristics and Critical analysis
- c) Digital Resources for Teaching Mathematics- Geogebra & Virtual Manipulative (Meaning, Application, Advantages and Limitations)

Unit 5

Professional Development of Teacher

- a) Competencies of Mathematics teacher
- b) Need and Avenues of Continuous Professional Development
- c) Contribution of mathematicians- Aryabhata, Ramaujan, Euclid, Phythagoras
- d) Mathematics teacher merits & demerits, Characteristics& Maths teaching innovation :- team teaching, Program learning, peer group.

Suggested tasks: (Any One)PRACTICUM :-

- a) Plan and implement lessons in mathematics using appropriate methods/approaches to teach :
Generalizations
Theorems/ Proofs
Problem Solving
Lecture cum Demonstration

Take up a problem in mathematics (from any area like number system, geometry etc.). Make a group of 3 or 4 students to discuss about the probable ways of solving

- b) Conduct one lesson in the math using manipulative- Physical/ virtual.
- c) Assignment: For any one selected topic, prepare Pedagogical Analysis Plan
- d) Critically appreciate any one textbook of mathematics.
- e) Conduct one lesson in the math using manipulative- Physical/ virtual.
- f) Prepare a diagnostic test in mathematics.
- g) Critically appreciate any one textbook of mathematics.
- h) Collect the names of Mathematicians and Prepare a report about their contribution to Mathematics .

References:

- * Boyer, Carl B., (1969): A History of Mathematics; Wiley, New York.
- * Content cum Methodology of Teaching Mathematics for B.Ed; NCERT New Delhi.
- * Davis David R., (1960); Teaching of Mathematics Addison Wesley Publications.
- * Ediger Mariow (2004); Teaching Math Successfully, Discovery Publication.
- * Gupta H.N. and Shankaran V (Ed.), 1984; Content cum Methodology of Teaching Mathematics, NCERT New Delhi.
- * Hudgins, Bryce B. (1966); Problem Solving in the classroom, MacMillan, New York.
- * James Anice (2005); Teaching of Mathematics, Neelkamal Publication.
- * Johan R.E. et.al, (1961): Modern Algebra; First Course, Addison-Wesley Publishing Company INC. USA.
- * Kapur S.K. (2005); Learn and Teach Vedic Mathematics; Lotus Publication.
- * Kulshreshtha; Teaching of Mathematics, R. Lal and Sons.
- * Kumar Sudhir; Teaching of Mathematics, Anmol Publications, New Delhi, India.

- * Mangal, A text book on Teaching of Mathematics, Prakash Bros., Ludhiana, India.
- * NCERT (2006) Position Paper-National Focus Group On Teaching of Mathematics , New Delhi
- * Novak,J.D. & Gowin ,D.B.,(1984) , Learning How To Learn ,New York, NY, Cambridge University Press
- * Hollands (1990), Development of mathematical skills, Blackwell Publishers, Oxford, London
- * Schonnel F.J.(1965) , Diagnostic and Remedial Teaching in Arithmetic , Lever and Boyd , London
- * Pamela Cowan (2006), Teaching Mathematics, A Handbook for Primary and Secondary School Teachers, Routledge , London and New York
- * Tanner H. And Jones S. (2000) , Becoming a successful teacher of mathematics, Routledge Falmer , London
- * Thompson D.R and Rubenstein,R.N(2010), Teaching and Learning High School Mathematics , John Wiley and Sons Inc., New Jersey,
- * Weinberg A.S.(1999),Connecting Mathematics and Science to Workplace Contexts : A Guide to Curriculum materials, Corwin Press Inc., California

PC-3 Pedagogy of Physical Science

Marks :100
External :80
Internal :20

Objectives

The course will enable the student teachers to -

- * gain insight on the meaning and nature of physical science for determining aims and strategies of teaching- learning
- * appreciate the fact that every child possess natural curiosity about her natural surroundings
- * appreciate that science is a dynamic and expanding body of knowledge
- * understand the process of science and role of laboratory in teaching- learning situation
- * appreciate various approaches of teaching-learning of physical science
- * use effectively different activities/ experiments / laboratory experiences for teaching- learning of physical science
- * identify the concepts of physical science that are alternatively conceptualized by teachers and students in general
- * explore different ways of creating learning situations considering learning needs and context of the learner and the relevant concept
- * integrate knowledge in physical science with the other school subject
- * facilitate development of scientific attitudes in learners
- * construct appropriate assessment tools for evaluating learning of physical science.
- * examine the different pedagogical issues in the content of learning physical science.

Unit 1

Nature of Science

□ Science as a domain of inquiry, as a dynamic and expanding body of knowledge, science as interdisciplinary area of learning (e.g. Thermodynamics, Biomolecular Surface Chemistry, etc.), Science is an international enterprise, tentative nature of science, science promotes skepticism and perseverance.

* Science as a process of constructing knowledge; Scientific methods: a critical view, How science works; Role of science teacher.

* Science and society- Physical science and society; physical science for environment, health, peace and equity.

* Contribution of eminent scientists- Isaac Newton, John Dalton, J.C. Bose, Albert Einstein Niels Bohr, C.V. Raman, De Bogle, Bimla Buti, V. Ramakrishan, etc.

Unit 2

Aims and Learning objectives of Physical Science

1. Knowledge and understanding through science ;Nurturing process skills of science , developing scientific attitude and scientific temper.
2. Nurturing curiosity, creativity and aesthetic sense in science (Secondary Stage)/Physics and Chemistry (Higher Secondary stage).
3. Relating Science (Physics/ Chemistry) education to environment (natural environment, artifacts and people), technology and society and appreciating the issues at the interface of science, technology and society; Imbibing various values through teaching –learning of Science; Developing problem solving skills.
4. Learning objectives- Meaning; features of a well defined learning objective; Anderson and Krathwohl's taxonomy.
5. Identifying and writing learning objectives for different content areas in Science/ Physics/ Chemistry consistent with the cognitive development of learners (e.g Mechanics, Heat, Electricity,

magnetism, Light, Acids, Bases and Salts, Thermodynamics, Metallurgy, Physical and Chemical changes, Nature and state of Matter, etc.); Learning objectives in constructivist perspective.

Unit 3

Pedagogical shift and Approached and strategies of learning Physical Science

1. Pedagogical shift from science as a fixed body of knowledge to the process of constructing knowledge; Pedagogical shift in nature of science, knowledge, learners, learning and teachers, assessment, science curriculum and planning teaching-learning experiences (taking examples from science/ Physics/Chemistry, such as Solutions, Chemical Equilibrium, Electrochemistry, Mechanical and Thermal Properties of Matter, Reflection, Refractions, Wave optics, etc.)
2. Democratizing Science learning: Critical pedagogy
3. Need of inclusion in all aspects of teaching-learning of physical sciences – science curriculum, approaches, ICT and professional development of teachers.
4. Approaches and Strategies -- Historical background of learning Physical Science; Essential components of all approaches and strategies, selecting appropriate approach and strategy.
5. Constructivist approach; Collaborative learning approach, Problem solving approach; Concept mapping; Experiential learning; Cognitive conflict; Inquiry approach, Analogy strategy.
6. Facilitating self-study; Communication in Science -- qualities of an effective Science communicator, developing communication skills in learners.

Unit 4

Learning Resources in Physical Science

1. Identification and use of learning resources from immediate environment (e.g. Natural pH Indicators, Soaps and Detergents, Baking Soda, Washing Soda, Common Salts, Fruits, Fiber, Pulleys, Projectiles, Lenses and Mirrors, Propagation of Waves in solid, liquid and gas, etc.); Using community resources-- bringing community to the class and taking class to the community; Pooling of learning resources in school complex/ block /district level.
2. Improvisation of apparatus, identifying some inexpensive sources of chemicals, Science kits.
3. Using laboratory as a learning resource, approaches to laboratory work, planning and organizing laboratory work, safety in laboratories, Physics laboratory, Chemistry laboratory, handling hurdles in utilization of resources.
4. Print and ICT resources -- Textbooks, Journal and Magazines; Dale's cone of experiences ; Different forms of ICT and its applications in science education-- audio-aids, video-aids, audio-video aids, educational T.V.; Use of computer for simulation, internet and open learning resources.
5. Factors affecting media selection ICT for inclusive education, skills to be developed in students for meaningful use of ICT.
6. Social networking sites and their use in Science education; Integrating ICT in teaching-learning process taking examples (e.g. Acid, Base, Salt, Dual Nature of Radiation, Radioactivity, etc.)

Unit : 5

Planning for teaching-learning of Physical Science & Professional Development .

1. Need of planning teaching-learning experiences; Identification and organization of concepts – basic principles and factors need to be considered for it; Basic elements of a Physical Science lesson with examples from Science/Physics/Chemistry.
2. Facilitating formation of groups; Planning and organizing activities in Physical Science, planning laboratory work and ICT application in learning Science/ Physics/ Chemistry.
3. Reflective planning; Unit plan; Developing lesson designs on different topics and through various approaches taking examples from Upper Primary, Secondary and Higher Secondary stage (Physical and Chemical Changes, Redox Reaction, Light, Magnetic Effect of Electric Current, etc.)
4. Professional development – Teaching as a profession, need for pre-service and in-service professional development programme, major shift in teacher education programme.

5. Various opportunities for in-service professional development –interaction with peer teachers, reading, attending training programme, membership of professional organisation, sharing through conferences, seminars and Journals, travel, cultivating science hobbies ,mentoring, teacher's exchange programme, acquiring higher qualification, collaborating with universities and other schools etc.

6. Role of reflective practices in professional development–questionnaires, research and portfolio.

PRACTICUM :-

1. Actual experience of Science/Physics/Chemistry laboratory of practicing school (report submission)

2. Planning and conducting experiments for Science/Physics/Chemistry

*Managing records

* Setting-up of apparatus

Storage of chemicals and apparatus

*Safety measures being taken in the laboratories and steps taken by the student-teacher

* Design of laboratory – structure and physical facilities

*Designing laboratory experiences for using in teaching-learning process in classroom situation – two innovative activities and two improvised apparatus (artifacts).

(3) Report of one Action Research carried out in the practicing school

(4) Report on measures being taken for inclusive teaching-learning and gender issues in practicing school and involvement of the student-teacher

(5) Presentation (s) used for teaching-learning in the class

(6) Report on a case study on identifying and addressing issue of alternative concepts in Physical science

(7) Critical review of a recently published research paper in Science/Physics/Chemistry Education Journal

(8) Critical review of a Textbook of Science/Physics/Chemistry.

PC-4 PEDAGOGY OF GENERAL SCIENCE

Marks :100
External :80
Internal :20

- Develop insight on the meaning and nature of General science for determining aims and strategies of teaching- learning.
- Appreciate that science is a dynamic and expanding body of knowledge.
- Appreciate the fact that every child possesses curiosity about his/her natural
- Identify and relate everyday experiences with learning of science.
- Appreciate various approaches of teaching- learning of science.
- Explore the process skill in science and role of laboratory in teaching- learning.
- Use effectively different activities / experiments/ demonstrations / laboratory experiences for teaching-learning of science.
- Integrate the science knowledge with other school subjects.
- Analyze the contents of science with respect to parts, branches, process skills, knowledge organization and other critical issues.
- Develop process-oriented objectives based on the content themes/units.
- Identify the concepts of science that are alternatively conceptualized by teachers and students in general.

Unit-I

Nature and Scope of General Science

Concept, Nature, Need & Importance of Science & Science Teaching.

Main discoveries and development of science (special reference to ancient India)

Science as a domain of enquiry, as a dynamic and expanding body of knowledge, science as a process of constructing knowledge. Science as interdisciplinary area of learning (Physics, chemistry, biology etc) science for environment, health, peace & equity, science and society., Fact, concept, principles, laws and theories-their characteristics in context of general science.

Unit-II

Teaching-learning of social science

Questioning; Collaborative strategies; games, simulations, dramatization, roleplays; Values clarification; problem-solving, Discussion, story-telling, project and decision-making, use of media and technology, concept mapping.

Methods: Interactive verbal learning; experiential learning through activities, experiments; Investigative field visits. Planning, organizing and conducting of small community survey.

Unit-III

Teaching-learning of General Science

Principles of science and its applications consistent with the stages of cognitive development of learners.

Pedagogical shift from science as fixed body of knowledge to constructing knowledge, scientific method – observation, enquiry, hypothesis, experimentation, data collection, generalization (teacher-educator will illustrate taking examples from different stage-specific content areas keeping in mind the variation, e.g. structure and function, molecular aspects, interaction between living and non-living, biodiversity, etc.): Communication in sciences. Questioning; Collaborative strategies; simulations, Demonstration, lab Method, Problem Solving, Heuristics Project Method, Inductive and deductive Method, Heuristic, use of media and technology, concept mapping Innovative methods of science teaching.

Unit-IV

ICT & Materials in Teaching-learning of General Science

Use of ICT: Video clips, Power points presentations, films etc.

Planning, preparation and presentation of Instructional Material.

Techniques: Using textbooks and atlas as a part of oral lessons, non-oral working lessons; using medium and large scale maps; using pictures, photographs, satellite imageries and aerial photographs; using audio-visual aids, CDs, multimedia and internet; case study approach.

Planning, Organization and activity of science club.

Unit-V

Teaching-learning Resources in General Science and Evaluation

People as resource: the significance of oral data.

Types of primary and secondary sources: data from field, textual materials, journals, magazines, newspapers, etc.

Using the library for secondary sources and reference material, such as dictionaries and encyclopedias.

Various teaching aids, Audio-visuals & online resources.

Meaning, concept and construction of Achievement test, diagnostic and remedial test.

Blue print: Meaning, concept, need and construction.

Open-book tests: Strengths and limitations

Continuous and Comprehensive Evaluation (CCE) in Sciences.

Characteristics of Assessment in Sciences

References:

Sharma, Dr.H.L. (1989), "School Science Education in India", Published by commonwealth Publishers 4378/4B, Ansari Road, Murari Lal Street New Delhi-110002

Sood, J.K. 1987, Teaching Life Sciences Kohli Publishers, Chandigarh.

Sharma, L.M. 1977, Teaching of Sciences & Life Sciences Dhanpat Rai & Sons, Delhi,

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PC-5 PEDAGOGY OF Chemistry

Marks :100
External :80
Internal :20

Objectives:

Upon completion of the course, the student teacher will be able to:

- 1) Understand the nature, scope and importance of Physical science with special reference to secondary school content.
- 2) Understand the aims and objectives of teaching Physical science.
- 3) State the specific behavioral changes under each objective.
- 4) Understand and make use of different approaches & methods of teaching Physical science.
- 5) Prepare objective based lesson plans and use them in their internship.
- 6) Understand and employ several teaching techniques helpful to develop scientific attitude and scientific method.
- 7) Plan, use and maintain the physical science laboratory systematically.
- 8) Understand the principles of text-book construction.
- 9) Understand the importance of appropriate instructional materials (hardwares and softwares) in teaching Physical science and use them by preparing/selecting them in their practice teaching.
- 10) Understand the importance of principles of curriculum construction in the organisation of Physical science contact.
- 11) Get mastery in Physical science content and imbibe the special qualities of Physical Science teacher.
- 12) Prepare and use different tools of evaluation to assess the achievements of students in Physical Science.
- 13) Develop professionally by attending lectures of professional interest, reading journals, and magazines and enroll as members of professional organisation.
- 14) Organise co-curricular activities in science i.e. seminars, field trips, exhibitionsdiscussions etc through the science club.
- 15) Apply the knowledge of physical science to develop scientific thinking and scientific out look.
- 16) Develop skills in analyzing the content in terms of concepts and in learning experiences.
- 17) Construct and administer unit test, conduct experiments improves teaching aids.

CONTENT

Unit 1

Meaning, Nature and Impact of Chemistry

Concept of science - Science as process and science as a product;

Nature and Scope of Science

Impact of Science and Technology on modern living.

Scientific Attitude - Meaning definition and importance.

Qualities of a person who possesses scientific attitude.

Scientific Method-Meaning, importance and steps involved (with an illustration).

Unit 2

Aims and Objectives of Teaching Physical Science

Aims of teaching Chemistry in Secondary school:

1 Personal development aim,

2 Learner's academic and process skills development aim,

3 Disciplinary aim and

4 Cultural aim.

Objectives of teaching Chemistry:

1 Bases for formulation of objectives

2 Objectives of teaching Chemistry at Secondary level; (To be Discussed keeping in view of the objectives of teaching Chemistry enunciated in the chemistry syllabi of secondary school of M.P.); Instructional objectives of teaching physical science and stating them in observable behavioral changes ; i) Knowledge ii) Understanding, iii) Application, iv) Skill, v) Attitude, vi) Interest, vii) Appreciation.

Unit 3

Approaches and Methods of Teaching Physical Science

Enquiry Approach -Meaning, Uses with Illustrations, Advantages and disadvantages.

Inductive Approach-Meaning, Uses with Illustrations, Advantages and disadvantages.

Deductive Approach-Meaning, Uses with Illustrations, Advantages and disadvantages.

Problem Solving Approach- Meaning, Uses with Illustrations, Steps, Advantages and disadvantages.

Demonstration Method- Meaning, uses, Advantages and disadvantages.

Lectures-Cum-Demonstration Method- Meaning, uses with Illustration, Advantages and disadvantages.

Laboratory Method- Meaning, uses with Illustration, Advantages and disadvantages.

Guided Discovery Method - Meaning, uses with Illustration, Advantages and disadvantages.

Biographical Method-Meaning, uses with Illustration, Advantages and disadvantages.

Individual Instruction Techniques and Active Learning Strategies.

Concept Mapping: Its use for summarizing a unit and evaluating students understanding

Unit 4

Instructional Design, Resources and Teaching Aid for teaching Physical Science:

Lesson Planning-Meaning, Steps, Importance and Format of Lesson Plan according to active learning strategies.

Unit Plan-Meaning, Steps, Importance and Format of Lesson Plan

Resource Unit-Meaning, Steps, Importance and Format of Lesson Plan Audio-Visual Aids (Preparation and Use)

i Charts;

ii Models;

iii OHP transparencies;

iv Filmstrips;

v slides;

vi Video tapes;

vii Films;

viii Educational C.D.'s

Mass Media –

i Television (T.V.);

ii Radio - Meaning and importance.

Community Resources and Self learning materials –

iii Meaning and importance.

Chemistry Laboratory-Planning, Equipments;

Importance, Safety measures & organizing of Laboratory;

Importance & organizing library; Choice of book for library.

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Helpstudentpoint.com

SIP 1- INTERNSHIP PROGRAMME (School Intership Phase-I)

School Internship is designed to lead to the development of broad repertoire of perspectives, professional capacities, teacher dispositions, sensibilities and skills. During the internship, a student-teacher shall work as a regular teacher and participate in all the school activities, including planning, teaching and assessment, interacting with school teachers, community members and children.

Objectives –

After completion of the Internship the student - teachers will be able to –

1. Develop the understanding of the school and its management.
2. Develop the ability to plan and manage the class-room teaching.
3. Develop the sensibility towards diverse needs of learners in school.
4. Develop ability to discharge various responsibilities expected from a teacher.
5. Organize and conduct the co- curricular activities.
6. Get acquainted with various school records maintained by the school.
7. Maintain records expected from a teacher.
8. Develop skills of conducting community contact programmes.
9. Get acquainted with the functioning of SMC.

Execution of the Internship Programme

The internship programme shall be divided into 2 years. In the first year, 4 weeks will be allotted.

This will include one week of school observation and three weeks of practice - teaching during which each student - teacher has to teach 2 periods per day (one period each for 2 pedagogy subjects). Besides teaching, the student - teacher has to complete his/her tasks and assignments related to the courses mentioned in the first year. The three weeks practice teaching will also include the delivery of criticism lessons (one in each pedagogy subject) and also observation of 5 lessons of peers of each of the two subjects. This practice of teaching programme is adopted so as to give a proper training of teaching skills and thorough guidance to the student-teachers by the subject lecturer.

Practice Teaching

S. No.	Activity	Marks
1.	Practice Teaching in both the pedagogy subjects in Schools (for three weeks) (At least 18 lessons in each subject)	50+50=100
2.	Peer Group Lesson Observation(ordinary+criticism-5 lesson in each round (5+5)	5+5=10
3.	Criticism Lessons (1-1 in both pedagogy subjects)	10+10=20
4.	Test (Blue print + question paper + Evaluation Key+Remedial Teaching)	10+10=20
	Total Marks	150

SAP – 2 - EXTERNAL ASSESSMENT

ONE FINAL LESSON OF PEDAGOGY OF A SCHOOL SUBJECT

[III YEAR]

- The weightage of final lesson will be 100 marks. Final lesson will be conducted at the end of first academic year i.e. after the completion of 1st phase of internship.
- During the final practical examination each candidate will have to teach one Lesson in any one of the two teaching subjects. However, he shall have to prepare lesson plan in both the teaching subjects and should be prepared to deliver lesson in both the subjects if required.
- The Board of examiners for external examination will consist of:
 - a.The Principle of the college concerned.
 - b.One senior member of the college.
 - c.Two external examiners appointed by the university.

Note: - The selection of the faculty member and two examiners be such that, as far as possible, Board of Examiners represent all the three faculties-Humanities, Languages and Science

	EXTERNAL EVALUATION[III Year]	
Course No.		Marks
SIP 2	Final Lesson OF First Pedgogy Subject (Final Practical Exam)	100
	Total Marks (III Year)	100