University of Rajasthan
Jaipur

SYLLABUS

B.Sc. (Hons.) PART-III

2016
B. Sc Honors PART III  

Paper IX: Basic Computer Physics and Applications

Unit- I

Algorithm development: Problem analysis, flow chart, decision tables; Examples of simple algorithms; Programme Design: Debugging syntax error, run-time error, logical error, programme verification and testing.

Data Representation: Representation of positive and negative numbers, fixed point representation, floating point representation. Arithmetic operations with normalized floating point numbers and its consequences, character representation, rounding off of numbers, absolute and relative errors, error detection and error correcting codes.

Unit- II

Programming Language C:

Numeric constants, declaring variable names, character data type; Arithmetic operators, hierarchy of operations, assignment statements, Input/output statements; Library functions, Elementary Programmes in C for numeric and string processing.

Conditional statements: relational operators; Arithmetic IF and Logical IF statements; Unconditional transfer: GO TO statement; Looping: DO loops, nested loops; Functions and subroutines; Subscripted variables: vectors and arrays; Writing and executing C programmes.

Programmes in C to (i) compute magnetic field due to a current carrying coil (ii) compute electric field due to a system of point charges (iii) study frequency response of an LCR circuit (iv); Evaluate Bessel’s function, Legendre function, Hermite Polynomial, Laguerre’s Polynomial by series expansion. Evaluation of simple functions by Taylor Series Expansion.

Unit- III

Iterative Methods: Solution of algebraic and transcendental equations using bisection method, method of false position, Newton-Raphson method; Complex zeros, zeros of polynomials; Simple applications related to Physics like programmes in C to evaluate zeros of simple functions.

Interpolation: Lagrange interpolation, Difference tables, truncation error in interpolation, Spline interpolation.
Unit- IV

Least Square Approximation: Linear regression, Polynomial regression, fitting exponential and trigonometric functions, approximation of functions by Taylor’ series and Chebyshev polynomials, curve fitting and polynomial fitting; Programmes in C related to physics on above topics.

Numerical Integration: Trapezoidal rule, Simpson’s rule, errors in integration formulae, Gaussian quadrature formulae. Programmes in C related to physics on above topics.

Unit- V

Numerical Solution of Ordinary differential equations: Taylor’s method, Euler’s method and Runge-Kutta methods; Programmes in C related to physics on above topics.

Numerical Solution of Partial Differential Equations

Finite Difference methods for solution of (i) The diffusion equation (ii) the wave equation and (iii) the Laplace equation; Programmes in C related to physics on above topics.

Reference Books:

2. Computer System Architecture, Morris-Mano (Prentice Hall of India)
3. Computer Oriented Numerical Methods, V. Rajaraman (Prentice Hall of India)
4. Mathematical Methods, Potter and Goldberg (Prentice Hall of India)
Syllabus: B.Sc. (Hons.) Part-III

Paper-X: Introductory Nuclear and Particle Physics

Note: Five questions are to be set taking one from each unit (each question will have an internal choice). Student will attempt all the five questions. 40% weightage will be given to problems and numericals.

Unit I: Basic Nuclear Characteristics

(i) Nuclear mass, nuclear size and nuclear matter—The mass table, binding energy of nucleons, nuclear size, semiempirical mass formula, Nuclear matter-characteristics, theory of binding energy and the pairing energy, Nuclear stability and abundance of nuclides. Spin and parity of nuclear states, magnetic dipole and electric quadrupole moments of nucleus (Qualitative discussion only).

(ii) General nature of force between nucleons, scattering of neutrons by protons at low energy, two nucleon system-the deuteron magnetic dipole and electric quadrupole moments, non-central forces, p-p and n-n scattering at low energy, charge independence of nuclear forces and concept of iso-spin invariance.

Unit II: Nuclear Models and Fission

(i) Empirical evidence for the regularity of nuclear properties—nuclear mass and binding energy, magic numbers. The single particle shell model-the average shell model potential. Multipole fields, the electromagnetic matrix elements, life time-energy relations, the Weisskopf formula of transition rate, nuclear isomerism, internal conversion, Zero-zero transitions.

(ii) Fission-Discovery of fission, Theory of fission, Energy release, criticality of a Reactor and four factor formula, types of fuels and types of reactors, Breeder Reactor, Neutron cycle in a thermal Nuclear Reactor.

Unit III: Nuclear Interaction

(i) Weak interactions: nuclear beta decay, the neutrino, electron capture experimental information, Fermi and Gamow Teller transitions, Fermi Theory, selection rules (non-relativistic case only). Mass of neutrino, parity violation.
The strong interaction: strength of strong interaction, nuclear and particle resonances i.e. introduction of resonance states in high energy particle interactions. Alpha decay and barrier penetration and related experimental information. Selection rules of strong interaction. Introduction of SU (3) symmetry.

Unit IV: Introduction of Particles and Conservation Laws


Discovery of pion and its characteristics, deltas, Stangeness and kaons etc, lambda and other hyperons. Introduction of charge conjugation, space parity and Gellman Nishijima Scheme. Patron, quark: model-quark and gluons, quark composition of baryons and mesons $\frac{1}{2}$Y particle, W and Z-particles and Higgs. Emphasis should be given on experimental discoveries and conservation laws while introducing the particles and resonances.

Unit V: Passage of radiation in matter

(i) The interaction of neutron and gamma-radiation with matter: related effects and Laws, passage of charged particles through matter, energy loss by collision, energy loss by radiative processes, absorption of electromagnetic radiation. Experimental Studies-Multipole coulomb scattering, range-energy curve straggling, capture and loss, stopping power for heavy ions, concept of radiation safety.

(ii) Nuclear techniques-Tandem, electrostatic generator Linear accelerators-drift tube accelerators, orbital accelerators-cyclotrons, the Synchro cyclotron, Bending and Focussing magnets-The magnetic spectrometer. Production of high energy neutrons.

Detectors-Ionization Chamber technique, G.M. Counter, scintillation detector, Emulsions, neutron detectors.

In general the scope of the syllabus is defined by Chapters 5, 6 and 7 for unit I and II Chapters 2, 3 and 4 for unit V and by Chapters 9, 10 and 11 for unit III and IV of the book entitled “Elements of Nuclear Physics” by W.E. Burcham published by Longman 1979.
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The related examples given at the end of aforesaid chapters of book by Burcham may be done as illustrative exercises for practice.

Further books suggested for reference:
1. Nuclear Physics, Irving Kaplan
2. Concepts of Nuclear Physics, B.L. Cohen
3. Introductory Nuclear Physics, Kenneth S. Krane
4. Introduction to Nuclear Physics; CMHI. Smith
5. Nuclear Physics, S.N. Ghoshal

Paper-XI: Physics of Materials

Note: Five questions are to be set taking one from each unit (each question will have an internal choice). Student will attempt all the five questions. 40% weightage will be given to problems and numericals.

Unit-I

Introduction: Materials Science and engineering, classification of engineering materials, levels of structure, structure-property relationships in materials.

Crystal Geometry and Structure Determination: Space lattices, Space lattices and crystal structures, Crystal directions and planes, Bragg’s law of X-ray diffraction, Powder method, structure determination, Extinction rules for cubic crystals.

Structure of Solids: Crystalline and non-crystalline states, Discussion of solidification and crystallization, glass transition.

Polymers: Classification of polymers, structure of long chain polymers, crystallinity of long chain polymers.

Unit-II

Chemical Bonding in Solids: Bond energy, bond type and bond length, Ionic bonding, Calculation of lattice energy of ionic crystals, Madelung constant, covalent bonding, Metallic bonding, Secondary bonding, Variation in bonding character and properties.

Phase Diagrams: Covalent solids, Metals and alloys, Ionic solids, Phase rule, Single component systems, Binary phase diagrams, Level rule.

Unit-III

Band Theory of Solids: Formation of bands (qualitative discussion), Electrons in a period field of a crystal (Krong-Penney Model), Brillouin zones, number of states in a band, Bloch Theorem and Bloch function,
Dispersion relation inside a band, band shapes, effective mass of an electron, Distinction between metals, insulators and intrinsic semiconductors.


Unit-IV

Electrical conductivity: Equilibrium state of electron gas in a conductor in the absence of electric field, electron drift in an electric field, relaxation time and mean free path, electrical conductivity of electron gas, Wiedmann-Franz law, Temperature dependence of electrical conductivity of pure metal. Hall effect and determination of density and mobility of charge carriers in semi conducting materials.


Qualitative discussion of pyroelectric and piezoelectricity.

Unit-V


Reference Books:
4. Introduction to Solid by L. Azaroff.

**Paper-XII : Atomic and Molecular Physics**

Note: Five questions are to be set taking one from each unit (each question will have an internal choice). Student will attempt all the five questions. 40% weightage will be given to problems and numericals.

**Unit-I : Monovalent and Divalent Atoms**

Background from quantum theory: The four quantum numbers; spectral terms arising from L-S coupling, s,p,d,f notation, Matrix elements of dipole moment selection rules, emission and absorption probabilities, Half life of excited states; width of a spectral line-natural, Doppler and others, Spectra of mono and divalent atoms; Doublet fine structure of hydrogen lines; screening constants for monovalent atoms, series limits, doublet structure of alkali spectrum, spectra of helium and alkaline earth atoms, singlet and triplet series, Isotope effect and deduction of m/M from hydrogen and deuterium spectra.

**Unit-II : Magnetic Field effects and x-ray spectroscopy**

Effect of magnetic field on energy levels: Gyromagnetic ratios for orbital and spin moments; vector model, J-J coupling, Lande g factor, strong and weak field effects, illustrative cases of H, Na, Ca, and Hg, X-ray spectra: The continuous X-ray spectrum; Daune and Hunt limit. Characteristic X-rays; Moseley's law, doublet fine structure, H-like character of X-ray energy states, X-ray absorption spectra, absorption edges. Qualitative discussion of near edge and extended fine structure; determination of atomic number of atoms.

**Unit-III : Diatomic Molecules**

Sharing of electrons, formation of molecular orbitals, qualitative discussion of H₂ ion, H₂ molecule, Electronic levels and quantum numbers for electronic states of diatomic molecules: singlet and triplet.

Unit-IV : Triatomic Molecules


Unit-V : Experimental Techniques

Emission spectroscopy: Emission sources, prism grating and crystal spectrographs, Prism material useful for UV, V and IR regions, constant deviation systems. Concave grating, different types of mountings, monochromators, resolution and dispersion in various spectrographs, high resolution spectroscopy, Febry-Perot and Lummer plate in high resolution.

Absorption spectroscopy: Continuous sources for absorption studies in X-ray, UV, V and IR region, single-beam and double-beam instruments, detection systems-photographic plate, photomultiplier tube, bolometer. Laser techniques: Laser imaging of objects, burnable lasers for high resolution-spectroscopy, pulsed lasers for time resolved spectroscopy.

Reference Books:
1. G. Herzberg; “Atomic Spectra and atomic structure”.
2. H. Kuhn; “Atomic Spectra”.
4. H. Herzberg; “Molecular Spectra and Molecular structure.”
6. R.C. Johnson; “Introduction to Molecular Spectra.”
7. White; “Atomic Spectra”.
8. B.K. Agrawal; “X-ray Spectroscopy.”
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List of Physics Practicals

Max. Marks: 100  Min. Pass Mark: 40

Duration: Two Practicals of five hours duration each spread over two days.

The students are expected to perform 15 experiment in academic session, the suggested list of experiments is given below. The institution may, however, set other experiments of the equivalent level and may communicate the same to the Convener. Board of Studies.

1. Determination of Planck constant by photo cell (retarding potential method using optical filter, preferably five filters).
2. Determination of Planck’s Constant using solar cell.
3. Determination of Stefan’s Constant (B-B method).
4. Study of Iodine spectrum with the help of grating and spectrometer and ordinary bulb light.
5. To find the magnetic susceptibility of a paramagnetic solution using Quincke’s method. Also find the ionic molecular susceptibility of the ion and magnetic moment of the ion in terms of Bohr magnetrons.
6. Study of polarization by reflection form a glass plate with the help of Nicol Prism, and photo cell and verification of Brewster’s Malu’s law.
7. e/m measurement by Helical method.
8. Measurement of electric change by Millikan’s oil drop method.
9. Study of the characteristic of a GM counter and verification of inverse square law for the same strength of radioactive source.
10. Study of random process and statistical distribution using GM counter.
12. Study of gamma ray spectra using scintillation spectra meter.
13. Study of Bremsstrahlung by electrons of 100 KeV to 2 MeV energy using scintillation spectrometer.
15. Study of excitation of characteristic X-rays by electron.
17. Study of parametric amplifier.
2. CHEMISTRY

Paper-IX : Inorganic Chemistry

<table>
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<th>Duration</th>
<th>Max. Marks</th>
<th>Min. Pass Marks</th>
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<td>Paper-IX</td>
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<td>75</td>
<td>120</td>
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<tr>
<td>Paper-X</td>
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<tr>
<td>Paper-XI</td>
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<td>Paper-XII</td>
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<td>Practicals</td>
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<td>40</td>
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Note: Each paper will contain ten questions having two questions from each unit. Candidates are required to attempt five questions in all selecting one question from each unit.

Unit-I

Metal-Ligand Bonding:

(a) Limitations of crystal field theory, molecular orbital theory of octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.

(b) Organometallic Compounds: Definition and classification of organometallic compounds, synthesis, properties and structures of organometallic compounds of magnesium, aluminium, tin and lead.

(c) Metal Carbonyls: Preparation, properties and bonding of transition metal carbonyls. Detailed study of mononuclear and polynuclear carbonyls.

Unit-II

Inorganic Polymers:

(a) Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones, phosphonitrilic halides and condensed phosphates.

(b) Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarbonates, metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

Unit-III

Nuclear Chemistry:

(a) Fundamental particles of nucleus (nucleon), concept of nuclides, representation of nuclides, isotopes, isobars and isotones with specific examples. Applications of radioisotopes, size concept in nucleus and atom. Qualitative idea of the stability of nucleus (n/p ratio).
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(b) Nuclear chemistry-II: Shell and liquid drop model, natural and artificial radioactivity, disintegration series, disintegration rates, half life, average life, nuclear binding energy, mass defects, Einstein's mass energy relations, artificial transmutation, nuclear reactions, spallations, nuclear fission and fusion, nuclear reactors, Hazards of radioactive emanations.

Unit-IV

Bioinorganic Chemistry:

(a) Role of bulk and trace metal ions in biological systems with special reference to Na, K, Mg, Ca, Fe, Cu and Zn.

(b) Metalloporphyrins: Chlorophylls and their role in photosynthesis. Hemoglobin and Myoglobin and their role as oxygen carriers.

Unit-V

(a) Nitrogen fixation: Mechanism, nitrogenase enzyme, dinitrogen complexes as models for nitrogen fixation.

(b) Metalloenzymes: General discussion of enzymes, functions of metal ions, inhibition (explanation based on coordination chemistry), carboxypeptidase-A and cytochrome-C.

Reference Books:

1. Manfred Bochmann, Organometallics 1: Complexes with transition Metal-Carbon σ bonds; (Oxford Chemistry Primers).
3. R.C. Mehrotra and A. Singh, Organometallic Chemistry.
5. J.E. Huneey, Inorganic Chemistry.
8. R. Sarkar and Nityanand Saha, General and Inorganic Chemistry (Hon. Consulting Editor).
15. Dr. A.C. Deb, Fundamentals of Biochemistry.
18. Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern, Biochemistry (2nd Edn.).
Heterocyclic Compounds: Nomenclature, Five and Six
membered heterocyclic compounds, Aromatic Character, preparation,
reactions, chemical reactivity, orientation (Electrophilic and nucleophilic
substitution reaction) basicity of pyrrole, furan, thiophene and pyridine.
Condensed five and six membered heterocycles, structure, preparation
and reactions of indole, quinoline and isoquinoline.

Polynuclear Compounds: Structure of naphthalene, mechanism
and orientation of electrophilic substitution in naphthalene, preparation
and properties of naphthalene and anthracene, some important
derivatives of naphthalene like naphthols and naphthylamines.
Preparation and reaction of diphenyl, diphenylmethane and
triphenylmethane.

Unit-II

Synthetic Dyes: Color and constitution (electronic concept).
Classification of dyes. Chemistry and synthesis of Methyl orange,
Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein,
Alizarin and Indigo.

Drugs: Chemotherapy, Synthetic uses and side effect of:
Analgesics: Aspirin, Phenacetin, Paracetamol.
Antimalarials: Chloroquine, Plasmoquine.
Antibiotics: Chloramphenicol (Chloromycetin).
Sulpha drugs and their mechanism of action. Synthesis of
sulphadiazine, sulphapyridine, sulphathiazole, sulphaguanidine and
sulphamethazole.

Polymers and polymerization: Addition and condensation
polymerization, their mechanism, copolymerization, coordination
polymerization, Ziegler-Natta catalyst, plastics, thermoplastic and
thermosetting resins, plasticizers, polystyrene, PVC, polyacrylates,
polyacrylonitrile, dacron, terylene, nylon-66, bakelite, melamine and
polyurethanes. Elementary idea of the stereochemistry of polymers.
Synthetic and natural rubber.

Unit-III

Amino Acids, Peptides and Proteins: Classification, structure
and stereochemistry of amino acids, Physical properties; zwitter ion
structure, isoelectric point and electrophoresis. Preparation and reaction
of $\alpha$-amino acids.

Structure and nomenclature of peptides and proteins. Classification
of proteins, peptide structure determination, end group analysis,
selective hydrolysis of peptides. Classical peptide synthesis, solid-
phase peptide synthesis. Structure of peptides and proteins. Levels of
protein structure. Protein denaturation/renaturation.
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Nucleic acids: Introduction, constituents of nucleic acids (RNA and DNA). Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Unit-IV

Carbohydrates: Introduction, classification, constitution and reaction of glucose and fructose, mutarotation and its mechanism, cyclic structure, pyranose and furanose forms, Haworth projection formulae, configuration of monosaccharides, determination of ring size, conformational analysis of monosaccharides, Epimerization, chain lengthening and chain shortening in aldoses. Interconversion of aldoses and ketoses.

Disaccharides: Structure determinations of maltose, lactose and sucrose.

Polysaccharides: Structure of starch and cellulose.

Organometallic Compounds: Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions.

Organotin compounds: Formation and chemical reactions.

Organolithium compounds: Formation and chemical reactions.

Unit-V

Mass Spectroscopy: Introduction, instrumentation, factors affecting fragmentation, ion analysis, ion abundance, fragmentation modes, mass spectral fragmentation of simple organic compounds—alkanes, primary alcohols, aliphatic ketones, aldehydes and carboxylic acids, Types of peak: molecular ion peak, isotopic peak, base peak, metastable peak, doubly charged ion, Mc Lafferty rearrangement, retro Diels-Alder fragmentation, Nitrogen rule.

Organosulphur compounds: Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides.

Reference Books:

3. Jonathan Clayden, Nick Greeves, Stuart Warren and Peter Wothers; Organic Chemistry; First Edition; Oxford University Press, USA.
6. William Kemp; Application of Spectroscopy; Third Edition; Palgrave Publisher Ltd., New York.

**Paper XI : Physical Chemistry**
**Unit-I : Quantum Mechanics**

Schrodinger’s wave equation for particle in three dimensional box, H-atom, quantum no. and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

M.O. 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 $\sigma$, $\sigma^*$ and $\pi$, $\pi^*$ 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$_2$, comparison of M.O. and V.B. model.

**Unit-II**

(a) **Photochemistry**

Introduction of radiation with matter, difference between thermal and photochemical processes, Laws of photochemistry: Grothus—Dropper law, Stark—Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of the fluorescence, phosphorescence, non radioactive processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions—energy transfer processes (simple example).

(b) **Physical properties and molecular structure**

Optical activity, polarization (Clausius Mossotti equation), orientation of dipole in the electric field, dipole moment, induced dipole moment, measurement of dipole moment temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties—paramagnetism, diamagnetism and ferromagnetism.

**Unit-III**

**Electrochemistry**

Types of reversible electrodes: Gas-metal ion, metal-metal ion, metal insoluble salt anion, and redox electrodes. Electrode reactions, Nernst’s equation, derivation of cell E.M.F. and single electrode potential, Standard hydrogen electrode, reference electrode, standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells—Reversible and irreversible cells, conventional representation of electrochemical cells. E.M.F. of cell and its measurements, computation of cell e.m.f. Calculation of
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thermodynamic quantities of cell reaction (ΔG, ΔH and k), Polarization, Overpotential and Over Voltage. Structure of double layer, theories by Helmholtz, Guoy-Champman and Stern. Concentration cells with and without transport, Liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Introduction of Polarographic technique.

Classification of electrochemical cells, Requirement of power source, Lead storage cell and fuel cell.

Corrosion—Types, Theories and methods of combating it.

Unit-IV

(a) Macromolecules :
Linear, Branches, network and homopolymer.
Polymer Classification—Condensation polymers and addition polymers number average and weight average, molecular weight determination methods of polymers by (I) Osmotic pressure (II) Viscosity (III) Light scattering. Properties of macromolecules.

(b) Chemical kinetics :

Unit-V

Phase Equilibrium :
Solid solutions : Compound formation with congruent M.Pt. (Mg-Zn) and Benzophenone—dimethylanime incongruent M.Pt NaCl-H₂O, Picric acid and Benzene, FeCl₃-H₂O and CuSO₄-H₂O system.

Liquid-Liquid Mixtures : Ideal liquid mixtures, Rault’s law and Henry’s law, non ideal system, AzeotropesHCl—H₂O and Ethanol-Water system.


Immiscible liquids—Steam distillation.

Surface Phenomena, Micelles : Surface active agents, classification of surface active agents, micellization, hydrophilic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization. Phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

Adsorption : Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro kinetic
phenomenon), catalytic activity at surfaces; Electrode/electrolyte interface.

References:
1. Glasston, Physical chemistry.

Paper XII: Analytical Chemistry

Unit-I

(a) Electrogravimetry: Theory, electrode reactions, overpotential, completeness of deposition, electrolytic separation of metals, character of the deposit, electrolytic separation of metals with controlled cathode potential. Electrolytic determinations at constant current—Copper and Lead. Electrolytic determinations with controlled cathode potential—Antimony, copper, lead and tin in an alloy.

(b) Coulometry: Coulometry at controlled potential, separation of Ni and Co by coulometric analysis at controlled potential, coulometry at constant current, coulometry titrations.

Unit-II

(a) Polarography: Principle and experimental set-up. Diffusion current and Half-wave potential—Qualitative and quantitative applications of polarography in analytical chemistry.
   (i) Wave height concentration graph.
   (ii) Internal standard (piloton method)
   (iii) Standard addition method.
   Use of polarography in: (i) Zn and Cu in brass
   (ii) Dissolved oxygen in sample.

(b) Amperometry: Amperometric titrations, technique of amperometric titrations with the dropping mercury electrode, titration with the rotating platinum micro electrode, biampirometric titrations.

(c) Modified Voltammetric methods: Current sampled (TAST) Polarography, Pulse polarography, Differential pulse polarography, Cyclic Voltammetry, Sinusoidal Alternating current polarography, Stripping Voltammetry.

Unit-III

(a) Mass spectrometry: Instrumentation and technique, Elementary idea about electron impact, chemical ionization and matrix
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assisted laser desorption ionization (MALDI), mass spectrometer techniques. Principle of Fragmentation, Molecular ion peak, base peak, isotopic peaks and metastable ion peak. Determination of molecular formula, mass spectra of alkanes, alkenes, alkynes, cycloalkanes and arenes, alcohols and ethers, aldehydes and ketones.


Unit-IV

Diffraction Pattern: Fundamental principles, instrumentation, use of x-ray, electron and neutron in diffractometry and applications of x-ray, electron and neutron diffractometry in biological and as analytical techniques. Applications of x-rays in C.T. scan.

Unit-V

(a) Automated Methods of analysis: Automatic instruments and automation. Automation of sampling and preliminary sample treatment for air, water and soil, continuous flow method, Discrete methods, Automatic Anlaysis based on Multilayer Films.

(b) NMR Spectroscopy: Theory of nuclear magnetic resonance, experimental methods of NMR spectroscopy, applications of proton NMR including applications in MRI technique.

Reference Books:
2. A.I. Vogel, Analytical Chemistry.
5. I.M. Kolthop, Analytical Chemistry.

Chemistry Practical

Inorganic Chemistry

1. Qualitative Analysis of mixture containing six radicals one of which should be a rare ion. The mixture may contain radicals of any combination including interfering acid radicals and insolubles.
2. Quantitative estimation of any three of the following mixture by volumetric and gravimetric methods.
   (a) Copper-Zinc
   (b) Zinc-Nickel
   (c) Silver-Copper
3. Inorganic Preparations (any four) & its characterisation of coordination compounds:
   (a) Bis(dimethylglyximato)nickel (II) complex.
   (b) Tetraaminecopper (II) sulphate.
   (c) Cis-Potassiumaquodioxalatochromate (III) complex.
   (d) Hexaamminenickel (II) chloride.
   (e) Prussian blue.
   (f) Chloropentaamminecobalt (III) chloride.
   (g) Carbonatotetraamminecobalt (III) nitrate.

4. Analysis of (any three) of the following:
   (a) Available chlorine in bleaching powder.
   (b) Water analysis for total hardness.
   (c) Analysis of two components.
   (d) Analysis of cement for Ca, Al or Mg.
   (e) MnO₂ in pyrolusite.

**Organic Chemistry Practicals**

1. Quantitative Estimations
   (a) Determination of neutralization equivalent of an organic acid.
   (b) Determination of Saponification value of an ester/oil.
   (c) Estimation of glucose by titration with Fehling’s solution/Benedic solution.

2. Qualitative analysis
   Analysis of an organic mixture containing two solid components using water, NaHCO₃ and NaOH for separation and preparation of suitable derivatives.

3. Two step preparation of simple compounds; the students are expected to perform at least three of the following preparations.
   (a) Preparation of p-aminobenzene from aniline.
   (b) Preparation of p-nitroaniline from acetanilide.
   (c) Preparation of syn-tribromobenzene from aniline.
   (d) Preparation of m-nitroaniline from nitrobenzene.
   (e) Preparation of acetanilide from acetophenone (Beckmann rearrangement).
   (f) Preparation of anthranilic acid from phthalic anhydride.
   (g) Preparation of eosin from phthalic anhydride.

**B.Sc. (Hons.) Part III Practicals**

Physical Chemistry:

**Section (A):** Potentiometry (Multimeters may also be used)
1. To find out the strength of acid by titrating it against alkali.
2. Determination of dissociation constants of weak acids.
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3. Determination of no. of electrons involved in a cell reaction by setting up a concentration cell.
4. Determination of transport number of anion by e.m.f. measurements.

Section (B) : pH metric titrations:
1. To find out the strength of strong acid by titrating it against strong base.
2. To find out the strength of strong acid by titrating it against weak base.
3. To find out the strength of weak acid by titrating it against strong base.
4. Find out the strength of HCl and CH₃COOH in a mixture of both by titrating it against NaOH.

Section (C) : Spectrophotometer experiment or Colourimetric experiment
(a) Verify Lambert Beers law & determine the concentration of the given aqueous solution of unknown concentration of salt.

Kinetics:
1. Determine the effect of ionic strength on the rate of persulphate iodide reaction.
3. Determination the conc. Of given solution of H₂SO₄ acid by measuring heat changes during dilution.
4. Compare cleansing power of two samples of detergents by surface tension measurement.

Instructions to the Examiners
Max. Marks : 100
Duration : 10 hrs.
(Completed in two day)

Distribution of Marks in Chemistry Practical
1. Qualitative analysis of Inorganic Mixture for SIX radicals Ox Inorganic Preparation
2. Quantitative estimations (gravimetric & volumetric)
3. Separation & identification of TWO compounds in a mixture or organic two stage preparation
4. Quantitative estimations
5. Physical
   (a) Major Ex.
   (b) Minor Ex.
6. Record
7. Viva

Asstt. Registrar (Acad.-I)
University of Rajasthan
Jaipur
3. ZOOLOGY (HONS.)

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<td>Paper-XIII Ecology</td>
<td>3 hrs.</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Paper-XIV Environmental Biology</td>
<td>3 hrs.</td>
<td>50</td>
<td>120</td>
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<tr>
<td>Paper-XV Developmental Biology</td>
<td>3 hrs.</td>
<td>50</td>
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<tr>
<td>Paper-XVI Evolution</td>
<td>3 hrs.</td>
<td>50</td>
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</tr>
<tr>
<td>Paper-XVII Applied Zoology-1</td>
<td>3 hrs.</td>
<td>50</td>
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<tr>
<td>Paper-XVIII Applied Zoology-2</td>
<td>3 hrs.</td>
<td>50</td>
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<tr>
<td>Practicals</td>
<td>100</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

**Paper-XIII : Ecology**

**Section-A**

1. Aim and Scope of Ecology.
3. Ecosystem : Abiotic and biotic factors.

**Section-B**


**Section-C**

9. Ecological Succession : Types and patterns, concept of climax, Details of xerosere and hydrosere successions.
Syllabus: B.Sc. (Hons.) Part-III


Section-D


Paper-XIV: Environmental Biology

Section-A


2. Natural resources: Present status and future needs.

3. Management of natural resources: Renewable (Forests, Wildlife, Water) and non-renewable (Water, Soil, Minerals and Energy)

Section-B

4. Environmental pollution I: General outline and various types of pollutants. A detailed account of pollution of water, air and soil.

5. Environment pollution II: Sources and remedies for thermal, noise, radiation, industrial chemicals, agrochemicals, insecticides and pesticides and household pollutants.

Section-C


7. Radiation and Environment: Types of radiation, fall out, effects of radiation nuclear accident.

8. Basic concepts of bioaccumulation, biomagnification and biodegradation of pollutants.

Section-D


Paper-XV : Developmental Biology

Section-A
1. Gametogenesis : spermatogenesis and oogenesis, vitellogenesis, egg membranes.
2. Fertilization - sperm-egg interactions, biochemical events, post fertilization events.
3. Parthenogenesis.

Section-B
4. Types of animal eggs, patterns of cleavage, fate maps, germ layers, gastrulation and cell lineage.
5. Extra embryonic membranes, types and physiology of placenta.
6. Organizer concept, induction process.

Section-C
7. Organogenesis of heart, kidney nervous system and sense organs.
9. Regeneration in invertebrates and vertebrates.

Section-D
10. Various types of stem cells and their applications (with special reference to embryonic stem cells)
11. Cloning of animals.
   (i) Nuclear Embryonic Transfer Techniques
   (ii) Nuclear Transfer Techniques
   (iii) Embryonic or Therapeutic cloning.
12. Teratological effects of xenobiotics.

Paper-XVI : Evolution

Section-A
1. Concept of evolution.
3. Origin of prokaryotic and eukaryotic cells.

Section-B
5. Concept of species and speciation.

Section-C
7. Adaptations mimicry.
Syllabus : B.Sc. (Hons.) Part-III


Section-D

10. Zoogeography – Principles and concepts of parallelism, endemism etc., factors influencing animal distribution.


Section-A

1. The scope and history of microbiology.
2. Major characteristics of microorganisms.
3. Microbial classification, nomenclature and identification.

Section-B

4. Bacteria: Morphology, fine structure, cultivation, reproduction and growth, pure culture and characteristics.
5. Bacterial nucleic acids.

Section-C

6. The world of Bacteria.
   6.1 Ordinary Gram negative bacteria.
   6.2 Ordinary Gram positive bacteria.
   6.3 Bacteria with unusual properties.
   6.4 Gram positive filamentous bacteria.

7. Microorganisms: General characteristics of fungi (molds and yeast) algae, protozoa, viruses.

8. Medical Zoology : Brief introduction to pathogenic microbes, viruses, rickettsia, spirochetes and bacteria.

Section-D

   9.1 Entamoeba
   9.2 Trypanosoma
   9.3 Leishmania
   9.4 Plasmodium
   9.5 Wucheria and
   9.6 Dracunculus

10. Arthropods as vectors of Human diseases
    Malaria, Dengue, Filaria, Japanese encephalitis and Plague.
1. Bacteria and genetic engineering (outline idea only): benefits of genetic engineering potential hazards and regulations of genetic engineering.

2. Enzymology of genetic engineering: Restriction enzymes, DNA ligase and polymerase.


4. Analysis and expression of cloned gene in host cells: Restriction enzyme analysis, Southern blotting, Northern blotting. In-situ hybridization, PCR (polymerase chain reaction), DNA fingerprinting.

Section-B

5. Protoplast fusion in prokaryotes and eukaryotes.
6. Recombinant DNA technology and its application.
8. Introduction of cloned genes into the host cells: Transformation, transduction.

Section-C

9. Transgenic animals and their uses.
10. Brief account of cloning: Genomic research, its advantages and disadvantages.

Section-D

12. Environmental biotechnology (outline idea only): Metal and petroleum recovery, pest control, waste-water treatment.

List of Recommended Books:

Syllabus : B.Sc. (Hons.) Part-III

12. De Robertis and DeRobertis : Cell and Molecular Biology (Saunders College)
15. Farnsworth : Genetics (Harper and Row)
17. Glick : Molecular Biotechnology.
18. Grant : Biology of Developmental System.
32. Roitt, L : Essential Immunology (ELBS).
33. Savage : Evolution (Holt, Reimhart and Winston.)
34. Strickberger : Genetics (MacMillan).
35. Stryer, L et al. : Biochemistry (Freeman).
39. Wilson, E.B.: Cell in Development and inheritance (Macmillan)

**PRACTICAL ZOOLOGY**
B.Sc. Hons Part III
Ecology and Environmental Biology

**Analysis of Environmental Components**

(i) Soil pH

(ii) Water analysis – pH, alkalinity, acidity, dissolved O₂ and free CO₂, Salinity (Chlorides)

(iii) Study of phyto and zoo-planktons in a given water sample.

(iv) Quantitative estimation of zoo-planktons in given water sample.

(v) Simple methods to measure population density.

(vi) Field study of any one of the following habitats; freshwater; lake/pond, river, desert.

**Developmental Biology**

Study of Frog/toad development with the help of:

(i) Preserved material available: egg, cleavage, blastula, gastrula, neurula, tail bud, mature tadpole larva, metamorphic stages, froglet/toadlet.

(ii) Histological slides: cleavage, blastula, gastrula, neurula, tail bud.

(iii) Study of living tadpole larva and its metamorphosis study.

**Study of Chick Development**

(i) Whole mounts : 18 hrs, 21 hrs, 24 hrs, 33 hrs, 48 hrs, 72 hrs and 96 hrs of incubation.

(ii) If possible primitive streak stage in living embryos after removal of the blastoderm from the egg may be demonstrated.

(iii) Study of the embryo at various stages of incubation in vivo by making a window in the egg shell may also be demonstrated.
Syllabus: B.Sc. (Hons.) Part-III

(iv) Study of various foetal envelopes in a 10-12 day old chick embryos (amnion, chorion, allantois and yolk sac)

Evolution:
Simple Neumericals based on population genetics.

Applied Zoology XVII
1. Preparation and use of culture media for microbes.
2. Study of microbes in food material (like curd etc.)
3. Preparation of Bacterial slides:
   (i) Ordinary Gram-positive bacteria
   (ii) Ordinary Gram-Negative bacteria
   (iii) Gram-positive filamentous bacteria.
4. Study of Microscopic slides:
   (i) Entamoeba
   (ii) Trypanosoma
   (iii) Leishmania
   (iv) Plasmodium
   (v) Wuchereria
   (vi) Dracunculus

Applied Zoology XVIII
(i) DNA finger printing.
(ii) Genomic DNA isolation from Eukaryotic cells.
(iii) Agarose gel electrophoresis of DNA
(iv) Small scale preparation of Plasmid DNA
(v) Restriction digestion of genomic and Plasmid DNA.

ZOLOGY PRACTICALS

Scheme of Examination:
Max. Marks: 100
Min. Pass Mark: 40
Total Duration: 8 hours (In two days, hr. each day)

Distribution of Marks:
1. Exercise in ecology and environmental biology 10
2. Developmental biology 10
3. Evolution 6
4. Applied Zoology-I (Microbiology) 10
5. Applied Zoology-II 10
6. Identification and comment upon spots (1 to 8) 24
7. Viva-voce 10
8. Class-record 10
9. Seminar/project report 10
Total 100
4. BOTANY (HONS.)

<table>
<thead>
<tr>
<th>Papers</th>
<th>Duration</th>
<th>Max. Marks</th>
<th>Min. Pass Marks</th>
</tr>
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<tbody>
<tr>
<td>Paper-IX Biochemistry and Molecular Biology</td>
<td>3 hrs.</td>
<td>75</td>
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<tr>
<td>Paper-X Systematics of Angiosperms</td>
<td></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Paper-XI Biotechnology</td>
<td>3 hrs.</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Paper-XII Seed Science</td>
<td>3 hrs.</td>
<td>75</td>
<td></td>
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<tr>
<td>Practical 2 days (50 marks each)</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Practical-I Paper IX, X</td>
<td></td>
<td></td>
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<tr>
<td>Practical-II Paper XI, XII</td>
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</tbody>
</table>

Scheme of Examination
Common for all Papers

Time: 3 hrs

Max. Marks: 75

1. Two types of question papers for each theory paper will be applicable to total duration of 3 hours. One question paper will comprise the objective type of questions and other will be of descriptive long answer type question.

2. Descriptive type of question paper (to be given during the first two hours of the examination) will have 6 questions out of which a student is supposed to attempt any 3. This portion of the paper will carry maximum 45 marks.

3. The objective type question paper will be given after 2 hours of descriptive type paper and will have 35 questions of the objective types. This portion of the paper will carry 30 marks. The objective types of questions will be of the following types:
   - Multiples choice types questions-20 of 1/2 marks each.
   - Fill in the blanks/true or false type question 10 of 1/2 marks each.
   - Very short answer types questions-5 of 1 mark each.

Paper-IX: Biochemistry and Molecular Biology

Unit-I

Nucleic Acids: Compositions of nucleic acids and synthesis
Syllabus: B.Sc. (Hons.) Part-III


Amino acid and protein metabolism: Structure, characteristics and classification of amino acids; protein and non-protein amino acids; amino acid biosynthesis; GS/GOGA cycle; Transamination: peptide bond and polypeptide chain; primary, secondary, tertiary and quaternary structure of proteins; protein biosynthesis, and its regulation; post-translational Modification of proteins; protein targeting; protein degradation.

Unit-II

Carbohydrate metabolism: Classification; structure of some representative examples of monosaccharides, disaccharides, polysaccharides; stereoisomers, enantiomers and epimer; biosynthesis and degradation of sucrose and starch.

Lipid metabolism: Saturated and unsaturated fatty acids: fatty acid biosynthesis; oxidation of fatty acids; storage and mobilization of fatty acids lipids.

Unit-III

Gene structure, expression and regulation: Gene organization in prokaryotes and eukaryotes; operon concept; gene regulation in prokaryotes and eukaryotes; inducible, repressible, positive and negative gene regulation; interrupted genes in eukaryotes; RNA splicing; mRNA stability.

Recombinant DNA technology: Restriction endonucleases prokaryotic and eukaryotic cloning vectors; genomic and cDNA libraries; Southern and northern analysis; various techniques of gene mapping and DNA fingerprinting (RFLP, RAPD, AFLP); chromosome walking, polymerase chain reaction; DNA sequencing.

Suggested Readings


Suggested Laboratory Exercises
1. Chemical tests to demonstrate the presence of starch, sugar, fat and protein in plant material.
2. To identify the amino acids in a mixture by resolving through paper chromatography or TLC.
3. To prepare the standard curve for protein and determine the protein content in unknown samples by Biuret method.
6. Isolation of plant genomic DNA and its pooling.
8. Preparation of tissue culture media, sterilization and inoculation of plant material.
9. Demonstration of techniques of invitro culture of various explants.
10. Isolation of plant protoplasts (e.g. tobacco, Petunia) using enzymes available commercially and estimation of their yield.

Note: In the practical classes emphasis should be given on basic principles of spectrophotometry, chromatography, electrophoresis and rDNA technology and related fundamentals.

Suggested Readings (for laboratory exercises)
Syllabus: B.Sc. (Hons.) Part-III


Paper-X: Systematics of Angiosperms and Environmental Biology

Unit-I

Introduction: Aims and components of systematics; introduction to identification, nomenclature, phylogeny and classification.

Systematics in practice: Importance of herbarium specimens and their preparation; role of herbaria and botanical gardens; documentation (floras, monographs, manuals, journals, abstracts, indices and dictionaries); keys for identification of plants—single access and multiaccess; value of computers and databases for identification.

Taxonomic hierarchy: Taxonomic category; taxonomic groups; concepts of species, genus and family.

Botanical nomenclature: Principles and rules; ranks and names; type method; principle of priority and its limitations; names hybrids and cultivars; concept of biocode.

Phylogeny of angiosperms: A general account of the origin and evolution of angiosperms (special reference to Bennettitalean Gnetalean, Caytonialean and herbaceous origin theories); primitive
living angiosperms; co-evolution of angiosperms and animals. Systems of classification: Bentham and Hooker's system, Engler and Prantl's system, and Takhtajan's system.

Unit-II

Modern taxonomy: Supporting evidences/inputs for taxonomy; taxonomy in relation to anatomy, embryology, palynology, ecology, cytology (cytotaxonomy), secondary metabolites in plants (chemotaxonomy).

Numerical taxonomy: Concepts, characters and attributes; OTU's; coding; cluster analysis: cladistics.

Environmental Biology

Introduction: Inter-relationships between the living world and the environment; the components and dynamism; homeostasis; relevance to man.

Earth as a system: The biosphere, the hydrosphere, the atmosphere and the lithosphere; components within biosphere, (biomes); parameters delimiting individual biomes.

The environment: Soil-general account and adaptations; the living world-biotic component of environment; types of biotic interactions; fire as an ecological factor.

Organismal ecology/biotic components: Individuals species, populations, communities and their characteristics.

Ecosystems: Concepts of ecosystem; homeostasis; structure of ecosystem; functions of ecosystem; transfer of energy and minerals via grazing and detritus chains and role of microorganisms; cycles (hydrologic, gaseous); role of humans in maintaining biogeochemical cycles.

Diversity of ecosystem: Aquatic (fresh water); terrestrial (forest/grassland); man-made ecosystems.

Unit-III

Phytogeography: Introduction; endemism, static and dynamic plant geography; a short account of vegetation of India.

Human ecology and ecological management: The human population; renewable and non renewable natural resources and their management; conservation of biodiversity; endangered species; conventional and non-conventional energy sources.
Syllabus: B.Sc. (Hons.) Part-III

Impact of human activities: Pollution of air, water and soil; a brief account of environmental toxicology; incidence of noise; thermal and radioactive pollution; prevention and control of pollution; global warming, desertification and ozone depletion. Role of national and international organizations in environmental management; formulation of optimal models.

Bio-indicators.

Environmental impact assessment: A brief account.

Suggested Readings

**Angiosperm Systematics**


**Environmental Biology**


Chapman, J. Land Reiss, M.J. 1995. Ecology : Principles and
Applications. Cambridge University Press.

Cunningham, W.P. and Saign, S.W. 1977. Environmental Science : A
Global Concern. WCB, McGraw Hill.

Publishing Co. Ltd., New Delhi.

Cubenmire, R.F. 1974. Plants and Environment A Text Book of

Kendeigh, S.C. 1980. Ecology with Special Reference to Animals and

Publishing House Pvt. Ltd., Delhi.

Ltd., Delhi.

Pvt. Ltd., New Delhi.

Ltd., New Delhi.

Dehradun.

Environmental Issues (~edition). Butter and Tanner Ltd., Great
Britain.

Collins College Publishers, USA.

An Imprint of Addison Wesley, Longman Ink., California.


Publishing Co. Ltd., Bombay.
Syllabus: B.Sc. (Hons.) Part-III

Systematics of Angiosperms

1. Description of the locally available species of the following families & genera.
2. Ranunculaceae: *Ranunculus, Delphinium.*
3. Brassicaceae: *Brassica, Alyssum, Iberis, Coronopus*
4. Capparidaceae: *Capparis, Cleome*
5. Caryophyllaceae: *Dianthus, Stellaria, Spergula.*
6. Rutaceae: *Citrus, Murraya.*
7. Tiliaceae: *Corchorus, Grewia.*
8. Fabaceae: *Faboidae: Lathyrus, Clitoria, Melilotus, Cajanus; Caesalpinioideae: Cassia, Caesalpinia; Mimosoideae: Prosopis, Mimosa, Acacia.*
11. Apiaceae: *Coriandrum, Anethum.*
12. Rubiaceae: *Hamelia, Mussaenda.*
15. Asclepiadaceae: *Calotropis, Asclepias.*
17. Acanthaceae: *Adhatoda, Peristrophe.*
18. Lamiaceae: *Ocimum, Salvia.*
19. Chenopodiaceae: *Chenopodium, Beta.*
22. Cannaceae: *Canna.*
23. Liliaceae: *Asphodelus, Asparagus.*

Environmental Biology

1. Mechanical analysis of soils by sieve method.
2. Determination of soil porosity and density (sand and pit method)
3. Determination of water holding capacity and field capacity of soil.
4. Determination of permeability (capillarity and percolation) of different types of soils.
5. Titrimetric estimation of total carbonates of soil samples.
6. Quantitative determination of soil organic matter by Walklay and Black’s rapid titration method.
7. Determination of species area curve by minimal quadrat size.
8. Analysis of the herbaceous vegetation for frequency, density and abundance.
9. Study the height spectrum of herbaceous vegetation by line transect method.
11. Estimation of biomass of aerial parts of herbaceous plants (fresh weight and dry weight).
12. Analysis of different water samples for pH, oxygen, carbon-dioxide (titrimetric estimation), turbidity and temperature.
13. Demonstration of desert and aquatic ecosystems with the help of models.
14. Field visit: students should be taken for field visits to places of ecological/environmental interest. They should submit detailed report of the visit in the form of project report in the final practical examination for evaluation. The report shall carry marks.

Suggested Readings (for Environmental Biology laboratory exercises)


Syllabus : B.Sc. (Hons.) Part-III


Note to Teachers:

The students are to be familiarized with the families listed above in the practical classes with representative species or any other that may be available locally. However, questions pertaining to these may be asked in the theory examinations.

The teachers should prevent the students from collecting plants and submitting them for the practical examinations. Instead, the students should be asked to prepare field reports.

Paper-XI : Biotechnology

Unit-I

1. Introduction, historical developments, scope, terminology and perspectives.

2. Genetic manipulation through tissue culture techniques, concept of differentiation, dedifferentiation, re-differentiation, Media: composition, preparation, sterilization, Callus growth patterns, organogenesis and plant regeneration. Cell culture techniques, screening of cell lines, selection for nutritional quality, disease resistance, salt and drought tolerance; anther culture and production of haploids, uses of haploids.

Unit-II

3. Gene manipulation through protoplast culture: isolation of protoplasts, fusion of isolated protoplast, culture of protoplasts, somatic hybrid; direct DNA uptake by protoplast, Agrobacterium-mediated gene transfer and electroporation.

Unit-III

4. Recombinant DNA technology: isolation and purification of DNA from plant cells, DNA sequencing, gene isolation, cutting and joining DNA molecules, restriction endonucleases, ligases; cloning vehicles; plasmids and bacteriophages; cloning strategies-enzymatic synthesis of genes, selection of vehicle/vector,
attachment to the vehicle, transfer of recombinant DNA to the host, expression of the transferred plant genes in bacteria; genomic DNA libraries.

5. Application of biotechnology in agriculture and medicine.

Practicals
1. Callus induction, organogenesis and plant regeneration (Tobacco, Petunia or any other suitable material).
2. Protoplast isolation, fusion.
3. Isolation, purification of DNA from plant material.

Paper-XII Seed Science

Unit-I

Introduction: Importance and History of Seed Technology, Development of seed testing in India.

Seed Testing Procedures: Aim, Sampling, types of samples, sampling equipment, method of testing physical purity, genetic purity (seedling and plant stages), moisture content, (oven method, moisture meter); Germination-3, STTC text, embryo excise methods; blotter methods, roll towel; sand or pot; seeding evaluation.

Morphology and anatomy of Seed: Development and structure in dicotyledons and monocotyledons (Leguminosae, Poaceae), exomonomorphic feature, gross internal morphology, seed coat anatomy (basic types in contest’s classification).

Unit-II

Seed Storage: Principles and methods of safe seed storage, types of storage structures, deterioration in storage and its control.

Physiology of Seed: Dormancy—Significance, types and release of dormancy: Longevity—Life span of seed, factors affecting longevity.

Unit-III

Seed Health: Kinds of seed borne inoculum; location of seed borne inoculum; effects of the inoculum. Methods of seed health testing (Dry seed examination, washing test, blotter method, Hilner’s methods).

Seed Certification: Concept, minimum certification standards, general and crop standards, Field inspection ISTA certificates.

The seeds Act of India, National Seeds Corporation, State seed corporation, Central Seed Testing Laboratory.

Practicals: Based on theory syllabus.
# Syllabus: B.Sc. (Hons.) Part-III

## MATHEMATICS
B.A./B.Sc. (Hons) Part III – 2010

Teaching: 3 Hours per Week per Theory Paper.

<table>
<thead>
<tr>
<th>Examination</th>
<th>Min. Pass Marks</th>
<th>Max. Marks 400</th>
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<tbody>
<tr>
<td>Science 160</td>
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<tr>
<td>Paper – IX Algebra</td>
<td>3 hrs.</td>
<td>100</td>
</tr>
<tr>
<td>Paper – X Complex Analysis</td>
<td>3 hrs.</td>
<td>100</td>
</tr>
<tr>
<td>Paper – XI Dynamics and Computer Programming inc</td>
<td>Theory: 2½ hrs.</td>
<td>68</td>
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<tr>
<td></td>
<td>Practical: 2 hrs.</td>
<td>32</td>
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Paper – XII Any one of the following

1. Statistics
2. Spherical Triangometry and Astronomy
3. Integral Equations and Calculus of Variations
4. Calculus of Several Variables

Duration | Max. Marks
---------|-----------
3 hrs.   | 100       
3 hrs.   | 100       
3 hrs.   | 100       
3 hrs.   | 100       

**Note:**

1. Papers IX, X and XII will be divided into FIVE Units. Two questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

2. Paper XI is divided into FOUR Units. TWO questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking ONE question from each Unit. All questions carry equal marks.

3. Common paper will be set for both the Faculties of Social Science and Science. However, the marks obtained by the candidate in the case of Faculty of Social Science will be converted according to the ratio of the Maximum marks of the papers in the two Faculties.

4. Each candidate is required to appear in the Practical examination to be conducted by internal and external examiners. External examiner will be appointed by the
University and internal examiner will be appointed by the Principal in consultation with Local Head/Head, Department of Mathematics in the college.

5. An Internal/external examiner can conduct practical Examination not more than 100 (Hundred) candidates (20 Candidates in one batch).

6. Each Candidate has to pass in Theory and Practical examinations separately.

Paper – IX : Algebra
Teaching : 3 Hours per Week
Duration of Examination : 3 Hours Max. Marks : 100
Note : This Paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1 : Definition and simple properties of Groups and Subgroups. Permutation group, Cyclic group. Cosets, Lagrange’s theorem on the order of subgroups of a finite order group.

Unit 2 : Mophism of groups, Cayley’s theorem. Normal subgroups and Quotient groups. Fundamental theorems of Isomorphism.


Paper – X : Complex Analysis
Teaching : 3 Hours per Week
Duration of Examination : 3 Hours Max. Marks : 100
Note : This paper is divided into FIVE Units. TWO questions will be
Syllabus : B.Sc. (Hons.) Part-III

set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.


Unit 2: Complex integration, Complex line integrals, Cauchy integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions. Cauchy integral formula, Analyticity of the derivative of an analytic function, Morera’s theorem, Poisson integral formula, Liouville’ theorem.

Unit 3: Taylor’s theorem. Laurent’s theorem. Maximum modulus theorem.

Power series – Absolute convergence, Abel’s theorem, Cauchy-Hadamard theorem, Circle and Radius of convergence, Analyticity of the sum function of a power series.

Unit 4: Singularities of an analytic function, Branch point, Meromorphic and Entire functions, Riemann’s theorem, Casorati-Weierstrass theorem.


Unit 5: Conformal mapping, Bilinear transformation and its properties.

Elementary mappings : \( w(z) = \frac{1}{2} \left( z + \frac{1}{z} \right), \) \( z^2, \) \( e^z, \) \( \sin z, \) \( \cos z, \) \( \log z. \)


Paper – XI : Dynamics and Computer Programming in C
Teaching : 3 Hours per Week
Duration of Examination : 2½ Hours
Max. Marks : 68
Note : This paper is divided into FOUR Units. TWO questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking ONE question from each Unit. All questions carry equal marks.
Unit 1: Velocity and acceleration – along radial and transverse directions, along tangential and normal directions. S.H.M., Hooke’s law, motion along horizontal and vertical elastic strings.

Unit 2: Motion in resisting medium – Resistance varies as velocity and square of velocity. Work and Energy. Motion on a smooth curve in a vertical plane. Motion on the inside and outside of a smooth vertical circle.


Unit 4: Programming languages and problem solving on computers, Algorithm, Flow chart, Programming in C-Constants, Variables, Arithmetic and logical expressions, Input-Output, Conditional statements, Implementing loops in Programs, Defining and manipulating arrays and functions.

Practical:
Teaching: 2 Hours per Week per Batch
(20 Candidates in each Batch)

Examination:
Duration: 2 Hours

Scheme
Max. Marks = 32
Min. Pass Marks = 13

Distribution of Marks:
Two Practicals of
10 Marks each = 20 Marks
Practical Record = 06 Marks
Viva-voce = 06 Marks
Total Marks = 32 Marks

The paper will contain TWO practicals. The candidates are required to attempt both practicals.

Programming in C and execution for the result of
1. Solution of linear algebraic equations by Gauss elimination method
2. Solution of algebraic and transcendental equations by Bisection, False position and Newton – Raphson Methods
3. Solution of ordinary differential equations by Euler’s and Runge-Kutta 4th order method
4. Numerical integration by Trapeszoidal and Simpson’s one third rule

Note:
1. Each Candidate (Regular/non-Collegiate) has to prepare his/her practical record.
2. Each Candidate has to pass in Practical and Theory examinations separately.

Paper – XII : Any One of the Following:
Paper – XII (I) : Statistics
Teaching : 3 Hours per Week

Duration of Examination : 3 Hours
Max. Marks : 100

Note: This paper is divided into FIVE Units. TWO questions will be set from each Unit. The candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1 : Frequency distributions and measures of location, Measures of dispersion, Skewness and Kurtosis, Moments off frequency distributions.

Unit 2 : Mathematical expectation, Moment generating and Cumulative functions. Discrete probability distributions (Binomial, poisson, Geometric and Hypergeometric).

Unit 3 : Continuous probability distributions (Rectangular and Normal distributions).

Unit 4 : Methods of least squares and curve fitting. Correlation and Regression, Multiple and partial correlation.

Unit 5 : Theory of probability.

Paper – XII (II) : Spherical Trigonometry and Astronomy
Teaching : 3 Hours per Week

Duration of Examination : 3 Hours
Max. Marks: 100

Note: This paper is divided into FIVE Units. TWO questions will be set from each Unit. The candidates are required to attempt FIVE question in all taking ONE question from each Unit. All questions carry equal marks.
Unit 1: Spherical triangles. Relation between sides and angles. Right angled triangles.
Unit 2: Celestial sphere. Astronomical coordinate system, Diurnal motion, Twilight.
Unit 3: Atmospheric Refraction. Time.
Unit 4: Precession and Mutation.
Unit 5: Aberration Parallax and Eclipses.

Paper – XII (III) : Integral equations and Calculus of Variations
Teaching : 3 Hours per Week
Max. Marks : 100

Note: This paper is divided into FIVE Unit. TWO question will be set from each Unit. The candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1: Linear Integral Equations - Definition and classification, Conversion of initial and boundary value problems to an integral equation, Eigen values and Eigen functions and their properties for symmetric kernels. Solution of homogeneous and general Fredholm integral equations of second kind with degenerate kernels.


Unit 5: Variational problems in parametric form. The moving boundary value problem for a function of the form \( \int_{x_1}^{x_2} f(z,y,z) \, dx \). Euler's finite difference method. Ritz method for variational problem.

Paper-XII (IV): Calculus of Several Variables
Teaching: 3 Hours per Week
Duration of Examination: 3 Hours
Max. Marks: 100

Note: This paper is divided into FIVE Units. TWO questions will be set from each Unit. The candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1: Normed vector space, Distance, Inner product. Open and Closed sets. Compactness, Connectedness. Sequence and series. Continuous functions.

Unit 2: Calculus in vector space - Functions on n-space, Space of continuous functions, Differentiability and the chain rule, Properties of derivative. Partial derivatives, Jacobian, Differentiation under integral sign.


6. GEOGRAPHY (HONS.)

Minimum Marks : 160 (40%)  Maximum Marks : 400

<table>
<thead>
<tr>
<th>Four Papers</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper-IX India : A Systematic Geography</td>
<td>80</td>
</tr>
<tr>
<td>Paper-X Evolution of Geographical Thought</td>
<td>80</td>
</tr>
<tr>
<td>Paper-XI Agricultural Geography : An Introductory Course</td>
<td>160</td>
</tr>
<tr>
<td>Paper-XII Aplied Geography</td>
<td>80</td>
</tr>
<tr>
<td>Practical</td>
<td>80</td>
</tr>
</tbody>
</table>

Notes:

1. Students are permitted to use stencils, simple calculator and Log tables wherever needed in the examinations.

2. One question (Question No. 1) of 20% marks of the total. Question No. 1 will be compulsory and will cover the entire course contents of the paper. Question be set in two Parts:
   (a) Question on Map (to be supplied) of 10% marks.
   (b) Question on objective type (Multiple choice and very short answer) of 10% marks.

3. Nine questions will be set with three questions from each section.

4. The Candidate will attempt five questions selecting at least one from each section.

5. The students are required to pass both in theory and practical separately.

6. The theory paper will be of 3 hours duration.

Paper-IX : India : A Systematic Geography

Section A

India in the context of Asia and the world.

Systematic Geography:

Land—Major terrain units of India and their characteristics. Drainage systems and their functional significance to the country. The Indian monsoon-regional and seasonal variations in climate and climatic
Syllabus: B.Sc. (Hons.) Part-III

Division: soil types, their characteristics and distribution and the problems of soil conservation, vegetation-cover-vegetation types and their distribution. Forest resources and their conservation.

Mineral and power resources—reserves, production and problems of conservation, Resource regions of India.

Section B

People—Numbers, distribution density and growth, with special reference to the post-independence period. Socio-economic implications of explosive growth of population literacy and education-spatial patterns, urbanisation—its relation with economy and ecology.

Economy—Changing nature, Indian economy and overview.

Agriculture—Main characteristics and problems of Indian agriculture, spatial aspects of irrigation developments, technological developments in Indian agriculture, green revolution and its spatial dimension, regionalisation of agriculture in India, food production and population growth.

Section C

Industry—Industrial development and the Indian economy—an overview. Locational factors and spatial pattern of major industries in India—iron and steel, engineering goods, textiles, chemicals, cement, sugar, paper etc. industrial regions of India.

Transport and Trade—Development of transport network, different modes and their functional significance. Internal and international trade-composition and change (both in spatial and temporal terms).

Recommended Books:

   and Stationary Co., New Delhi, 1960.
8. Sdasyuk, G. and Sengupta—Economic Regionalisation of India,
   Census of India Publication, New Delhi, 1968.
9. Sharma, T.R.—Location of Industries in India. Hind Kitab,
   Bombay, 1949.
    International Geographical Congress held New Delhi. 1968.
12. Spate, O.H.K. and Learmonth, A.T.A.—India and Pakistan,
15. Wadia, Mehar and Wadia, D.N.—Minerals of India, National
    Book Trust, New Delhi, 1966.

Paper-X : Evolution of Geographical Thought

Section A

The nature of Geography is the early classical period with
reference to the works of Horodotus, Eratosthenes, Strabo and
Ptolemy. Early Medieval Geography.

Section B

The Revival of Geography from the 16th to the early 19th century.
The Works of Varenius, Humboldt and Ritter.
The Nature of Geographical Thought in the second half of 19th
century.
The dualism in Geography.

Section C

The Works of Pesche1 and W.M. Davis, Ratzel, Semple Richtnosen,
Syllabus: B.Sc. (Hons.) Part-III

Hetter, Herbertson and Saur. Concepts of Areal differentiation and Region.

Natural Regions and Geographical Regions, Concept of Ecology.

Recommended Books:


Paper-XI: Agricultural Geography

An Introductory Course

Section A

Nature, Scope and significance of Agricultural Geography.
Approaches to the study of Agricultural Geography-commodity, environmental, systematic and regional.
Determinants of agricultural Land use—Physical, Social, Economic and cultural.

Section B

Whittlesey’s agricultural types-there characteristics and distribution in the world.
A critical review of Whittlesey’s agricultural classification.

Section C

Indian Agriculture—(a) Problems and prospects, (b) regions.

Recommended Books:


Reference Books:


Paper-XII Applied Geography

Section A

Nature, scope and content of applied geography; identification of problems of interdisciplinary nature (like environment resource base, resource-use, development and disparity).

Issues related to variations in physical environment. Variations
Syllabus : B.Sc. (Hons.) Part-III

land quality affecting agricultural productivity; environmental degradation, environmental disaster and environmental management.

Section B

Issues related to human resource-quality vs numbers; social and demographic issues; diversity and disparity; carrying capacity of the earth; human resources use and manpower planning.

Issues related to economy; spatial organization of economic activities (like agriculture, industry, transport, trade, etc.) spatial inequalities-causes and consequences.

Section C

Environment and sustainable development with a focus on man environment relationship. Review of policies related to planning formulated for local, regional and national level with special reference of india.

Recommended Books :


Practicals: Map Projection & Surveying

General Principles, classification, indentification, transformation and choice of projections.

Construction, Properties, limitations and uses of the following projection:

Cylindrical: Simple, Equal Area and Mercator's

Conical: One standard, Two standard Boone's, Polyconic and international.

Zenithal: Gnomonic, Stereographic Orthographic, Equidistant and Equal Area (Polar Cases only).

Conventional: Sinusoidal and Mollweide's (normal Cases only).

Dumpy level: Survey and Contouring.

Recommended Books:


Reference Books:


PSYCHOLOGY (HONS.)

<table>
<thead>
<tr>
<th>Papers</th>
<th>Duration</th>
<th>Max. Marks</th>
<th>Min. Pass Marks</th>
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</thead>
<tbody>
<tr>
<td>Paper-IX</td>
<td>3 hrs.</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Paper-X</td>
<td>3 hrs.</td>
<td>75</td>
<td>120</td>
</tr>
<tr>
<td>Paper-XI</td>
<td>3 hrs.</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Paper-XII</td>
<td>3 hrs.</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Practicals</td>
<td></td>
<td>100</td>
<td>40</td>
</tr>
</tbody>
</table>

Note: There will be 4 theory papers in subject Psychology in BA Hons Part III. There will be common papers for Arts and Science. Question No. 1 will be compulsory and will cover the entire course contents of the paper. Question I will contain two parts A & B. A part of I questions will contain 20 questions of multiple choice. Each question will be of 3/4 mark. Thus A part will be of 15 marks. B part will contain 10 questions to be answered in the limit of 20 words. Each question of B part will be of 1 1/2 marks. Thus B part will be of 15 marks. Separate question paper for this objective type will be provided to each student and answers will be given in this question paper only in the space provided for this purpose in the objective type question paper. Candidates will be given one hour to attempt this first compulsory question out of three hours in total time allotted for this paper.

In the second part of the question paper, three questions of essay type will be attempted selecting at least one from each section. Each question will be of 15 marks. This objective type question will be compulsory to attempt in all four theory papers.
B.A./ B.Sc. Honours Part-III

Paper-I: Psychometrics

Section-A

1. The need of psychological measurement and testing, the origin of psychological measurement and testing.
2. Scaling: Kinds of scales, their characteristics and uses of scaling in psychological problems.

Section-B

5. Problems of Testing Construction: Drafting and compilation of test items. Item analysis. Establishing the characteristic of a good test i.e. reliability, validity and need for cross validation.

Section-C

8. Tests of Interest and Aptitude: Interest test (educational and vocational), Attitude tests, Aptitude tests, Academic tests (achievement tests), Testing in progressions.


Reference Books:


Paper-II: Applied Psychology

Section-A


3. Organization psychology: Leadership and supervision, participated management, job design, organizational structure and climate, communication.

Section-B

5. Human factors in Equipment design


Section-C


8. Counselling psychology: Nature of guidance and counselling, uses of psychological tests in guidance and counselling, career planning and development, occupational information.


Reference Books:

2. Schien-Organizational Psychology, New Delhi, Prentice-Hall, 1967
5. Poffenberger-Principles of Applied Psychology

Paper-III: Personality and Motivation

Section-A

2. **Personality assessment**: Observational Methods, rating scales, interview, different personality inventories, MMPI, 16 PF, EPI, projective techniques: Rorschach and TAT.

3. **Type and Trait Approach**

**Section-B**

4. **Psychoanalytic theory of personality**

5. **S-R theory of personality**

6. **Factor theories of personality**: Cattell and Eysenck.

**Section-C**

7. **Motivational phenomena and goal direction**: Classification, purpose and direction in motivational activities. Human performance and Motivational variables.


**Reference Books:**


2. Mischel, W.-Theories and Assessment of Personality


4. Atkinson-Personality, Motivation and Achievement.


Paper-IV: Environmental Psychology

Section-A

1. Nature and Scope of Environmental Psychology: Methodological approaches to environmental psychology.
3. Attitude toward Environment: Formation and change.

Section-A

5. Environmental Stress: Pollution and Behaviour.
6. Personal Space and Territoriality: Definition, functions & determinants.

Section-A

9. Save the Environment: Changing behaviour to save the environment.

Reference Books:

2. Baum, A sunger J.E. and Valins, S.- Advances in Environmental Psychology Vol. 4.
Practicals

1. Assessment of Attitude
2. Assessment of Interests
3. MPI
4. Population Density and Mental Stress
5. Need Achievement
6. Vocational Attitude Maturity
7. HSPQ
8. Work Attitude
9. TAT
10. Picture Frustration Study
11. Raven’s SPM
12. WAIS