University of Rajasthan
Jaipur

SYLLABUS

B.Sc. Part-III

Examination - 2019

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(Academic)
University of Rajasthan
JAIPUR

SCHEME OF EXAMINATION

B.Sc. (Pass Course) Part-III

The number of paper's and the maximum marks for each paper together with the minimum marks required for a pass are shown against each subject separately. It will be necessary for a candidate to pass in the theory part as well as the practical part of a subject/paper, wherever prescribed, separately. Classification of successful candidates shall be as follows:

First Division	60%	of the aggregate marks prescribed at (a) Part First Examination excluding those obatined in the compulsory subject, (b) Part Second Examination, (c) Part Third Examination taken together
Second Division	48%	

All the rest will be declared to have passed the examination, if they obtain a minimum pass mark in each subject *viz.* 36%. No division shall be awarded at the Part First and Part Second Examinations.

CONTENTS

1. PHYSICS

Scheme			
Paper I	Exam: 3 hours duration	Min Pass marks: 12	Max. Marks : 33
Paper II	Exam: 3 hours duration	Min Pass marks: 12	Max. Marks : 33
Paper III	Exam: 3 hours duration	Min Pass marks: 12	Max. Marks : 34
Practical	Exam: 4 hours duration	Min Pass marks: 18	Max. Marks : 50

Paper I: Quantum Mechanics and Spectroscopy

Work Load: Two hours Lecture per week

Scheme of Examination: First question will be of nine marks comprising of six short answer type parts each with answer not exceeding half a page. Remaining four questions will be set with one question from each of the unit and will be of six marks each. Second to fifth question will have two parts namely (A) and (B) each carrying three marks. Part (A) of second to fifth question shall be compulsory and Part (B) of these questions will have internal choice.

Unit – I : Evolution of quantum physics

1. Difficulties of classical mechanics to explain: the black-body emission spectrum, specific heat of solids. Plank quanta concept and radiation law, Photo electric effect and Einstein's explanations. Compton effect, De-Broglie hypothesis, diffraction and interference experiments of particle (Davisson-Germer experiment).

2. Uncertainty principle: position and momentum, angle and angular momentum, energy and time. Application of uncertainty principle: (i) Ground state energy of hydrogen atom, (ii) ground state energy of simple harmonic oscillator, (iii) Natural width of spectral lines, (iv) Non-existence of electron in nucleus.

3. Operators: linear operators, product of two operators, commuting and non-commuting operators, simultaneous eigen functions and eigen values, orthogonal wavefunctions. Hermitian operators, their eigenvalues. Hermitian adjoint operators.

eigenvalues and eigenfunctions; expectation values of operators: position, momentum, energy; Ehrenfest theorem and complementarity, Concept of group and phase velocity, wave packet, Gaussian wave packet, bra-ket notation.

Unit – II : Schrödinger wave equation and its solutions

1. Schrödinger wave equation: general equation of wave propagation, propagation of matter waves, time dependent and time-independent Schrödinger equation, wavefunction representation (ψ), physical meaning of ψ, properties and conditions on ψ, postulates of wave mechanics, operators, observable and measurements; probability current density.

2. Time independent Schrödinger equation, stationary state solution, one dimensional problem: particle in one dimensional box, eigenfunctions and eigenvalues, discrete energy levels, generalization into three dimension and degeneracy of energy levels, concept of a potential well and barrier, step potential, penetration through rectangular barrier, reflection and transmission coefficients, barriers with special shapes (graphical representation), quantum mechanical tunneling (alpha decay).

Unit – III : Schrödinger equation solutions in special cases

1. Symmetric square well potential, reflection and transmission coefficients, resonant scattering; Bound state problems: particle in one dimensional infinite potential well and finite depth potential well, energy eigenvalues and eigenfunctions, transcendental equation and its solution; Simple harmonic oscillator. Schrödinger equation for simple harmonic oscillator and its solution, eigenfunction, eigenvalues, zero point energy, quantum and classical probability density, parity, symmetric and antisymmetric wave functions with graphical representation.

2. Schrödinger equation in spherical coordinates, Schrödinger equation for one electron atom in spherical coordinates, separation into radial and angular variables, solution of radial equation and angular equation, qualitative discussion of spherical harmonics, series solution and energy eigenvalues, stationary state wavefunction. Wave-functions of H-atom for ground and first

excited states, average radius of H-atom, Bohr correspondence principle, orbital angular momentum and its quantization, commutation relation, eigenvalues and eigenfunctions.

UNIT IV: H-atom, Atomic and Molecular spectroscopy

1. Energy level derivation for H-atom, quantum features of hydrogen spectra and hydrogen like spectra, Stern-Gerlach experiment, electron spin, spin magnetic

moment, spin-orbit coupling, qualitative explanation of fine structure, Franck–Hertz experiment, Zeeman effect, normal Zeeman splitting, Qualitative understanding about Stark effect.

2. Absorption and emission spectroscopy, its block diagram, brief explanation about function of each elements and it's limitations; single beam spectrophotometer.

3. Molecular spectroscopy: concept of rigid rotator, rotational energy levels, rotational spectra, selection rules, intensity of spectral lines, isotopic effect; Vibrational energy levels, vibrational spectra, selection rules, isotopic effect, effect of anharmonicity in vibrational spectra, vibrational–rotational spectra of CO and HCl molecules.

Reference books

1. David J. Griffiths, Introduction to Quantum Mechanics, 2nd edition.
2. R. Shankar, Principles of Quantum Mechanics, 2nd edition.
3. Arthur Beiser, Perspective of modern Physics, 6th edition.
4. AK Ghatak and S Lokanathan, Quantum Mechanics: Theory and application.
5. HS Mani, GK Mehta, Introduction to modern Physics.
6. C.N. Banwell and E.M. McCash, Fundamental of Molecular Spectroscopy, 4th edition.
7. H.E. White, Intoduction to atomic physics,

Paper II: Nuclear and Particle Physics

Work Load: Two hours Lecture per week

Scheme of Examination: First question will be of nine marks comprising of six short answer type parts each with answer not exceeding half a page. Remaining four questions will be set with one question from each of the unit and will be of six marks each. Second to fifth question will have two parts namely (A) and (B) each carrying three marks. Part (A) of second to fifth question shall be compulsory and Part (B) of these questions will have internal choice.

UNIT - I

Properties of Nucleus : Discovery of Nucleus, Ruttherford Scattering. Constituents of the Nucleus, Mass, Charge, Size, Nuclear Density, Charge Distribution, Hofstadter's experiment.

Nuclear Angular momentum, Nuclear Magnetic Dipole Moment, Electric Quadrupole Moment, Spin. . Isospin, Wave Mechanical Properties: Parity and Statistics, Classification of Nuclei. Mass Defect and Binding Energy, Packing Fraction, Mass Spectrograph.

Nuclear Forces: Properties of Nuclear Forces, Yukawa Meson Theory, Nuclear Potential.

Nuclear Models: Segre Chart, Liquid Drop Model, Semi Empirical Mass Formula, Condition of Stability, Fermi Gas Model, Evidence for Nuclear Shell Structure, Nuclear Magic Numbers and Basic Assumptions of the Shell Model.

UNIT - 2

Radioactive Decays: Alpha Decay-Basics of α-Decay Processes, Theory of β-Emission Spectrum, Gammow Factor, Geiger Nuttal Law, Range of Alpha Particles,

Beta Decay- Energy Kinematics for β-Decay, β-Decay Spectrum, Positron Emission, Electron Capture, Pauli's Neutrino Hypothesis.

Gamma Decay- Gamma Ray Emission and Kinematics, Internal Conversion

Applications of Radioactivity

Nuclear Fission and Fusion: Nuclear Fission, Spontaneous Fission and Potential Barrier, its Explanation by Liquid Drop Model, Chain reaction, Controlled chain reaction, Four Factor Formula, Nuclear Reactors, Classification of Nuclear Reactor, Uncontrolled Chain Reaction, Nuclear Fusion, Energy released in Nuclear Fusion, Fusion in stars.

Nuclear Reactions: Types of Reactions, Conservation Laws, Kinematics of Reactions, Q-Value, Threshold Energy, Reaction Rate, Reaction Cross-Section.

UNIT - 3

Interaction of Nuclear Radiation with Matter: Energy Loss by Heavy Charged Particles in Matter , Interaction of Electrons with Matter, Range of Charged Particle, Bremsstrahlung, Cherenkov Radiation, Gamma Ray Interaction With Matter.

Radiation Detectors: Gas filled detector, Avalanche, Geiger Discharge, Ionization Chamber, Proportional Counter, Geiger Muller Counter, Current mode and Pulse Mode Operation of Detector.

Particle Accelerators: Ion source, Van-de-Graff Accelerator (Tandem Accelerator), Linear Accelerator, Cyclotron, Synchrocyclotron, Betatron, Proton Synchrotron

UNIT - 4

Elementary Particles: Necessity of high energy to discover elementary constituents, historical introduction to discovery of elementary particles (electron, positron, neutrinos,

strange mesons, charm quark, intermediate vector bosons, bottom quark, top quark and Higgs boson) Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.), elementary particles included in the standard model.

Fundamental Interactions : Four types of fundamental forces. Symmetries and Conservation Laws, Diescrete symmetries C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction, CP violation.

Quark Model : Flavor symmetries, Gellmann-Nishijima formula, the eightfold way, Quark model, Octet Diagram for Mesons and Baryons, Concept of Quark model, the November Revolution, Baryon Decuplet, Color Quantum Number and Gluons.

Suggested Books:

1. Nuclear and Particle Physics, W. E. Burcham and M Jobes, Addison Wesley Longman Inc.
2. Nuclear and Particle Physics, Brian R Martin, John Wiley & Sons.
3. Introduction to Nuclear and Particle Physics, Das and Ferbal, World Scientific.
4. Elements of Nuclear Physics, Walter E. Meyerhof, McGraw-Hill Book Company.
5. Introductory Nuclear Physics, Kenneth S. Krane, John Wiley & Sons.
6. Introduction to Elementary Particles, David J. Griffiths, John Wiley & Sons.
7. Radiation Detection and Measurement, G.F. Knoll (John Wiley & Sons)
8. Introduction to Nuclear and Particle Physics, V. K. Mittal, R. C. Verma, S. C. Gupta, PHI
9. Concepts of Modern Physics, A. Beiser, McGraw-Hill Book Company.

Paper III: Solid State Physics

Workload: Two hours Lecture per week

Scheme of Examination: First question will be of ten marks comprising of five short answer type parts each with answer not exceeding half a page. Remaining four questions will be set with one question from each of the unit and will be of six marks each. Second to fifth question will have two parts namely (A) and (B) each carrying three marks. Part (A) of second to fifth question shall be compulsory and Part (B) of these questions will have internal choice.

Unit I

Bonding in Solids and Crystal structure:

Force between atoms, Ionic bonds, Covalent and metallic bonds, Vander waal's and Hydrogen bonding. Periodicity in lattices, Basis, lattice point and space lattice, Translation vectors, Unit and primitive cell, Crystal systems, Packing fractions for Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC) and Hexagonal lattice structures, Bravais space lattices.

Crystallography and Diffraction:

Direction, planes and miller indices in a crystal lattice, Reciprocal lattice and its significance, Conversion of SC and FCC structures in reciprocal lattice frame, Concept of crystalline, polycrystalline and amorphous materials, X-ray diffraction by solids: Laue and Braggs equation, Study of crystals by X-rays: FWHM, Sherrer formula and Lattice Constants (for simple cubic structure), Electron and Neutron diffraction (qualitative).

Unit II

Band theory of solids:

Formation of bands, Periodic potential and Bloch Theorem, Number of states in the bands, Kroning Penny model, Brilliuon zones, Crystal momentum and physical origin of effective mass, Negative Effective Mass and Holes, Energy dispersion relations: weak and tight binding.

Semiconductors:

Energy band Structures in Insulators, Conductors, Semiconductors, Concept of Direct and Indirect band gap in semiconductors, Generation and recombination of charge carriers, Mobility of current carriers, Hall Effect in semiconductors: Hall coefficient, Mobility, Charge carrier concentration, Conductivity and Hall angle.

Unit III

Thermal properties of Materials:

Elastic waves, Phonon, Phonon dispersion relations in monoatomic and diatomic linear lattice, Lattice heat capacity, Classical theory of specific heat, Dulong-Petit's law, Einstein and Debye's theory of specific heat of solids and limitations of these models, concept of Thermoelectric Power.

Electrical properties of Materials:

:de-Lorentz theory, Sommerfeld's Model, Thermal conductivity, Electrical conductivity, Widemann-Franz relation, Thermionic Emission, Escape of electrons from metals, Hall Effect in Metals, Density of states.

Unit IV

Magnetic properties of Materials:

Classification of Magnetic Materials. Origin of Atomic Magnetism, Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum theory of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism. Concept of Domain Wall, Magnetostriction, Heisenberg's Exchange Interaction, Relation between Exchange Integral and Weiss Constant.

Superconductivity:

Experimental features of superconductivity: Critical Temperature, Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation); Cooper Pair and Coherence length. Josephson Effect (No derivation)

Reference Books

1. Introduction to Solid State Physics---- Charles Kittel (Wiley Publication)
2. Elementary Solid state Physics-----M. Ali Omar (Pearson Education)
3. Elements of X-ray diffraction----B. D. Cullity (Prentice Hall)

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Practicals

Teaching	4 hrs/week	
Max. Marks	Duration	Min. Pass Marks
50	5 hrs.	18

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

Section–A

1. Determination of Planck's constant by photo cell (retarding potential method using optical filters, preferably five wave length).
2. Determination of Planck's constant using solar cell.
3. Determination of Stefan's constant (Black body method)
4. Study of the temperature dependence of resistance of a semiconductor (four probe method).
5. Study of Iodine spectum with the help of grating and spectrometer and ordinary bulb light.
6. Study of characteristics of a GM counter and verification of inverse square law for the same strength of a radioactive source.
7. Study of β-absorption in Al foil using GM Counter.
8. To find the magnetic susceptibility of a paramagnetic solution using Quinck's method. Also find the ionic molecular susceptibility of the ion and magnetic moment of the ion in terms of Bohr magneton.
9. Determination of coefficient of rigidity as a function of temperature using torsional oscillator (resonance method).
10. Study of polarization by reflection from a glass plate with the help of Nicliol's prism and photo cell and verification of Brewster law and law of Malus.
11. e/m measurement by helical Method.
12. Measurement of magnetic field using ballistic galvanometers and search coil. Study of variation of magnetic field of an electromagnet with current.
13. Measurement of electric charge by Millikan's oil drop method.

Section–B

1. Study of a R-C transmission line at 50 Hz
2. Study of a L-C transmission line
   (i) at fixed frequency.
   (ii) at variable frequency.
3. Study of resonance in an LCR circuit (using air core inductance and damping by metal plate)

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(i) at fixed frequency by varying C, and
(ii) by varying frequency.

4. Study of the characteristics of junction diode & Zener diode.
5. Study of
   (i) Recovery time of junction diode and point contact diode.
   (ii) Recovery time as a function of frequency of operation and switching current.
6. To design Zener regulated power supply and study the regulation with various loads.
7. To study the characteristics of a field effect transistor (FET) and design/study amplifier of finite gain (10).
8. To study the frequency response of a transistor amplifier and obtain the input and output impendence of the amplifier.
9. To design and study of an R-C phase shift oscillator and measure output impedence (frequency response with change of component of R and C).
10. To study a voltage multiplier circuit to generate high voltage D.C. from A.C.
11. Using discrete components, study OR, AND, NOT logic gates, compare with TTL integrated circuits (I.C.'s).
12. Application of operational amplifier (OP-AMP) as : Minimum two of the following exercises–(a) Buffer (for accurate voltage measurement) (b) inverting amplifier (c) Non inverting amplifier (d) Summing amplifier.

2 CHEMISTRY
Scheme

Max Marks: 150

	Duration (hrs)	Max. Marks	Min. Pass Marks
Paper I	3	33	
Paper-II	3	33	36
Paper-III	3	34	
Practical	5	50	18

Note: Ten (10) questions are to be set taking two (02) questions from each unit. Candidates have to answer any 5 questions selecting at least one question from each unit.

CH-301 Paper-I : Inorganic Chemistry
(2 hrs or 3 periods/ week)

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, electronegativity and hardness and softness.

Unit-II

Metal-ligand bonding in Transition Metal complexes:
Limitations 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.

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

Unit-III

Electron spectra of Transition Metal Complexes:
Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

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-IV

Organometallic Chemistry:
Definition, nomenclature and classification of organometallic compounds. Preparation,

properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, a brief account of metalethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Unit-V

Bioinorganic Chemistry:
Essential and trace elements to 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+}. Nitrogen fixation.

Inorganic Polymers:
Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

CH-302 Paper-II : Organic Chemistry
(2 hrs or 3 periods/week)

Unit-I

Nuclear Magnetic Resonance (NMR) Spectroscopy:
Proton magnetic resonance (1H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals. Interpretation of NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using NMR data.

Organic Synthesis via Enolates: Acidity of α-hydrogens in reactive methylene compounds, alkylation of diethyl malonate and ethyl acetoacetate. Claisen condensation, Keto-enoltautomerism in ethyl acetoacetate. Synthetic applications of ethyl acetoacetate and malonic ester.

Unit-II

Heterocyclic Compounds
Introduction: Molecular orbital diagram and aromatic characteristics of pyrrole, furan, thiopheneand pyridine. Methods 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 heterocyles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher-indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Unit—III

Carbohydrates
Classification and nomenclature, Monosaccharides, mechanism of osazone formation. Epimers, anomers and mutarotation Interconversion of glucose and fructose, chain lengthening and chain

shortening of aldoses. Erythro and threodiastereomers. Conversion of glucose into mannose. Configuration of monosaccharides. Determination of ring size of monosaccharides. Formation of glycosides, ethers and esters. Cyclic structure of D(+)-glucose and fructose. Structures of ribose and deoxyribose.

Nomenclature and structure of disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose); Glycosidic linkage.

Unit-IV

Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α-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.

Nucleic acids – Introduction, constituents of nucleic acids - nucleosides and nucleotides.

Unit-V

Organosulphur Compounds : Nomenclature, structural features, methods of formation and chemical reactions of thiols, sulphonic acids, sulphonamides and Sulpha drugs: sulphaguanidine, sulphadiazine (sulphapyrimidine), sulphamethoxazole, sulphacetamide.

Synthetic Polymers : Addition or chain-growth polymerization. Free radical and ionic polymerization. Ziegler-Natta Catalyst Condensation or step-growth polymerization. Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubber.

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.

CH-303 Paper III: Physical Chemistry

(2 Hrs. or 3 periods/week)

UNIT-I

Elementary quantum Mechanics:

Black-body, radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's mode of hydrogen atom (no derivation) and its defects. Compton effect.

De Broglie hypothesis, the Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of

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the wave function, postulates of quantum mechanics, particle in a 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 functions.

UNIT-II

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 level from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ^*, π, π^* 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. models.

UNIT-III

Spectroscopy
Introduction: Electromagnetic radiation, spectrum, basic features of different spectrometers, statement of the Born-Openheimer approximation, degrees of freedom.
Rotational Spectrum: Diatomic molecules, Energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotator, isotope effect.
Vibrational Spectrum: Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, 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: Basic principles and applications, 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 Frank Condon principle. Qualitative description of σ, π and n M.O. their energy levels and the respective transitions.

UNIT-IV

Photochemistry
Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Stark -Einstein law, Jablonski diagram depicting various processes occurring in the exited sate, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

Physical Properties and Molecular Structure
Optical activity, polymerization – (Clausius-Mossotti equation), orientation of dipoles in an 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 ferromagnetic.

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UNIT-V

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 vapor 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 in freezing point. Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

Practical: CH-304: Laboratory Course – III

(6 hrs/week)

INORGANIC CHEMISTRY

Synthesis and Analysis of:

a) Potassium trioxalatoferrate (III), $K_3[Fe(C_2O_4)_3]$
b) Bis (dimethylglyoximato) nickel (II) complex, $[Ni(DMG)_2]$
c) Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4$
d) Potassium *cis*-diaquabis(oxalato)chromate (III) dihydrate, $K[cis\text{-}Cr(H_2O)_2(C_2O_4)_2].2H_2O$

Instrumentation

Calorimetry

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

Adulteration-Food stuffs

Effluent analysis water analysis

Solvent Extraction

Separation and estimation of Mg (II) and Fe (II)

Ion Exchange Method

Separation and estimation of Mg (II) and Fe (II)

ORGANIC CHEMISTRY

Laboratory Techniques

Steam Distillation

Naphthalene from its suspension in water
Clove oil from Clove
Separation of o- and p-nitrophenols

Column Chromatography

Separation of fluorescein and methylene blue
Separation of leaf pigments from spinach leaves
Resolution of racemic mixture of (+) mendelic acid

Qualitative Analysis

Analysis of an organic mixture containing two solid components using water, $NaHCO_3$, for separation and preparation of suitable derivatives.

Synthesis of Organic Compounds

(a) Acetylation of salicylic acid, aniline, glucose and hydroquinone,

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Benzoylation of aniline and phenol

(b) Aliphatic electrophilic substitution

Preparation of iodoform from ethanol and acetone

(c) Aromatic electrophilic substitution

Nitration

Preparation of m-dinitrobenzene

Preparation of p-nitroacetanilide

Halogenation

Preparation of p – bromoacetanilide

Preparation of 2, 4, 6 – tribromophenol

(d) Diazotizatoin / 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.

Stereochemical Study of Organic Compounds via Models

R and S configuration of optical isomers.

E, Z configuration of geometrical isomers.

Conformational analysis of cyclohexanes and substituted cyclohexanes.

PHYSICAL CHEMISTRY

Electrochemistry

(a) To determine the strength of the given acid condcutometrically using standard alkali solution.

(b) To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.

(c) To study the saponification of ethyl acetate conductometrically.

(d) To determine the ionization constant of a weak acid conductometrically.

(e) To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of Fe^{++}/Fe^{+++} system on the hydrogen scale.

Refractometry, Polarimetry

(a) To verify the law of refraction of mixture (e.g. of glycerol and water) using Abbe's refractometer.

(b) To determine the specific rotation of a given optically active compound.

Molecular Weight Determination

(a) Determination of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.

(b) Determination of the apparent degree of dissociation of an electrolyte (e.g. NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry

(a) To verify Beer-Lambert law $KMnO_4/K_2Cr_2O_7$ and determined the concentration of the given solution of the substance.

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(Instructions to the Examiner)

CH-304 Chemistry Practical (Pass Course)

Max. Marks: 50 **Duration of Exam:5 hrs.** **Minimum marks: 18**

Inorganic Chemistry

Synthesis and Analysis of one of the four syntheses given in the syllabus.

OR

Separation and estimation of Mg (II) and Fe (II) by solvent extraction method.

OR

Separation and estimation of Mg (II) and Fe (II) by ion exchange method. 10

Organic Chemistry

(1) Synthesis of one of the six organic preparations. 8

(2) Analysis of an organic mixture containing two solid components using water / $NaHCO_3$/ NaOH and preparation of suitable derivatives.

OR

Column chromatography techniques.

Perform one of the *three* column chromatography experiments given in syllabus. **10**

Physical Chemistry

Perform one of the physical chemistry experiments given in the syllabus. **12**

Viva-voce **5**

Record **5**

50

Books Suggested (Theory Course)

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Caus. Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS
3. Concepts of Models of Inorganic Chemistry B. Douglas. D. McDaniel and J. Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver P.W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield Addison Wesley.
6. Inorganic Chemistry, A.G. Sharpe, ELBS
7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall.
8. Organic Chemistry, Morrison and Boyd, Prentice Hall.
9. Organic Chemistry, L.G. Wade Ji. Prentice Hall.
10. Fundamentals of Organic Chemistry, Solomons, John Wiley.
11. Organic Chemistry Vol. I, II, III S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
12. Organic Chemistry, F.A. Carey, McGraw Hill, Inc.
13. Introduction to Organic Chemistry. Streitwieser. Heathcock and Kosover. Macmilan.
14. Physical Chemistry, G.M. Barrow. International Student Edition, McGraw Hill.
15. Basic Programming with Application, V.K. Jain. Tata McGraw H ill.
16. Computers and Common Sense. R. Hunt and Shelly, Prentice Hall.

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17. University General Chemistry, C.N.R. Rao, Macmillan.
18. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
19. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
20. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.

Books Suggested (Laboratory Courses)

1. Vogel's Qualitative inorganic Analysis, revised, Svehla, Orient Longman.
2. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett. R.C. Dene0y, G.H. Jeffery and J. Mendham. ELBS.
3. Standard Methods of Chemical Analysis. W.W. Scott. The Technical Press.
4. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
5. Handbook of preparative Inorganic Chemistry. Vol [& II, Braver, Academic Press.
6. Inorganic Synthesis, McGraw Hill.
7. Experimental Organic Vol I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, 'rata McGraw Hill.
8. Laboratory manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
9. Vogel's Textbook of Practical Organic Chemistry, RS. Furniss, Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
10. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.
11. Experiments in Physical Chemistry, R.C.Das and B. Behra, Tata McGraw Hill
12. Advanced Practical Physical Chemistry, J.I3. Yadav, Goel Publishing House.
13. Advanced Experimental Chemistry, Vol. 1-Physical, J.N. Gurtii and R. Kapoor, S. Chand & Co.
14. Selected Experiments in Physical Chemistry, N.G. Mukerjee. J.N. Ghjose& Sons.
15. Experiments in Physical Chemistry, J.C. Ghosh, Bharati Bhavan. (Instructions to examiners)

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3. Zoology
(2017-18)

Scheme:
Max. Marks: 100 Min. Pass Marks: 36

Paper I	**: 3 Hrs duration**	**33 Marks**
Paper II	**: 3 Hrs duration**	**33 Marks**
Paper III	**: 3 Hrs duration**	**34 Marks**
Practicals	**: 4 Hrs. duration**	**50 Marks**

NOTE:

1. There will be two parts of every theory question paper with total duration of 3 hours. First part of question paper will comprise question No. 1 containing 9 (Paper I & II) or 10 (Paper III) very short answer (Maximum 25 words) type questions, each of 1 mark. This part is compulsory to attempt. Questions should be evenly distributed covering entire syllabus.
   Second part of question paper will be of long answer type questions having three sections. There will be total 9 questions (Q. No. 2 to 10) in this part, *i.e.*, three from each unit /section out of which candidate will be required to attempt any 4 question selecting at least one question from each unit/section. Each question will carry 6 marks.
2. The candidate has to answer all questions in the main answer book only.

PAPER –I: Z-301
STRUCTURE AND FUNCTIONS OF CHORDATE TYPES

Section – A

Chordates

1. Comparison of habit, external features and anatomy of *Herdmania* and *Branchiostoma* (excluding development).
2. Ascidian tadpole larva and its metamorphosis.
3. Affinities of Hemichordata, Urochordata and Cephlochordata
4. Habit, habitat and salient features of *Petromyzon*, Ammocoete larva.

Section – B

Comparative Anatomy

1. Integument including structure and development of placoid scales, feathers and hair.
2. Basic plan of vertebrate endoskeleton.
3. Alimentary canal.
4. Heart and aortic arches.
5. Respiratory system.
6. Urinogenital system.
7. Brain
8. Sense organs (ear and eye).

Section – C

Chordate Adaptations

1. Pisces: Scales and fins, migration and parental care.
2. Amphibia: Parental care.
3. Reptilia: Poisonous and non poisonous snakes, poison apparatus.
4. Aves: Flight adaptations, bird migration.
5. Mammals: Adaptive radiation, dentition.

PAPER –II: Z-302
ECOLOGY AND ENVIRONMENTAL BIOLOGY

Section – A

Ecology

1. Basic concepts in ecology, its meaning and history.
2. Concepts of limiting factors.
3. Ecosystem: Biotic and abiotic factors.
4. Ecosystem: Production, consumption and decomposition in an ecosystem: Concepts of food-chain, food web, trophic structure, ecological pyramids
5. Biogeochemical cycles of O_2, CO_2, H_2O, N, P and role of microbes.
6. Ecosystem: Homeostasis, functional aspects, productivity concepts and determination, ecotone, edge effects, niche.
7. Population ecology: Density and methods of its measurement, natality, mortality, age ratio and distribution, pyramids, fluctuations, biotic potential, dispersal, growth forms, population interactions and propagation, brief idea of demography.
8. Community ecology: Characteristics of natural communities, structure, composition, stratification.
9. Ecological succession: Types and patterns, concept of climax, details of xerosere and hydrosere successions.
10. Habitat ecology: Brief account of fresh water, marine, terrestrial and estuarine water ecosystems.
11. Major biomes of the world.
12. Ecology and human future: Growth rate role of human kind in modifying natural communities in term of public health and welfare with respect to use of pesticides, conservation and pollution.

Section – B

Environmental Biology-I

1. Environment and its concepts, global environment, hydrosphere, lithosphere and atmosphere.
2. Natural resources: Present status and future needs.
3. Conservation and management of natural resources: Renewable (forest, wildlife, water) and non renewable (soil, minerals and energy).
4. Environmental pollution I: General outline and various types of pollution of water, air, and soil.
5. Environmental pollution II: Sources and remedies for noise, radiation, industrial chemicals, agrochemicals, insecticides, pesticides and household pollutants.

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Green House effect, Ozone layer depletion, EI-Nino and La Nina effects.

7. Radiation and environment: Types of radiation, fallout effects of radiation nuclear accidents.
8. Basic concepts of bioaccumulation, biomagnifications, biodegradation of pollutants.

Section - C

Environmental Biology -II

1. Wildlife conservation: Vanishing and threatened animals and plants with special reference in Rajasthan, Wildlife management efforts by Government and non Government organization (including wild life acts).
2. Impact of urbanization: Development and distribution of urban centers, factors , problems and solutions of urbanization, fauna of oriental region.
3. Space ecology: Space ecosystem, space problems and their solutions, colonization.

PAPER –III: Z-303
APPLIED ZOOLOGY, ETHOLOGY AND BIOSTATISTICS

Section – A

Applied Zoology

Principles and Practices of the following:

1. Vermiculture.
2. Sericulture (including ericulture).
3. Lac culture.
4. Apiculture.
5. Prawn culture.
6. Poultry keeping.
7. Pisciculture.

Economic Importance of the following:

1. Protozoa.
2. Corals and coral reefs.
3. Helminthes.
4. Arthropods; Insects and their management
5. Mollusca: Outline idea of pearl culture.

Section – B

Ethology

1. Introduction and history of Ethology.
2. Concepts of Ethology : Fixed action pattern, sign stimulus, innate releasing mechanism, action specific energy, motivation imprinting and learning.
3. Methods of studying brain behavior: Neuroanatomical , neurophysiological and neurochemical techniques.
4. Pheromones and their role in alarm spreading
5. Societies: Characteristics and advantage with special reference to honey bee, deer and monkey.
6. Biological rhythms and biological clocks.
7. Methods of studying animal behavior

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Section – C

Biostatistics

1. Introduction, scope and application of Biostatistics.
2. Understanding the concepts of descriptive and inferential statistics.
3. Frequency distribution.
4. Graphical and tabular presentation of data.
5. Mean, median, mode and their significance.
6. Standard deviation, standard error and their significance.

Practical - Zoology

Min. Marks: 18 **4 Hrs. / Week** **Max. Marks: 50**

I. **Anatomy:**

(a) **One Edible fish (Wallago / Labeo etc.):** External Features, General viscera, afferent and efferent branchial blood vessels, eye muscles and their innervations, brain, cranial nerves and internal ear.

(b) **Rat or any other suitable mammal:** Blood vascular, urino-gential and nervous system (brain, cranial nerves).

II. **Study of the following through Permanent Slide preparations:**

Striped muscle fibers; Smooth muscle fibers scales of edible fish hair of man, dog, goat and cow blood film of any vertebrate.

III. **Study of Microscopic Slides:** whole mounts of oral hood, velum and pharyngeal wall of *Amphioxus*; T. S. of *Amphioxus* through various regions; tadpole larva of *Ascidia*; whole mounts of *Salpa, Doliolum* and *Oikopleura*, V. S. of skin of fish, T. S. body of fish through various regions, V. S. of skin of bird, V. S. mammalian skin, T. S. mammalian liver, kidney, stomach, intestine, bone, spinal cord, lung, duodenum, pancreas, testis and ovary.

IV. **Study of Museum Specimens:** *Ascidia*, *Ciona*, *Botryllus*, Ammocoete larva, *Petromyzon*, *Myxine* or *Bdellostoma*, *Zygaena* (*Sphyrna*), *Torpedo*, *Chimaera*; *Acipenser*, *Amia* or *Lepidosteus*, *Labeo*, *Clarias*, *Anguilla*, *Hippocampus*, *Exocoetus*, *Echeneis*, any flat-fish, Protopterus, *Icthyophis* or any blind-worm *Proteus*, *Ambystoma*, Axolotl, Siren, *Alytes*, *Hyla*, *Testudo*, *Chelone*, and Fresh Water Tortoise, *Sphenodon*, *Hemidactylus Phrynosoma*, *Draco*, *Chameleon*; *Eryx*, *Hydrophis*, *Naja*, *Viper*, *Crocodilus*, *Alligator*, *Archaeoptery*, any Running Bird, *Pavo cristatus*, *Choriotis nigriceps Ornithorhynchus*, *Tachyglossus*, *Didelphys*, *Macropus*; Bat, *Loris*, Scaly anteater.

V. **Osteology:** A comparative study of articulated and disarticulated bones of any amphibian, reptile, bird and mammal with the help of models/ charts/ artificial skeleton/ bones.

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VI. Environmental Biology:

Analysis of Environment:

1. Soil pH
2. Water analysis: pH, alkalinity, acidity, dissolved O_2 and free CO_2, Salinity (Chloride).
3. Qualitative estimation of zoo-plankton in given sample of water.
4. Methods of ecological census of soil fauna and any one vertebrate.

VII. Ethology:

1. Study of any stored insect pest (food preference and response to light)
2. Antennal grooming in cockroach.
3. Visit to a Zoo/ Museum of Natural History /Wild life Sanctuary and/or Study of local faunal biodiversity (Candidates are expected to submit a detailed report of such visit).

VIII. Biostatistics:

1. Construction of frequency table, histogram, frequency polygon and pie chart.
2. Exercises on mean, median and mode (direct, short –cut and step-deviation methods).
3. Standard deviation and standard error.

Scheme of Practical Examination and Distribution of Marks

Time: 4 hrs. **Min. Pass Marks: 18** **Max. Marks: 50**

		Regular	Ex. /N.C. Students
1.	Anatomy (any system)	6	7
2.	Permanent Preparation	4	5
3.	Environmental Biology	6	6
4.	Ethology	3	5
5.	Biostatistics	5	6
6.	Identification and comments on Spots (1 to 8)	16	16
7.	Viva Voce	5	5
8.	Class Record	5	-
		50	**50**

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NOTE:

1. With reference to anatomy (Dissection), study of prescribed types (charts/models), candidates must be well versed in the study of various systems. CD ROMs multimedia computer based simulations including computer assisted learning (CAL) and other soft wares may be used.

2. With reference to permanent preparations and microscopic slides, in case of non-availability, **the exercise should be substituted with diagrams, photographs, models, charts, etc.**

3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.

4. The candidates may be asked to write detailed methodology wherever necessary and separate marks may be allocated for the same.

5. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.

6. **It should be ensured that animals used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently.**

Recommended Books:

1. Ahsan J and Sinha SP: A Hand book on Economic Zoology. 9th edition S. Chand & Co. Ltd., 1981.
2. Alcock J: Animal Behavior: An Evolutionary Approach. Sinauer Associates 2013.
3. Animal Societies and Evolution. Scientific American Publications.
4. Alexander R. M: The Chordates, Cambridge University Press. 1975.
5. Bailey NTJ: Statistical Methods in Biology. English Universities Press, 1964.
6. Breed MD and Moore J: Animal Behavior. Academic Press. 2015.
7. Grizimek's Encyclopedia of Ethology.
8. Gurumani N: An Introduction to Biostatistics. MJP Publishers, 2011.
9. Hand book of Ethological Method. Laharen Publications Garland STPM Press.
10. Kotpal RL: Modern Text Book of Zoology: Vertebrates. Global Media Publications 2010.
11. MacFarland D: Animal Behavior: Psychobiology, Ethology and Evolution 3rd edition Longman 1998.
12. Mahajan BK: Methods in Biostatistics. 7th edition Jaypee Publishers, 2010.
13. Manning A, Dawkins MS: An Introduction to Animal Behavior. Cambridge University Press 2012.
14. Mathur R: Animal Behavior. Rastogi Publications 2010.
15. Odum: Fundamentals of Ecology. Thomson Books/Cole 2005.
16. Odum: Ecology: A Bridge Between Science and Society Sinauer Associates 1997.
17. Prasad SN and Kashyap V: A Textbook of Vertebrate Zoology.13th edition Wiley Eastern Ltd. 2011.
18. Primrose S. B and Twyman R. M: Principles of Gene Manipulation and Genomics. John Wiley & Sons. 2013

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19. Rana S. V. S: Environmental Studies. 4th edition. Rastogi Publications 2012.
20. Rastogi VB Organic Evolution 6th edition Kedar Nath Ram Nath Publications,Meerut,Delhi, 1993.
21. Rastogi VB and Jayaraj MS Animal Ecology & Distribution of Animals Kedar Nath Ram Nath Publications, Meerut, Delhi, 1983.
22. Sharma P. D: Environmental Biology and Toxicology. 3rd edition Rastogi Publications, 2013
23. Sunder Rao PSS and Richard J: Introduction to Biostatistics and Research Methods. PHI Publishers, 2012.
24. Sharma P. D: Ecology and Environment. 12th revised edition, Rastogi Publications 2014-2015.
25. Werlace RA: Animal Behavior. Good Year Publishing Co., Inc.
26. Young JZ: The Life of Mammals. Oxford University Press 1970.
27. Young JZ: The life of Vertebrates. 2nd edition Oxford University Press. London 1962.

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4. BOTANY

Scheme

Min. Pass Marks: 36 — Max Marks: 100

Paper I	3 hrs. duration	Max. Marks 33
Paper II	3 hrs. duration	Max. Marks 33
Paper III	3 hrs. duration	Max. Marks 34
Practical Min. Marks: 18	4 hrs. duration	Max. Marks 50
Duration of examination of each theory paper-		3 hours
Duration of examination of practicals-		4 hours

Note:

1. There will be 5 questions in each paper. All questions are compulsory. Candidate has to answer all questions in the main answer book only
2. Q.No. will have 20 very short answer type Questions(not more than 20 words) of half marks each covering entire syllabus.
3. Each paper is divided into four units. There will be one question from each unit. These Q. No. 2 to 5 will have internal choice.

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Paper I

PLANT MORPHOLOGY AND ANATOMY

(2 hrs /week)

Unit-1

The basic body plan of flowering plant-modular type of growth. Diversity of Plant form in annuals, biennials and perennials; branching pattern: monopodial and sympodial growth; canopy architecture; meristematic, simple, complex and secretary tissues, tissue systems.

Unit-2

The Shoot system: The shoot apical meristem and its histological organization; vascularisation of primary shoot in monocotyledons and dicotyledons; cambium and its functions; formation of secondary xylem; a general account of wood structure growth rings, sapwood and heartwood; secondary phloem-structure and function, periderm. Anomalous secondary growth.

Unit-3

The Leaf: origin, development, arrangement and diversity in size and shape; Stomata-Structure and types, stomatal index, vascularisation of leaf-nodal structure and venation. Sensescence and abscission.

The root system: Root apical meristem; differentiation of primary and secondary tissues and their functions; structural modification for storage, respiration, reproduction and root- microbe interaction

Unit-4

Morphology and anatomy of seed (monocotyledons and dicotyledons). Significance of seed-suspended animation, dispersal strategies. Vegetative propagation.

Suggested readings :

Cutter, E.G. 1969. Part I Cells and Tissues. Edward Arnold, London.

Cutter, E.G. 1971. Plant Anatomy : Experiment and interpretation, part-II, organs. Edward Arnold; London.

Esau, K. 1977. Anatomy of Seed Plants. 2nd edition. John Wiley & Sons, New York.

Fahn, A. 1985. Plant Anatomy. Pergamon Press, Oxford.

Hartman, H.T. and Kester, D.E. 1976. Plant Propagation: Principles and of India Pvt. Ltd., New Delhi.

Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Co. Inc. Menlo Park, California, USA.

Raven, P.M., Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants. W.H. Freeman and Co. Worth Publishers, New York.

Thomas, P. (2000). Trees: Their Natural History. Cambridge University Press, Cambridge.

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Suggested Laboratory Exercises:

1. Study of any commonly occurring dicotyledonous plant to understand the body plan and modular type of growth
2. Life forms exhibited by flowering plants (by visit to a forest or a garden)
3. L.S. of shoot tip to study the organization of meristem and origin of leaf primordial.
4. Monopodial and sympodial types of branching in monocots & dicots.
5. Anatomy of primary and secondary growth in monocots and dicots using hand out sections of sunflower, maize, cucurbita stem and roots.
6. Anamolous secondary growth in stem: *Salvadora, Bignonia, Bougainvillia, Bouhaemia, Mirabilis, Leptadenia, Dracena*
7. Study of diversity in leaf shape and size. Internal structure of leaf-Dorsiventral and isobilateral leaves; study of stomatal types
8. Examination of seed (monocot and dicot). Structure, seed viability test.
9. Specimen study of modifications of plant parts for Vegetative reproduction.

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Paper-II

Ecology & Economic Botany

(2 hrs week)

Unit-I

Plants and Environment: Atmosphere (four distinct zone viz, stratosphere, troposphere, mesosphere and thermosphere) Adaptation (Morphological, anatomical and physiological responses) of plants to water (Hydrophytes and Xerophytes). Light (global radiation, photosynthetically active radiation Zonation in water body: littoral, limnetic and profoundal zones, photoperiodism, heliophytes and sciophytes) Temperature (Raunkier's classification of plants megatherm, mesotherm, microtherm, hekistotherm, themoperiodicity and vernalisation) Soil (soil profile, development-weathering and maturation) Soil texture, soil types, role of pH, organic matter, soil water, soil nutrients. Interactions among organisms (neutralism, amensalism, allelopathy, competition, predation, parasitism, protocooperation, mutualism. Environmental protection act.

Unit-2

Community, Ecosystem and Phytogeography Community characteristics: stratification, life forms and biological spectrum, frequency density and cover. Ecological succession types (primary and secondary: mechanism nudation, migration, ecesis, reaction and climax: xerosere, hydrosere. Ecosystems: Structure-abiotic and biotic components trophic level, food chain, food web ecological pyramids, energy flow (Box and Pipe model of Odum). Biogeochemical cycles of carbon, and phosphorus. Vegetation types of Rajasthan. Endangered plants of Rajasthan

Unit-3

Basic concept of center of origin of cultivated plants. Food plants-rice, wheat, maize, pulses, sugarcane. Vegetables: General account with a note on radish, onion, garlic, cabbage, spinach, cauliflower, cucumber, brinjal, lady finger and pea. Fruits: General account with a note on apple, banana, ber, mango, mulberry, jamun, watermelon, muskmelon, guava and orange. Vegetable oil groundnut, mustard and coconut.

Unit-4

Spices: General account with an emphasis on those cultivated in Rajasthan (Coriander, Fennel, Cumin, Fenugreek, Isabgol, Ajwain, Black cumin). Beverages: Tea and coffee. Medicinal plants: General account with an emphasis on species cultivated in Rajasthan

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(Senna [illegible] Safed musli). Fibers: Cotton and jute. Wood: General account of sources of firewood, timber and bamboos; Rubber. Ethnobotany: a general account.

Practical Exercises:

1. Study frequency and density, abundance of plant species of campus vegetation by quadrat method
2. Variation in soil moisture in relation to depth
3. To estimate bulk density of grassland and woodland soil.
4. To estimate the porosity of grassland and woodland soil sample.
5. To determine moisture content of grassland and wood land soil.
6. To measure dissolved oxygen content in polluted and unpolluted water samples.
7. To measure temperature of different water bodies.
8. Water holding capacity of the soil
9. Find out pH of soil sample by universal Indicator method.
10. Find out pH of water sample by pH meter
11. Find out transparency of a waterbody by Sechhidisk
12. Study morphology (external and internal) of hydrophytes (*Hydrilla* stem, *Typha* leaf and *Nymphaea/Eichhornia* petiole) and xerophytes (*Calotropis*, *Capparis* and *Casuarina* stem, *Nerium* leaf) with special reference to their adaptations.
13. Study following specimen with special reference to
    1. Botany of the economically important part
    2. Processing if any involved
    3. Specimen of cereals, pulses, spices beverages (tea & coffee) beans, sugar, oil seeds (mustard, groundnut)
14. Study of starch grain in potato and pea. Histochemical test Cellulose, lignin, starch, fat, protein and tannin.
15. Submit 5 specimens of locally important medicinal plants.

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Paper-III

Angiosperm- Taxonomy and Embryology

(2 hrs/week)

Unit-1

Introduction of Taxonomy. Units of classification. Concept of genus and species. Botanical Nomenclature. International Code of Botanical Nomenclature

Taxonomic literature. Floras, Gardens, Herbaria, Monographs, Icones, Library.

Types of systems of Classification. Bentham and Hooker's, Engler and Prantle's system.

Diversity of flowering plants illustrated by members and economic importance of the following families: Ranunculaceae, Brassicaceae, Papaveraceae, Malvaceae, Fabaceae, Caryophyllaceae and Apiaceae.

Unit-2

Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Arecaceae and Poaceae.

Unit-3

Ontogeny of the flower parts-development and variations. Structure of anther, microsporogenesis, Tapetum types and functions, development of male gametophyte, structure of pollen grains.

Types of ovule, Megasporogenesis, development of female gametophyte(Embryosac), Pollination, Pollination types, Fertilization, double fertilization, significance of double fertilization.

Unit-4

Development of dicot and monocot embryo. Formation of embryo. Types of Embryo. Endosperm, Types of Endosperm, Endosperm haustoria, Polyembrony, Induced polyembryony, Parthenocarpy, Apomixis and adventive e[illegible]

Nature of Laboratory Exercises

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(b) Taxonomy:

(1) The following genera are suitable for study of families

1. Ranunculaceae-*Ranunculus*, *Delphinium*.
2. Fabaceae *Pisum sativum*, *Cassia* and *Acacia*
3. Apiaceae *Coriandrum*
4. Convolvulaceae-*Ipomea*, *Jacquemontia*
5. Apocynaceae-*Catharanthus*, *Thevetia*
6. Asclepiadaceae-*Calotropis*
7. Lamiaceae- *Ocimum*, *Salvia*
8. Euphorbiaceae-*Euphorbia pulcherrima*, *Ricinus*
9. [illegible]aceae- *Adhatoda*.
10. Asteraceae-*Helianthus*
11. R[illegible]aceae-*Hamelia*
12. [illegible]aceae *Triticum*

13. Visit to a Local Botanical Garden/ Herbarium/National Park/ Study of Local Floral biodiversity (candidates are expected to submit a detailed report of such visit)

(ii) Types of Inflorescence and Fruits

(iii) Embryology:

- [illegible] of anther to study the wall layers and pollen sac with pollen grains.
- [illegible] the various types of ovule. Draw the diagrams
- [illegible] the various types of placentations
- [illegible] the germination of pollen grain [illegible] and observe the path of pollen tube.
- [illegible] of various stages of embryo [illegible] *Raphanus* fruits

Suggested Readings:

[illegible] of Angiosperms-[illegible] (1995) [illegible] Publishing Company [illegible] New Delhi.

[illegible] to the Principles of [illegible] Taxonomy V.V. Sivarajan (1984) Oxford & IBH Publishing Co. Pvt Ltd. New Delhi

[illegible] Taxonomy Susheela [illegible] (2003) Dominant Publishers and [illegible] New Delhi

[illegible] Bhojwani [illegible] Oxford and IBH Publishing Co. Pvt [illegible]

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P.C. N Sharma and [illegible] ma (2003) Structure, Development and [illegible]tion in Flowering [illegible] Ramesh Book Depot, Jaipur

[illegible] S.S. and Bhatnagar, S.P. (2000) The embryology of Angiosperms 4th [illegible] Vikas Publishing House, New Delhi

[illegible]duction to the Embryology of Angiosperm. Maheshwari, P. (1950) [illegible]

[illegible]dvances in the Embryology of Angiosperms. Ed. Maheshwirari P [illegible] Delhi

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BOTANY PRACTICAL EXAMINATION B.Sc PART-III

SKELETON PAPER

M.M. 50 TIME: 4 Hours

S.No.	Practical	Regular	Ex/NC
1	(a)Plant Taxonomy Describe vegetative and reproductive parts of flower in semi-technical language.Give floral diagram and floral formula and Identify the family giving reasons	7	7
	(b)Comment on the embryological exercise.	3	3
2	(a). Anatomical exercise on anomalous secondary growth	5	5
	(b) Anatomy of root/leaf/study of stomatal types	5	5
3	(a) Ecological exercise based on quadrat method/Exercise related to soil	3	3
	(b) Ecological Anatomy	4	4
	(c) Histochemical Test / Economic Botany	3	3
4	Comment upon spots (1-5).	10	15
5	Viva- Voce	5	5
6	Practical record	5	-
	TOTAL	50	50

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6. MATHEMATICS

Appendix-III

B.A./B.Sc. Part – III – 2019

Teaching : 3 Hours per Week per Theory Paper.
2 Hours per Week for Practical Paper.

Examination:

	Min.Pass Marks		Max. Marks
Scheme:	**Science – 54**		**150**
	Arts – 72		**200**
		Duration	**Max.Marks**
Paper – I	**Algebra**	**3 hrs.**	**40 (Science)** **53 (Arts)**
Paper – II	**Complex Analysis**	**3 hrs.**	**40 (Science)** **53 (Arts)**
Paper – III	**Mechanics**	**3 hrs.**	**40 (Science)** **54 (Arts)**
Practical	**Computer Programming in C**	**2 hrs.**	**30 (Science)** **40 (Arts)**

Note:

1. 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.

2. 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.

3. An Internal/external examiner can conduct Practical Examination of not more than 100 (Hundred) Candidates (20 Candidates in one batch).

4. Each candidate has to pass in Theory and Practical examinations separately.

उप-कुलसचिव
(शैक्षणिक)
राजस्थान विश्वविद्यालय
जयपुर

Paper -I : Algebra
Teaching : 3 Hours per Week
Duration of Examination : 3 Hours

Max. Marks: 40 (Science)
53(Arts)

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: Morphism of groups, Cayley's theorem. Normal subgroups and Quotient groups. Fundamental theorems of Isomorphism.

Unit 3: Definition and simple properties of Rings and Subrings. Morphism of rings. Embedding of a ring, Integral domain and field. Characteristics of a Ring and Field.

Unit 4: Ideals and Quotient Ring. Maximal ideal and Prime ideal. Principal Ideal domain. Field of quotients of an integral domain. Prime fields. Definition, Examples and Simple properties of Vector spaces and Subspaces.

Unit 5: Linear combination, Linear dependence and Linear independence of vectors. Basis and Dimension. Generation of subspaces. Sum of subspaces. Direct sum and Complement of subspaces. Quotient space and its dimension.

Reference Books:

1. N.S.Gopalkrishnan, University Algebra, New Age International, 1986.
2. Qazi Zameeruddin and Surjeet Singh, Modern Algebra, Vikas Publishing,2006
3. G.C.Sharma, Modern Algebra, Shivlal Agrawal & Co., Agra,1998.
4. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
5. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edition), Narosa Publishing House, New Delhi, 1999.(IX Edition 2010).
6. S Lang, Introduction to Linear Algebra (2nd edition), Springer, 2005.
7. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
8. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.
9. I.N.Herstein, Topics in Algebra, Wiley-Eastern Ltd., New Delhi

Malcolm Birkoff, Abstract Algebra, Cambridge University Press.

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Paper – II: Complex Analysis
Teaching : 3 Hours per Week
Duration of Examination : 3 Hours **Max. Marks: 40 (Science)**
53 (Arts)

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: Complex plane. Connected and Compact sets. Curves and Regions in complex plane. Jordan curve Theorem (statement only). Extended complex plane. Stereographic projection. Complex valued function – Limits, Continuity and Differentiability. Analytic functions, Cauchy-Riemann equations (Cartesian and polar form). Harmonic functions, Construction of an analytic function.

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.
Residue at a singularity, Cauchy's residue theorem. Argument principle. Rouche's theorem. Fundamental theorem of Algebra.

Unit 5: Conformal mapping. Bilinear transformation and its properties. Elementary mappings: $w(z)=\frac{1}{2}\left(z+\frac{1}{z}\right), z^2, e^z, \sin z, \cos z,$ and $\log z$.
Evaluation of a real definite integral by contour integration.
Analytic continuation. Power series method of analytic continuation.

Reference Books:

1. J.C.Chaturvedi and S.S.Seth, Functions of Complex variables, Student's Friends, Agra 1971.
2. H.S.Kasana, Complex Variables: Theory and Applications, Prentice-Hall, Delhi.
3. S. Ponnuswamy, Introduction to Complex Analysis, Narosa Pub., New Delhi
4. R.Murray Spiegel, Theory and Problems of Complex Variables, Schaum Outline Series.
5. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications (Eighth Edition), McGraw – Hill International Edition, 2009.
6. Joseph Bak and Donald J. Newman, Complex analysis (2nd Edition), Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

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Paper – III: Mechanics
Teaching : 3 Hours per Week
Duration of Examination : 3 Hours

Max. Marks: 40 (Science)
54 (Arts)

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: 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. Projectile.

Unit 3: Central orbits – p-r equations, Apses, Time in an orbit, Kepler's law of planetary motion. Moment of inertia – M.I. of rods, Circular rings, Circular disks, Solid and Hollow spheres, Rectangular lamina, Ellipse and Triangle. Theorem of parallel axis. Product of inertia.

Unit 4: Equilibrium of coplanar force, moments and friction.

Unit-5: Virtual work and Catenary.

Reference Books:

1. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.
2. A.S.Ramsey, Dynamics, CBS Publishing & Distributors, New Delhi.
3. A.S.Ramsey, Statics, CBS Publishing & Distributors, New Delhi.
4. M.Ray, A Text Book of Dynamics, S. Chand & Co., 2003.
5. I.H. Shames and G. KrishnaMohan Rao, Engineering Mechanics: Statics and Dynamics (4th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
6. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
7. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

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Practical: Computer Programming in C
Teaching: 2 Hours per Week per Batch

Examination: **Duration: 2 Hours**

Scheme			Science	Arts
Max.Marks			30	40
Min.Pass Marks			10	13
Distribution of Marks:				
Two Practicals of				
10 Marks each	=	20 Marks	(13 Marks each)	26
Practical Record	=	05 Marks		07
Viva-voce	=	05 Marks		07
Total Marks	=	30 Marks		40

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

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 manipulation arrays and functions.

Programming in C and execution for the result of

(i). Solution of linear algebraic equations by Gauss elimination method
(ii) Solution of algebraic and transcendental equations by Bisection, False position and Newton – Raphson Methods
(iii) Solution of ordinary differential equations by Euler's and Runga-Kutta 4th order method
(iv) Numerical integration by Trapezoidal 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.

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