Physics Sikkim Manipal University

Details of UG courses & Syllabus
(B. Sc. Three year course, Semester system)

Marks Distribution

Theory : External =80, Internal assessment =20 (80+20= 100) each paper
Practical: (40+ 10=50) each semester , 40 marks Practical + 10 Internal

B Sc I Year

Semester I:

Paper I: Mechanics and Properties of Matter
Paper II: Electricity and Magnetism
Lab Course: Practical

Semester II:

Paper I: Waves And Oscillations
Paper II: Optics
Lab Course: Practical

B Sc II Year

Semester III:

Paper I: Heat and Thermodynamics
Paper II: Solid state physics and Statistical Mechanics
Lab Course: Practical

Semester IV:

Paper I: Elements of Modern Physics
Paper II: Basic Electrical and Electronic circuits
Lab Course: Practical

B Sc III Year

Semester V:

Paper I: Electronics and Solid State Devices
Paper II: Mathematical Physics
Lab Course: Practical

Semester VI:

Paper I: Quantum Mechanics
Paper II: Digital and optoelectronics
Lab Course: Practical

B. Sc. Syllabus

Semester I:

Paper I: Mechanics and Properties of Matter

Laws of Motion and conservation laws: Frames of reference, Newton's Laws of motion, Work and energy, uniform circular motion, Conservation of energy and momentum. Conservative and non conservative forces, Motion of rocket, Motion of a particle in a central force field, Keplers laws of planetary motion, Newton's Law of Gravitation, Gravitational field, potential and potential energy, Gravitational potential and field intensity for spherical shell. Satellite, Basic idea of global positioning system (GPS).

Rotational Motion: Dynamics of a system of particles, Centre of mass, Angular velocity and momentum, Torque, Conservation of angular momentum, Equation of motion, Moment of inertia, theorem of parallel and perpendicular axis, moment of inertia of rod, rectangular lamina, disc, solid sphere, spherical shell, kinetic energy of rotation, rolling along a slope.

Fluids: Surface Tension and surface energy, Excess pressure across surface: application to spherical drops and bubbles, variation of surface tension with temperature - Jaegar's method. Viscosity: Flow of liquid, equation of continuity, energy of fluid, Bernoulli's theorem, Poiseuille's equation and method to determine coefficient of viscosity, Variations of viscosity of a liquid with temperature

Elasticity: Hooke's law, Stress –strain, Elastic potential energy, Elastic moduli: Young's, Bulk and shear modulus of rigidity, Poisson's ratio, relation between elastic constants Work done in stretching and in twisting a wire, Twisting couple on a cylinder, Strain energy in twisted cylinder, Determination of Rigidity modulus by statical and dynamical method (Barton's and Maxwell's needle), Torsional pendulum, Young's modulus by bending of beam, Determination of Y, η and σ and moment of inertia by Searle's method.

Reference Books:

1.Mechanics Berkeley Physics course,vol.1:Charles Kittel, et. Al. 2007, Tata McGraw-Hill.

2.Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley

3.Mechanics: Mathur, and Hemnch, S Chand Publications

4.Mechanics: J.C.Upadyaya, Ram Prasad and Sons, Agra.

5.Mechanics and General Properties of Matter:P.K.Chakraborthy, Books and Allied Pvt. Ltd

6.Elements of mechanics, Prakash & agrawal, Pragati Prakashan Meerut

Paper II : Electricity and Magnetism

Vector field and Electrostatics: Scalar and Vector field, gradient, divergence, Curl. Line, surface and volume integrals of Vector fields, Gauss-divergence and Stoke's theorems, Electrostatic Field electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field and potential due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, Electric potential as line integral of electric field, electric dipole, uniformly charged spherical shell and solid sphere. Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarization, Parallel plate capacitor filled with dielectric.

Magnetostatics: Lorentz force, Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

Electromagnetic Induction and Alternating current: Field due to Helmhotz coil, solenoid and current loop, Ballastic galvanometer, Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, Mutual inductance of coil system Energy stored in magnetic field, Alternating currents, Alternating voltage across R-C, L-C, and R-L and LCR circuits, condition of resonance.

Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books:

1. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
2. Electricity and magnetism, Satyaprakash, Pragati prakashan , Meerut.

Practical List: (Any 12 of the following)

1. Measurements using Vernier calipers, screw gauge and spherometer
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Moment of Inertia of an irregular body by Inertia Table
4. To determine the Young's Modulus by Bending of Beam Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine g by Bar Pendulum.
7. To determine the Elastic Constants of a Wire by Searle's method.
8. To determine the Young's Modulus of a Wire by Optical Lever Method.

9. To determine g by Kater's Pendulum.
10. To study the Motion of a spring and to determine (a) Spring Constant (b) Value of g
11. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) To check the electrical fuses.
12. Ballistic Galvanometer:
    (i) Measurement of charge and current sensitivity
    (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
13. To compare capacitances using De'Sauty's bridge.
14. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
15. To study the Characteristics of a Series RC Circuit.
16. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor.
17. To determine a Low Resistance by Carey Foster's Bridge.
18. Conversion of galvanometer into voltmeter.
19. Conversion of galvanometer into ammeter.
20. Comparison of two resistances by potentiometer.

Practical Books:

1. Practical Physics vol. I, Gupta Humar, Pragati Prakasan, MeerutA
2. Text Book of Practical Physics, Indu Prakash and Ramakrishna, Kitab Mahal, New Delhi
3. Practical physics, Gupta & Kumar, Pragati Prakasan, Meerut

Semester-II

Paper I: Waves And Oscillations

Wave Motion : Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves. Wave intensity. Differential equation of SHM and its solutions. Kinetic and Potential Energies. Fourier's Theorem and it's applications to square wave, saw tooth wave and triangular wave

Harmonic Oscillations: Simple harmonic oscillations in mechanical and electrical systems. Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). Anharmonic oscillations. Superposition of two Perpendicular Harmonic Oscillations. Lissajous figures.

Damped and Forced Oscillations: Damped harmonic oscillator, power dissipation in damped harmonic oscillator, relaxation time and quality factor. Electrically damped

harmonic oscillator(LCR circuit). Forced harmonic oscillations in mechanical and electrical system, Transient and steady state behaviour, Resonance, sharpness of resonance, bandwidth, energy dissipation, quality factor of forced oscillator, mechanical and electrical impedances.

Ultrasonics and Accoustics: Intensity and loudness of sound -Decibels - Intensity levels - musical notes - musical scale. Generation of ultrasonic waves, their detection and applications, Pizo electric effect , Qurtz crystal, Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula -measurement of reverberation time - Acoustic aspects of halls and auditoria.

Reference Books:

1. Wave and oscillations : J.C.Upadhyaya- Himalaya Publishing
2. Wave and oscillations : N.Subramanyam and Brijlal
3. Oscillations, Waves and Acoustics: M.Ghosh, D.Bhattacharya- S.Chand
4. Waves and Oscillations, Satya Parkash, Pragati Prakashan , Meerut

Paper II: Optics

Geometrial optics and instruments: Fermat's Principle and laws of reflection and refraction using Fermat's principle, coaxial system, Cardinal points of an optical system, combinations of thin lences, Ramsdon's and Hygun's eyepieces, telescope, spectrometer, choromatic and spherical aberrations, various methods to minimize the chromatic aberration (achromatism) and to reduce the spherical aberration.

Interference: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment, Fresnel's Biprism. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination and equal thickness Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer: measurement of wavelength and difference of two wavelengths.

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits and diffraction from plane transmission grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Polarization: Transverse nature of light waves. Plane polarized light and production by reflection and refraction, Brewster's and Malus Laws, Double refraction, Nicol prism superposition of two plane polarized light. Circular and elliptical polarization. Quarter wave and half wave plate.

Reference Books:

1. Principles of Optics, B.K. Mathur, 1995, Gopal Printing

2. Optics, S.P.Singh and J.P.Agrawal, Pragati Prakashan Meerut.
3. Physical Optics, A.K.Ghatak.
4. Optics, Satya Prakash, Pragati Prakashan Meerut,
5. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
6. A Text Book of Optics, Subramanyam & Brij Lal,S Chand Publications.

Practical List: (Any 12 of the following)

1. To study damping effect of simple harmonic motion using simple pendulum.
2. To determine the frequency of AC main by sonometer using non magnetic wire.
3. To determine the frequency of AC main by electric vibrator in transverse and longitudinal arrangement.
4. To investigate the motion of coupled oscillator
5. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment in transverse and longitudinal arrangement
6. To study of Lissajous Figures using CRO.
7. To determine the velocity of sound in air at room temperature using Kundt's tube.
8. To Determination the angle of prism by Spectrometer
9. To determine the Refractive Index of the Material of Prism with mercury light
10. To determine Dispersive Power of the Material of Prism with Mercury Light
11. To determine the value of Cauchy Constants of a material of a Prism.
12. To determine the resolving power of a Prism.
13. To determine the resolving power of telescope
14. To determine wavelength of sodium light using Newton's Rings.
16. To determine wavelength light for different colors b y plane diffraction Grating using mercury light.
17. To determine hight of tower using Sextant.

Practical Books:

1. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
2. Practical Physics Vol II, by Gupta Kumar, Pragati prakasan, meerut.
3. Practical Physics by Vinod Goyal, Ram Nath & Kedar Nath Publications

SEMESTER III

Paper I: Heat And Thermodynamics

Laws of Thermodynamics: Thermodynamic systems and variables, Zeroth Law of thermodynamics and thermal equilibrium. First law and internal energy, conversion of heat into work, Indicator diagram, Thermodynamic Processes, Work Done during Isothermal and Adiabatic Processes, Joule- Thompson expansion of real gas ,

Second Law of Thermodynamics: Inadequacy of first law , Reversible & irreversible processes, Principle of Heat engine and refrigerator, Second law of thermodynamics, Carnot's

cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Thermodynamic Potentials: Enthalpy, Gibbs free energy, Helmholtz and Internal Energy functions, Thermodynamic relations & applications : Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for $(C_P - C_V)$, C_P/C_V, second law in terms of entropy.

Theory of Radiation and Kinetic Theory of Gases: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. Derivation of Maxwell's law of distribution of velocities and its experimental verification. Mean free path , Law of equipartition of energy and its applications to specific heat of gases; mono-atomic and diatomic gases.

Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. Heat and thermodynamics, Pragati prakasan, meerut
3. Heat and Thermodynamics, Brijlal and Subramaniam

Paper II: Solid state physics and Statistical Mechanics

Crystals: Lattice , basis and crystal structure, translation, primitive lattice, two and three dimensional lattice types, point group symmetry and miller indices, sc, fcc and bcc structure: coordination number, packing fraction, NaCl, CsCl and ZnS structures.

Reciprocal lattice: X-ray diffraction, Bragg's law, Laue and Powder method of X-ray diffraction, Reciprocal lattice, Reciprocal of fcc and bcc lattice, Briloun Zone.

Statistical Mechanics: Probsbility and thermodynamical probability, postulate statistical mechanics, macrostate and microstate, Equilibrium and fluctuations constraints, ensembles and average properties, Phase space, μ-space and gamma –space, division of phase space in to cells, Microcanonical, canonical and grand canonical ensembles, Entropy and probability, interpretation of second law of thermodynamics, Boltzmann canonical distribution law,

Kinetic theory of gases: Kinetic theory of gases, Maxwell's distribution laws of speed and velocities, average, rms and most probable speeds , degree of freedom, Brownian motion, mean free path, law of equipartition of energy.

Reference Books:

1. Introduction to Solid State Physics, C. Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, R I. Sighal
5. Solid-state Physics, S O Pillai
6. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India

7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
8. Statistical Mechanics, Gupta Kumar,Pragati Prakashan
9. Statistical Mechanics, Satya Prakash, Kedar Nath Ram Nath and Sons

Practical list: (Any 12 of the following)

1. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
2. To determine the Coefficient of Thermal Conductivity of rubber tube.
3. To determine the Coefficient of Thermal Conductivity of glass.
4. Measurement of Planck's constant
5. To determine Stefan's Constant.
6. To verify Newton's Law of Cooling.
7. To determine J by Joule's calorimeter.
8. To study I-V characteristics of Photo cell.
9. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
10. To determine the coefficient of thermal conductivity of a bad conductor by Lee dise method.
11. To verify the laws of probability distribution throwing one coin, two coin and ten coin.
12. To show that deviation of probability from theoretical value decreases with increase in number of events.
13. Study of statistical distribution from the given data and to find most probable, average and rms value.
14. Study of random decay of nuclear disintegration and determination of decay constant using dices.
15. To determine the refractive index of a dielectric layer using SPR
16. To study the PE Hysteresis loop of a Ferroelectric Crystal.
17. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
18. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four probe method and determine its band gap.
19. To determine the Hall coefficient of a semiconductor sample.

Practical Books:

1. Practical Physics, Gupta & Kumar, Pragati Prakashan , Meerut
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, Kitab Mahal, New Delhi.

Semester-IV

Paper I: Elements of Modern Physics

Fundamental quantum concepts: Planck's quantum theory, Photo-electric effect , Compton scattering, De Broglie wavelength and matter waves; Davisson-Germer experiment, Two slit interference experiment with photons, Wave-particle duality, Matter waves and wave amplitude,

Atomic models and spectra: Rutherford and Bohr atomic modles, Problems with

Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; energy levels and fine structure of Hydrogen like atoms spectra. Optical spectra, L- S , j-j coupling, slection rules, fine structure of sodium d line, Zeeman effect, X-ray spectra and Moseley's law

Nuclear physics: Size and structure of atomic nucleus and its relation with atomic weight Nature of nuclear forces, binding energy, semi-empirical mass formula Radioactivity, α , β and γ-radiation, stability of nucleus; Law of radioactive decay; Mean life & half-life; mass defect, Fission - nature of fragments and emission of neutrons. Nuclear fusion, Nuclear reactor and thermonuclear reactions

Special Theory of Relativity: Constancy of speed of light, Postulates of special theory of relativity, Lorenz transformations, length contraction, time dilation, addition of velocities, relativistic mass, mass energy relation, relativistic momentum and energy, relativistic Doppler Effect

Reference Books:

1. Fundamentals of modern physics, Agrawal and agrawal, pragati Parkashan, meerut
2. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
3. Quantum Physics, Berkeley Physics Course Vol.4, E.H. Wichman, 2008, Tata McGraw-Hill .

Paper II: Basic Electrical and Electronic circuits

Basic Electrical current and Circuits: electric current, AC /DC electricity, current density, Equation of continuity, Lorentz –Drudge Theory, Ohm's law, Current and Power, Kirchhoff's laws and applications. Main electric circuit elements and their combinations. Basic electric devices: resistor, inductor and capacitor, colour coding of resistors, Ammeter, Voltmeter, Galvanometer, AC/DC generators, Multimeter, Transformer

Network Analysis and Network Theorems: current source, voltage source, Source equivalence, four terminal networks, open circuits and short circuit impedances, T and π representation, image parameters, iterative paramcters. Network theorems: Superposition, Reciprocity, Thevenin's, Norton's and Maximum power transfer theorems

Semiconductor devices: Types of semiconductors: intrinsic and n-type, p-type semiconductors, temperature dependence, energy band and Fermi level in intrinsic semiconductor, concentration of Hole and Electrons, P-N Junction diode, depletion region, forward, reverse biased junction diode, Zener diode, Tunnel diode, Photo diode, LED, Point contact diode & Varactor diode

Rectifier and filters: Diode as circuit element, power supply, Load line concept, Half wave, Full Wave and Bridge rectifier, Shunt capacitor filter, series inductor filter, L-section, π-section and T- section filters , Zener diode as voltage regulator,

Reference Books:

1. Electricity & magnetism , Satya Prakash, Pragati prakashan , meerut
2. Text Book of Electronic devices and Circuits, R S Sedha, S Chand
3. Hand Book of Electronics, Gupta Kumar , Pragati parakashan. Meerut
4. Basic Electronics, Agrawal and Agrawal, pragati parkashan, Meerut

Practical List: (Any 12 of the following)

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine value of Planck's constant using LEDs of at least 4 different colours.
3. To determine the ionization potential of mercury.
4. To determine the wavelength of H-alpha emission line of Hydrogen atom.
5. To determine the absorption lines in the rotational spectrum of Iodine vapour.
6. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
7. To determine the value of e/m by Magnetron Valve method.
8. Thomson method
9. To determine the value of e/m by Millikan oil drop apparatus
10. Verification of Superposition Network theorem
11. Verification of Thevenin's Network theorem
12. Verification of Norton's Network theorem
13. Verification of Maximum power transfer theorem
14. Charactristics of Zener diode
15. Child Langmuir law
16. Frank Hertz experiment

Practical Books:

1. Practical Physics, Gupta & Kumar, Pragati Prakashan Meerut
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, Kitab Mahal, New Delhi.

SEMESTER-V

Paper –I : Electronics and Solid State Devices

Solid state devices: Transistors, N-P-N and P-N-P Transistors characteristics (CB, CE and CC Configurations), Current gains α and β parameters, Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Active, Cutoff, and

Saturation regions. Voltage Divider Bias Circuit for CE Amplifier. Field effect Transistors - JFET, MOSFET, UJT, SCR and their characteristics and applications.

Transistor Amplifier: Classification of Amplifiers, transistor biasing, h-parameters, RC coupled amplifier: single stage and double stage, Impedance and Transformer coupled amplifier, Power amplifiers.

Feed back Amplifiers: principle of feed back amplifiers, advantages and disadvantages of negative feed back amplifiers, Types of feed back amplifiers: Voltage series and shunt feed back amplifiers , Current series and shunt feed back amplifiers.

Amplifiers (Voltage and Current)

Operational Amplifier: Characteristics of an Ideal Op-Amp (IC 741), Open-loop & Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator.

Reference Books:

1. Text Book of Electronic devices and Circuits, R S Sedha, S Chand
2. Hand Book of Electronics, Gupta Kumar , Pragati Parakashan. Meerut
3. Solid State Electronics, Agrawal & Agrawal, Pragati Prakashan Meerut.

Paper-II: Mathematical Physics

Vectors: Product of two vectors, Triple product of vectors, simple application of vectors, Differentiation & partial differentiation, scalar and vector fields, Gradient of scalar field, line, surface and volume integrals of vector field, Divergence and curl and their applications, Gauss divergence and Stoke's theorems

Tensor: n-dimensional space, identical and summation conventions, dummy and ral indices, Kronecker delta symbol, Covariant and contravariant tensor, Rank of tensor and Tensors of higher rank Invariant tensor, Addition, subtraction , product and contraction of tensors, Summation, convention ,Symmetric and Antisymmetric tensor, fundamental tensors, raising and lowering of indices: associated tensors

Matrices : Algebric oerations of matrices: Addition, multiplication, properties of matrix multiplication, sub-matrices, partitioning of matrices, special types of matrices, Tamspose, Conjugate and Adjoint of matrices, symmetric and antisymmetric matrices, Hermition and skew hermition matrices, determinat of matrices, unitary matrices.

Laplace and Fourier Transform: Definition of Laplace transform, condition of existence of Laplace transform, properties of Laplace transform, Laplace transform of derivative f(t) and derivative of order n, Laplace transform of integral of f(t), Laplace transform of multiplication by t, Laplace transform of division by t, Initial and Final value theorems. Fourier integral and its

forms, Fourier theorem and its application to square wave, saw tooth wave and triangular wave

Reference Books:

1. Mathematical Physics, Satya Prakash, Pragati Prakashan, Meerut
2. Mathematical Physics, Dass and Verma, S Chand & company
3. Mathematical physics, B S Rajput,

Practicals List:

1. Charactristics of PN junction diode
2. Charactristics of Zener diode
3. Charactristics of NPN / PNP Transistors (CE, CB and CC configuration)
4. Charactristics of Tunnel diodestudy of ripple factor of power supply using L and π-section filters.
5. Study of Half wave and full wave rectifiers
6. Study of regulated poer supply
7. Study of VR tube
8. Single stage RC coupled amplifier
9. Single staghe Transitor coupled amplifier
10. Study of RC coupled amplifier with negative feedback
11. Band gap of semiconductor using PN junction diode
12. OP - Amplifier: Add , Sub, Diff and Intg

Practical Books: Practical Physics, Gupta & Kumar, Pragati Prakashan, Meerut

SEMESTER-VI

Paper I : Quantum Mechanics

Time dependent Schrödinger equation: Concept of wave function, Time dependent Schrödinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of wave function Probability and probability current densities, Conditions for Physical acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators and commutation relations; Expectation values of position and momentum and energy.

Time independent Schrödinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrödinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wave packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function.

Application of Schrödinger wave equation in one dimension: Particle in one dimensional box, quantization of momentum and energy, continuity of wave function, boundary condition and emergence of discrete energy levels; Potential step and potential barrier, Tunneling effect, one dimensional harmonic oscillator: energy levels and eigen functions

Quantum theory of hydrogen-like atoms: Time independent Schrödinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; Radial wave functions , magnetic and orbital quantum numbers, spherical harmonics, radial Wave functions , energy levels, significance of quantum numbers, n, l, and m.

Reference Books:

1. A Text book of Quantum Mechanics, P.M.Mathews & K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, E. Merzbacher, 2004, John Wiley and Sons,
3. Quantum Mechanics , Satya Prakash, Pragati Prakashan, Meerut
4. Quantum Mechanics, Bransden & Joachain, Pearson Education publications

Paper-II : Digital and optoelectronics

Number Systems, Codes and Boolean Algebra: Binary, Decimal, Octal and Hexa decimal number systems & inter conversion, BCD, Gray, 8421, excess-3 codes, Laws of Boolean algebra, De Morgan's theorems

Digital Circuits: Difference between Analog and digital circuits, Logic gates (AND, OR, NOT, AND, NAND, XOR & XNOR) with circuits,. NAND and NOR Gates as Universal Gates. Half adder and full adders.

IC Technology:
Basic idea of IC technology, IC 555 Pin diagram and its application, Monolythic ICs, IC components(Integrated, Diffused, Thin Film), MOS Capacitors, Inductors, Thin film technology

Optoelectronics and Laser: Optical fiber, Graded index, step index fibers, refractive index, propagation of optical beams in fibers, fibers mode characteristics and cut off conditions, losses in fibers. Principle of Laser, Ruby laser, He Ne laser, Solid state laser.

Books:

1. Digital Electronics, Malvino, TMH publications
2. Digital electronics: Principle and practice, Kapoor and Maheswari, Mackmillan publ.

3. Text book of eletronics, D C Tayal, Kedar Nath Ram Nath Publications.

Practicals List :

1. Study of Logic Gates(OR, AND, NOR , NAND, XOR)
2. Verification of De Morgan's theorems
3. Study of Half adder
4. Study of full adder
5. Study of 555 timer
6. Study of Characteristics of LED
7. Study of Characteristics of UJT
8. Study of Characteristics of JFET
9. Study of Characteristics of MOSFET
10. Study of Characteristics of SCR
11. Study of Electron Spin Resonance (ESR)- determine magnetic field as a function of the resonance frequency
12. To determine the wavelength of Laser light using Diffraction of Single Slit.

Practical Books:

1. Practical Physics, Gupta & Kumar, Pragati prakashan Meerut
2. Advanced practical physics, SP singh, Pragati prakasan Meerut.

SCHEME OF EXAMINATION

AND

COURSE OF STUDY

of

Mathematics

For

B.Sc. (PCM & PGM)

(w. e. f. Session 2019--2020)

(Yearly - System)

DEPARTMENT OF MATHEMATICS

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

B.A./B.Sc. I Year

S.N.	Paper	Paper code	Maximum Marks
1.	Differential Calculus	BM101	65
2.	Integral Calculus and Trigonometry	BM102	65
3	Algebra and Matrices	BM103	70

B.A./B.Sc. II Year

S.N.	Paper	Paper code	Maximum Marks
1.	Differential Equations	BM201	65
2.	Real Analysis	BM202	65
3	Advanced Algebra	BM203	70

B.A./B.Sc. III Year

S.N.	Paper	Paper code	Maximum Marks
1.	Linear Algebra & Linear programming Problems	BM301	65
2.	Complex Analysis	BM302	65
3	Numerical Analysis	BM303	70

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: I[st] Subject Code: BM-101

Course Title: DIFFERENTIAL CALCULUS Paper -I

Examination Duration: 2:30Hours Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Successive Differentiation, Leibnitz's theorem, Indeterminate form.
II. Partial Differentiation, Euler's theorem, Homogeneous Functions, Jacobian.
III. Tangents and Normal, Curvature, Asymptotes.
IV. Singular Points, Maxima and Minima.
V. Curve Tracing (Cartesian, Parametric, Polar).

Books Recommended:

1. M.Ray : Differential Calculus, Shiva Lal Agarwal and Co., Agra.
2. Gorakh Prasad :Differential Calculus, Pothishala publication, Allahabad

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS
B.Sc. Semester: I[st] Subject Code: BM-102
Course Title: INTEGRAL CALCULUS & TRIGNOMETRY Paper -II
Examination Duration: 2:30Hours Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Properties of Definite Integrals, Beta- Gamma functions.
II. Rectification, Quadrature.
III. Volumes and surfaces of solids of revolution, Double and triple integrals.
IV. Separation into real and imaginary parts, Logarithmic of complex quantities, Hyperbolic functions with their inverses.
V. Gregory's series, Summation of trigonometric series.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.

2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

3. S.L.Loney: Plane Trigonometry (Part I, II), Arihant Publications.

4. M.D.Raisinghania, H.C.Sexena& H. K.Dass : Trigonometry, S. Chand & Company Pvt. Ltd. 2002.

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: I[st] | Subject Code: BM-103

Course Title: ALGEBRA AND MATRICES | Paper -III

Examination Duration: 2:30Hours | Max. Marks: 70

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 5. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Sets, Operations on sets, Realtions, Equivalence relations and partition Functions, Algebraic structures, Group, Example of groups, Subgroups, Permutation group.

II. Order of an element, Cyclic -group, Coset- decomposition, Lagrange's theorem and its consequences.

III. Quotient group, Homomorphism, Isomorphism.

IV. Rank of a matrix, Invariance of rank under elementary transformations, Adjoint of matrices, Inverse of matrices, Reduction to normal form.

V. Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four, Solutions of a system of linear equations using matrices, Eigen values, Eigen vectors and Characteristic equation, Cayley Hamilton theorem and its Applications.

Books Recommended

1.John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

2. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.

3.A.I. Kostrikin, Introduction to Algebra, Springer Verlag, 1984.

4.Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: II[nd] | Subject Code: BM-201

Course Title: DIFFERENTIAL EQUATIONS | Paper -I

Examination Duration: 2:30Hours | Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. First order exact differential equations, Integrating factors, Rules to find an integrating factor, First order higher degree equations solvable for x, y, p. methods for solving higher-order differential equations.

II. Basic theory of linear differential equations, Wronskian, and its properties, Solving a differential equation by reducing its order.

III. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters.

IV. The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

V. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Books Recommended:

1. MShepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS
B.Sc. Semester: II[nd] Subject Code: BM-202
Course Title: REAL ANALYSIS Paper -II
Examination Duration: 2:30Hours Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Finite and infinite sets, Examples of countable and uncountable sets, Real line, Bounded sets, Suprema and infima, Completeness property of R, Archimedean property of R, Intervals, Concept of cluster points and statement of Bolzano-Weierstrass theorem.

II. Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences, Cauchy's theorem on limits, Order preservation and squeeze theorem, Monotone sequences and their convergence. Monotone convergence theorem without proof.

III. Infinite series, Cauchy convergence criterion for series, Positive term series, Geometric series, Comparison test, Convergence of p-series, Root test, Ratio test, Alternating series, Leibnitz's test (Tests of convergence without proof), Definition and examples of absolute and conditional convergence.

IV. Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, log (1+x), $(1+x)^m$.

V. Sequences and series of functions, Point wise and uniform convergence, Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

Books Recommended

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.

2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia), P. Ltd., 2000.

3. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

4. Texts in Mathematics, Springer Verlag, 2003

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: II[nd] | Subject Code: BM-203

Course Title: ADVANCED ALGEBRA | Paper –III

Examination Duration: 2:30Hours | Max. Marks: 70

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 5. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Cayley's theorem. Normalizer and center of a group.
II. Normal subgroups and their properties, Simple group.
III. Rings, various types of rings, Subrings, Properties of rings.
IV. Ideals, Principal ideal ring, Quotient rings, Characteristics of a ring.
V. Integral domain, Field, Skew field: Examples and its characterizations.

Books Recommended

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Joseph A Gallian. Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
3. Khanna & Bhambhari, A course in Abstract Algebra, 4th ED, Vikash Publication 2006.

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: III[rd] Subject Code: BM-301

Course Title: LINEAR ALGEBRA & LPP Paper –I

Examination Duration: 2:30Hours Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Vector spaces, Subspaces, Algebra of subspaces, Quotient spaces, Linear combination of vectors, Linear span, Linear independence, Basis and dimension, Dimension of subspaces. Linear transformations, Null space, Range, Rank and nullity of a linear transformation, Matrix representation of a linear transformation, Algebra of linear transformations.

II. Dual Space, Dual basis, Double dual, Characteristic polynomial, Eigenvalues and eigen vectors, Isomorphisms, Isomorphism theorems, Invertibility and isomorphisms, Change of coordinate matrix.

III. Linear programming problems, Graphical approach for solving some LPP, Convex sets, Supporting and separating hyper planes.

IV. Theory of simplex method, Optimality and unboundedness, The simplex algorithm, Simplex method in tableau format, Introduction to artificial variables.

V. Two-phase method, Big-M method and their comparison. Duality, formulation of the dual problem, Primal-dual relationships, Economic interpretation of the dual.

Books Recommended

1. Stephen H.Friedberg, Arnold J.Insel, Lawrence E.Spence, *Linear Algebra*, 4thEd., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
2. David C.Lay, *LinearAlgebra and its Applications*, 3rdEd., Pearson Education Asia, Indian Reprint, 2007.
3. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005
4. F.S.HillierandG.J.Lieberman, *Introduction to Operations Research*, 8thEd., TataMcGrawHill, Singapore, 2004.
5. Hamdy A. Taha, *Operations Research*, An Introduction, 8th Ed., Prentice-Hall India, 2006.

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: III[rd] Subject Code: BM-302
Course Title: COMPLEX ANALYSIS Paper –II
Examination Duration: 2:30Hours Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Complex numbers and basic properties, Geometric representation of complex numbers, Trigonometrical and hyperbolic complex functions, Analytical, Cauchy-Riemann equations. Harmonic functions.

II. Conformal Mapping: Geometric representations, transformations, Theorems on Conformal mapping , Magnification, The circle, Inverse point w.r.t. a circle, Some elementary Transformations, Bilinear Transformations, Some special Bilinear Transformations, Fixed point and Normal form of a Bilinear Transformations.

III. Complex integration: Cauchy's Integral Theorem, Cauchy's fundamental theorem of integration, Cauchy's Integral formula, Cauchy's Integral formula for the derivative of Analytic functions, Morera's theorem.

IV. Cauchy's Inequality, Taylor's theorem, Laurent's series, Liouville's theorem.

V. Zeros and singularities of Analytic functions.

Recommended Books

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw – Hill International Edition, 2009.
2. G C sharma & M. jain: Complex Analysis, Y.K. Publishers.
3. Mark J. Ablowitz & A. S. Fokas: Complex Variables: Introduction & Applications Cambridge Univ. Press.

SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI GARHWAL, UTTARAKHAND

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: III[rd] Subject Code: BM-303

Course Title: NUMERICAL ANALYSIS Paper –III

Examination Duration: 2:30Hours Max. Marks: 70

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 5. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

I. Finite difference, Difference Operator, Factorial notation, Interpolation with equal Intervals.

II. Interpolation with unequal intervals, Divided difference, Central differences Stirling and Bessel formula (application only).

III. Numerical differentiation and Integration, Simpson's 1/3 and 3/8 rule, weddle's rule Trapezoidal rule and their accuracy.

IV. Numerical solution of algebraic and transcendental equation, iterative bisection, Regula Falsi, Newton Raphson, Graeffe method.

V. Numerical solution of differential equation, Picard's Euler, Modified Euler, Runge-Kutta Method.

Recommended Books

1. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M.K.Jain, S.R.K. Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, 5th Ed., New age International Publisher, India, 2007.

BSc Chemistry Syllabus

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications, the syllabus pertaining to B.Sc. (3 Year Degree Course) in the subject of Chemistry has been prepared as per provision of the UGC module and demand of the academic environment. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills. This B.Sc course of Chemistry consists of 3 year-course with semester system - in all six semesters (two semesters in a year). Total marks: 1500 (500 per year and 250 per semester) of core discipline.

BSc Sem I

S. No.	Paper	Paper Code	Max Marks (100)	
			Ext.	Int.
1	Inorganic Chemistry	BCH101	80	20
2	Organic Chemistry/Physical Chemistry	BCH102	80	20
5	Lab Course I	BCH10P	40	10

BSc Sem II

S. No.	Paper	Paper Code	Max Marks (100)	
			Ext.	Int.
1	Inorganic Chemistry	BCH201	80	20
2	Organic Chemistry/Physical Chemistry	BCH202	80	20
5	Lab Course II	BCH20P	40	10

BSc Sem III

S. No.	Paper	Paper Code	Max Marks (100)	
			Ext.	Int.
1	Inorganic Chemistry/ Physical Chemistry	BCH301	80	20
2	Organic Chemistry	BCH302	80	20
5	Lab Course III	BCH30P	40	10

BSc Sem IV

S. No.	Paper	Paper Code	Max Marks (100)	
			Ext.	Int.
1	Inorganic Chemistry/ Physical Chemistry	BCH401	80	20
2	Organic Chemistry	BCH402	80	20
5	Lab Course IV	BCH40P	40	10

BSc Sem V

S. No.	Paper	Paper Code	Max Marks (100)	
			Ext.	Int.
1	Physical Chemistry	BCH501	80	20

2	Organic Chemistry/ Inorganic Chemistry	BCH502	80	20
5	Lab Course V	BCH50P	40	10

BSc Sem VI

S. No.	Paper	Paper Code	Max Marks (100)	
			Ext.	Int.
1	Physical Chemistry	BCH601	80	20
2	Organic Chemistry/ Inorganic Chemistry	BCH602	80	20
5	Lab Course VI	BCH60P	40	10

Semester I (90 lectures)

Paper I: Inorganic Chemistry

1. Atomic Structure and Periodic Properties (16 Lecture)

Bohr's model, Summerfield's extension, de Broglie's wave particle duality; Heisenberg's uncertainty principle and Schrödinger's equation (qualitative); significance of ψ and ψ^2, radial density, angular probability, Quantum numbers and their significance. Aufbau principle, Pauli's exclusion/ant symmetry principle (statement and implication), Hund's rules, Slater's rules, quantum defect; Brief discussion of the following properties of the elements, with reference to s & p-block and the trends shown:

a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
b) Atomic and ionic radii
c) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization enthalpy and trends in groups and periods.
d) Electron gain enthalpy and trends in groups and periods.
e) Electro negativity, Pauling's scale. Variation of electro negativity with bond order, partial charge.

2. Chemical Bonding & Ionic Solids (14 Lecture)

Covalent bond: Valence Bond theory (Heitler-London approach). Concept of hybridization; Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_3, PCl_5, SF_6, ClF_3, I_3^-, BrF_2^+, PCl_6^-, ICl_2^- ICl_4^- and SO_4^{2-}.

Molecular orbitals (MO) approach of bonding (LCAO Method). Symmetry and overlap, symmetry of molecular orbitals, Bonding in Homonuclear molecules (H_2 to Ne_2) and NO, CO, CN^+, CO^+, CN^-, HF, HCl, CO_2, Comparison of VB and MO theories.

Covalent character in ionic compounds, Fajan's rules and consequences of polarization; Percentage Ionic character in covalent compounds, Dipole moment

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals; Lattice defects, semiconductors, lattice energy and Borne-Haber cycle. Solvation energy and solubility of ionic solids

Weak interactions-hydrogen bonding and Van der Waals forces

3. s-block elements **(5 Lecture)**

General discussion with respect to all periodic and chemical properties, diagonal relationship, chemical reactivity and trends in alkali and alkaline earth metals; structure and properties of Hydrides, oxides, halides and hydroxides, coordination complexes, Organometallic compounds of alkali metals, Crown and Crypts, Role of alkali and alkaline earth metal ions in bio-systems

4. p-b lock elements & Chemistry of Noble gases **(10 Lecture)**

General discussion and comparative study (all periodic and chemical properties) including diagonal relationship, of groups 13 to 17 elements; chemistry of elements-hydrides, oxides & oxy-acids, and halides (including inter-halogen compounds). Diborane-properties & structure, borohydrides, carbides, fluorocarbons, basic properties of iodine and polyhalides. Inert-pair effect: in heavier elements of 13, 14 & 15 group elements; its consequences in redox properties of their halides. Chemistry of noble gasses.

Books Suggested:

Inorganic Chemistry:

1. J.D. Lee Concise, Inorganic Chemistry, ELVS.
2. Puri, Sharma and Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
4. Selected topics in Inorganic Chemistry, Malik, Tuli and Madan, S. Chand &
5. Company, New Delhi.
6. Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhii. I.L. Finar, Organic Chemistry, Pearson.

Paper II: Organic Chemistry/Physical Chemistry

1. Structure and Bonding in organic compounds, and Mechanism of Organic Reactions (9 Lectures)

Hybridization, Shapes of molecules bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes resonance, aromaticity, Inductive, electromeric, resonance and mesomeric effects, hyperconjugation, dipole moment; hydrogen bonding (Applications to be discussed with relevant topics).

Homolytic and Heterolytic fission with suitable examples. Curved arrow notation, drawing electron movements with arrows, half headed and double headed arrows, formal charges; Electrophiles and Nucleophiles; Types, shape and relative stability of Carbocations,

Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions: Addition, Elimination and Substitution reactions. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

2. Stereochemistry of Organic Compounds **(12 Lectures)**

Concept of isomerism, Types of isomerism

Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeric centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules. D & L and R & S systems of nomenclature.

Geometric isomerism – determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds

Conformational isomerism – conformational analysis of ethane and n-butane; conformational analysis of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivative, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Difference between configuration and conformation

3. Gaseous, Liquid and Solid States **(18 Lecture)**

Kinetic theory of gases, Deviation of real gases from ideal behaviour, compressibility factor, van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomenon, critical constants and their calculation from van der Waals equation; Laws of corresponding states.

Molecular velocities: Root mean square, average and most probable velocities, qualitative discussion of the Maxwell's distribution of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance., collision number, mean free path and collision diameter, liquefaction of gases (based on Joule-Thomson effect);

Intermolecular forces, structure of liquids (a qualitative description) Structural differences between solids, liquids and gases. Physical properties of liquids including their methods of determination: surface tension, viscosity and refractive index. Liquid crystals, Difference between liquid crystal, solids and liquids.

Definition of space lattice, unit cell, crystal planes, Miller indices, Laws of crystallography – (i) law of constancy of interfacial angels (ii) law of rationality of indices (iii) law of symmetry; Symmetry elements in crystals, X-ray diffraction by crystals,. Derivation of Bragg's equation; Determination of crystal structure of NaCl, KCl and CsCl by Laue's method and powder methods.

4. Colloidal State **(6 Lecture)**

Definition of colloids, classification of colloids. Solids in liquids (sols): properties – kinetic, optional and electrical; stability of colloids, protective action, Hardy-Schulze law, gold

number. Liquids in liquids (emulsions): types of emulsions, preparation, emulsifier. Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids.

Books Suggested:

Organic Chemistry:

1. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
2. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
3. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
4. Elementary Spectroscopy, Y.R. Sharma, S. Chand,
5. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.

Physical Chemistry:

1. Atkins P.W., Physical Chemistry, Oxford University Press.
2. Bell D.W., Physical Chemistry, Thomson Press.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi
4. Puri and Sharma and Pathaniya, Principles of Physical Chemistry, Milestone Publisher and Distributors, New Delhi.
5. Bahl and Tuli, Essential of Physical Chemistry, S. Chand & Company, New Delhi.

Lab Course B.Sc. I st semester (4hours)

1. Mixture analysis for six radicals including interfering radicals and combination tests. Cations : NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+ Anions : CO_3^{2-}, S^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$ 12 marks

2. (i) Detection of extra element (N, S, X) in the organic compounds (containing two elements). 4×2 marks

   (ii) Detection of functional groups in the organic compounds (containing two functional groups).

3.(i) Determination of relative surface tension of a liquid and its parachor value. 10 marks

(ii) Determination of relative coefficient of viscosity of a liquid and its Rheochor value.

4. Viva 5 marks

5. Record 5 marks

Semester II (90 lectures)

Paper I: Inorganic Chemistry

1. Chemistry of Transition Elements (First Transition Series) (8 Lecture)

Characteristic properties of the elements; ionic radii, oxidation states, complex compound formation and magnetic properties. Their binary compounds, illustrating relative stability of their oxidation states, coordination number and geometry.

2. Chemistry of Transition Elements (Second and Third Series) (6 Lecture)

General characteristics, comparative treatment with their analogues in respect of ionic radii, oxidation state, magnetic behaviour and stereochemistry.

3. Chemistry of Lanthanides and Actinides (10 Lecture)

Electronic structure, oxidation states, ionic radii, lanthanide contraction and its consequences, complex formation, methods of separation of lanthanidesfractional crystallization, fractional precipitation, change in oxidation state, solvent extraction and ion exchange methods. General features of actinides-electronic configuration, atomic and ionic radii, ionization potential, oxidation states and complex formation.

4. Metal Carbonyls and Nitrosyls (10 Lecture)

Definition, nomenclature and classification based on nature of metal-carbon bond. Metal carbonyls. Mononuclear carbonyls, nature of bonding, structure and preparation. EAN and 18-electron rule. Definition, nomenclature, classification, general methods of preparation of organometallic compounds and a brief account of metal-ethylenic complexes. Applications of organometallic compounds-Ziegler-Natta catalyst, Wilkinson catalyst (No mechanism). Metal nitrosyl compounds, nitrosyl carbonyls. Dinitrogen and dioxygen complexes, tertiary phosphines as ligand.

Books Suggested:

Inorganic Chemistry:

1. J.D. Lee Concise, Inorganic Chemistry, ELVS.
2. Puri, Sharma and Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
4. Selected topics in Inorganic Chemistry, Malik, Tuli and Madan, S. Chand &
5. Company, New Delhi.
6. Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhii. I.L. Finar, Organic Chemistry, Pearson.

Paper II: Organic Chemistry/Physical Chemistry

1. Alkanes, alkenes, alkynes and dienes (20 Lecture)

Nomenclature, classification and isomerism in alkanes, methods of preparations physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. Cycloalkanes- nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations; Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring-bent or banana bonds.

Nomenclature of alkenes , methods of formation, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff Rule, Hoffmann Elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes -mechanisms involved in electrophilic and free radical additions,

Markownikoff's Rule, hydroborationoxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$. Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes.
Methods of formation, and chemical reactions of cycloalkenes.
Nomenclature and classification of dienes; isolated, conjugated and cumulative dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions- 1,2 and 1,4 additions, Diels -Alder reaction.
Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions. hydroboration- oxidation, metal- ammonia reduction, oxidation and polymerization.

2. Arenes and Aromaticity; Alkyl and Aryl Halides (12 Lecture)

Structure of benzene: molecular formula and Kekule structure. Stability and carbon –carbon bond length of benzene, resonance structure, MO picture. Aromaticity –the Hückel rule. Aromatic electrophilic substitution –general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction. Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.
Methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides. SN_2 and SN_1 reactions with energy profile diagrams. Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactiviteis of alkyl halides vs. allyl, vinyl and aryl halides.

3. Thermodynamics (Second and Third Law) (14 Lecture)

Brief introduction of First Law of Thermodynamics and related topics;
Second law of thermodynamics, need of the law, different statements of the law; Carnot cycle and its efficiency, Carnot theorem; Thermodynamic scale of temperature; Concept of entropy: entropy as a state function, entropy as a function of V and T, entropy as a function of P and T, entropy change in physical and chemical processes, entropy change in reversible and irreversible processes. Clausius inequality, entropy as criteria of spontaneity and equilibrium; Entropy change in ideal gases and mixing of gases;
Gibbs and Helmoltz functions; Gibbs function (G) and Helmoltz function (A) as thermodynamic quantities, A and G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T; Gibbs-Helmoltz equation, Clapeyron equation, Clausius-Clapeyron equation, reaction isotherm and reaction isochore;

Statement and concept of residual entropy, third law of thermodynamics, unattainability of absolute zero, Nernst heat theorem. Evaluation of absolute entropy from heat capacity data

4. Chemical Kinetics (10 Lecture)

Rates of reactions, rate constant, order and molecularity of reactions. Differential rate law and integrated rate expressions for zero, first, second and third order reactions. Half-life time of a reaction. Methods for determining order of reaction. Effect of temperature on reaction rate and the concept of activation energy. Reaction mechanism. Steady state hypothesis. Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis. Unimolecular surface reactions.

Books Suggested:

Organic Chemistry:

1. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
2. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
3. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
4. Elementary Spectroscopy, Y.R. Sharma, S. Chand,
5. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.
6. Jagdamba Singh, Undergraduate Organic Chemistry Vol.-I, Pragati Prakashan

Physical Chemistry:

1. Atkins P.W., Physical Chemistry, Oxford University Press.
2. Bell D.W., Physical Chemistry, Thomson Press.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi
4. Puri and Sharma and Pathaniya, Principles of Physical Chemistry, Milestone Publisher and Distributors, New Delhi.
5. Bahl and Tuli, Essential of Physical Chemistry, S. Chand & Company, New Delhi.

Lab Course B.Sc. IInd semester (4 hours)

1. (a) Redoxtitration: (i) Iodometry (ii) $Fe^{2+}/K_2Cr_2O_7$ 12 marks
   (b) Hardness of water by EDTA methods.
2. Organic synthesis involving nitration, halogenations, sulphonation, oxidation and benzoylation. 8 marks
3. (i) Determination of transition temperature of inorganic substances. 10 marks
   (ii) Construction of phase diagram of a two component system.
   (iii)Determination of heat capacity of calorimeter for different volumes.
4. Viva 5 marks
5. Record 5 marks

Semester III (90 lectures)

Paper I: Inorganic Chemistry/Physical Chemistry

1. Coordination Chemistry-I (10 Lecture)

Werner's theory for coordination compounds; its experimental verification, effective atomic number (EAN) concept, chelates. Nomenclature of coordination compounds (IUPAC system), isomerism in coordination compounds, stability of complexes and factors contributing to the stability; Valence Bond Theory (VBT) for coordination compounds, magnetic properties of complex compounds.

2. Coordination Chemistry-II: Metal-Ligand Bonding in transition Metal Complexes (8 Lecture)

Limitations of valence bond theory, an elementary idea about crystal field theory; crystal field splitting octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters. Jahn Teller Distortion in complexes.

3. Chemical and Ionic Equilibrium (14 Lecture)

General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and G°; Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant-Van't HofT equation, homogeneous & heterogreneous equilibria, Le Chetalier's principle.

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

4. Electrochemistry (10 Lecture)

Specific conductance, molar conductance and their dependence on electrolyte concentration. Ionic Equilibria and conductance, Essential postulates of the Debye-Huckel theory of strong electrolytes. Mean ionic activity coefficient and ionic strength. Transport number and its relation to ionic conductance and ionic mobility.

Conductometric titrations. pH scale. Buffer solutions, salt hydrolysis. Acid-base indicators.

Distinction between electrolytic and electrochemical cells. Standard EMF and electrode potential. Types of electrodes Reference electrode. Calculation of ΔG, ΔH, ΔS and equilibrium constant from EMF data. Potentiometric determination of pH. Potentiometric titrations.

Books Suggested:

Inorganic Chemistry:

1. J.D. Lee Concise, Inorganic Chemistry, ELVS.
2. Puri, Sharma and Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
4. Selected topics in Inorganic Chemistry, Malik, Tuli and Madan, S. Chand &
5. Company, New Delhi.
6. Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhii. I.L. Finar, Organic Chemistry, Pearson.

Physical Chemistry:

1. Atkins P.W., Physical Chemistry, Oxford University Press.
2. Bell D.W., Physical Chemistry, Thomson Press.

3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi
4. Puri and Sharma and Pathaniya, Principles of Physical Chemistry, Milestone Publisher and Distributors, New Delhi.
5. Bahl and Tuli, Essential of Physical Chemistry, S. Chand & Company, New Delhi.

Paper II: Organic Chemistry

1. Alcohols and Phenols **(16 Lecture)**

Alcohols: Classification and nomenclature. Monohydric alcoholsmethods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols-methods of preparation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4], esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation and pinacol-pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol.

Phenols: Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Electrophilic substitution: Nitration, halogenation and sulphonation, acylation and carboxylation, Mechanism of Fries rearrangement,Reimer-Tiemann Reaction, Claisen condensation, Lederer-Manasse reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

2. Ethers and Epoxides **(6 Lecture)**

Ethers: Structure, Physical properties, preparation (Williamson synthesis). Reactions : Cleavage by acids. Electrophilic substitution in ethers.

Expoxides: Preparation: From Halohydrins, Peroxidation of Carbon-carbon double bonds. Reactions with acid, base and Grignard reagents.

3. Chemistry of Carbonyl compounds (aldehydes and Ketones) (12 Lecture)

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis from acid chlorides, synthesis using 1,3-dithianes, from nitriles and carboxylic acids. Physical properties. Mechanism of nucleophilc additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives: Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, LiAlH4 and NaBH4 reductions. Halogenation of enolizable ketones. An introduction to α-, β-unsaturated aldehyde and ketones.

4. Carboxylic Acids and derivatives (14 Lecture)

Carboxylic Acids: Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids.

Hydroxy acids: maleic, tartaric and citric acids. Methods of formation and chemical reactions of unsaturated monocarboxylic acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

Carboxylic acid derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.
Preparation of carboxylic acid derivatives, chemical reactions. Mechanism of esterification and hydrolysis (acidic and basic).

Books Suggested:

Organic Chemistry:

1. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
2. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
3. S.M. Mukerji and Singh, Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
4. Elementary Spectroscopy, Y.R. Sharma, S. Chand,
5. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.
6. Jagdamba Singh, Undergraduate Organic Chemistry Vol.-I, Pragati Prakashan

Lab Course B.Sc. III semester (4 hour)

1. Inorganic preparations: 8 marks
   (i) Cuprous chloride
   (ii) Potash alum
   (iii)Chrome alum
   (iv)Ammonium ferric sulphate
   (v) Ferrous oxalate

3. Identification of simple organic compounds (formation of derivatives not included). 12 marks

3. (i) Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 10 marks
   (ii) Determination of enthalpy of solutions (NH_4NO_3 & $CaCl_2$).
   (iii) Separation of amino acids and sugars by paper / TLC chromatography.
4. Viva 5 marks
5. Record 5 marks

Semester IV (90 lectures)

Paper I: Inorganic Chemistry/Physical Chemistry

1. Thermodynamic and Kinetic Aspects of Coordination Compounds (8 Lecture)

A brief outline of thermodynamic and kinetic stability of metal complexes and factors affecting the stability of coordination compounds. Substitution reactions in square planar complexes.

2. Magnetic Properties of Transition Metal Complexes **(8 Lecture)**

Types of magnetic behaviour, methods of determining magnetic susceptibility; Gouy's and Quincke's methods, spin only formula, correlation of μs and μeff values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

3. Physical Properties and Molecular Structure **(8 Lecture)**

Optical properties and their relation with chemical constitution, polarization, 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 its application in determining the structure of molecules.

4. Surface Chemistry, Catalysis and Phase Equilibrium **(16 lecture)**

Bulk phases and interfacial region, types of interfaces; Surface tension and interfacial tension. Adsorption of gases on solids, chemisorption and physi-sorption, desorptoin. Adsorption isotherms; theories of adsorption, Langmuir isotherm, Freundlich isotherm, Adsorption and catalysis; Catalysis, characteristics of catalyzed reactions, classification of catalysis, miscellaneous examples.

Statement and meaning of the terms: phase, component and degree of freedom, derivation of Gibbs phase rule. One component systems-water, sulphur, carbon dioxide, helium. Phase equilibria of two component systems: solid-liquid equilibra, simple eutectic; Bi-Cd, Pb-Ag systems, desilverisation of lead; construction and interpretation of general phase diagrams for liquid vapour, liquid-liquid and liquid-solid systems.

Books Suggested:

Inorganic Chemistry:

1. J.D. Lee Concise, Inorganic Chemistry, ELVS.
2. Puri, Sharma and Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
4. Selected topics in Inorganic Chemistry, Malik, Tuli and Madan, S. Chand &
5. Company, New Delhi,
6. Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhii, I.L. Finar, Organic Chemistry, Pearson.

Physical Chemistry:

1. Atkins P.W., Physical Chemistry, Oxford University Press.
2. Bell D.W., Physical Chemistry, Thomson Press.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi
4. Puri and Sharma and Pathaniya, Principles of Physical Chemistry, Milestone Publisher and Distributors, New Delhi.
5. Bahl and Tuli, Essential of Physical Chemistry, S. Chand & Company, New Delhi.

Paper II: Organic Chemistry

1. Nitrogen Containing Organic Compounds **(14 Lecture)**

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium. Picric acid. Halonitroarenes-reactivity, structure and nomenclature of amines. Physical properties. Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabrielphthalimide reaction, Hofmann bromamide reaction. Reaction of amines, electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

2. Chemistry of Carbohydrates **(10 Lecture)**

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. General study of disaccharides (structure determination not required). General introduction of structure of ribose and deoxyribose.

3. Amino Acids, Peptides, Proteins and Nucleic Acids **(14 Lecture)**

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solidphase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation.

Nucleic acids : Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

4. Heterocyclic Compounds **(12 Lecture)**

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and 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 of condensed five- and six membered heterocycles. Preparation and reactions of quinolene and isoquinolene with special reference to Fischer-Indole synthesis, Skraups synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of quinolene and isoquinolene.

Books Suggested:

Organic Chemistry:

1. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
2. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.

3. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
4. Elementary Spectroscopy, Y.R. Sharma, S. Chand,
5. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.
6. Jagdamba Singh, Undergraduate Organic Chemistry Vol.-I, Pragati Prakashan

Lab B.Sc. IV semester (4 hour)

1. Preparation of inorganic complex compounds : 8 marks
(i) Tetraammine copper sulphate (ii) Prussian blue (iii) Hexammine nickel (II) chloride
(iv) Potassium trioxalato chromate (III) (v) Hexaammine cobalt (III) chloride.
2. Estimation of functional groups such as –OH, $–NH_2$, –CHO, –COOH etc. 12 marks
3. (i) Kinetics of First order reaction. 10 marks
(ii) Viscosity-composition curve for a binary mixture.
(iii) Determination of strength of unknown acids or bases by using pHmetry.
5. Viva 5 marks
6. Record 5 marks

Semester V (90 lectures)

Paper II: Physical Chemistry

1. Elementary Quantum Mechanics **(14 Lecture)**

Quantum mechanics of simple systems: Schrodinger's wave equation, and time dependent Schrodinger's wave equation, postulates of quantum mechanics. Eigen functions and eigen values and quantum mechanical operatore. Expectation value of a physical quantity. Orthogonality of wave functions. The particle in a one dimensional box problem and its solutions. Particle in three dimensional box. Degeneracy, rigid rotor and harmonic oscillator.

2. Molecular Spectroscopy **(14 Lecture)**

Region of electromagnetic spectrum, emission and absorption spectra, signal to noise ratio and resolving power, width and intensity of spectral transitions, pure rotational spectra, diatomic rigid rotor molecules, effect of isotope substitution, vibrational and vibration-rotational spectra of diatomic molecules, harmonic oscillator-rigid rotor approximation, anharmonicity effect, normal modes of vibration, infrared spectra of linear and bent AB2 molecules, electronic spectra of diatomic molecules, vibrational structure, Franck-Condon principle.

3. Photochemistry **(12 Lecture)**

Interaction of radiation with matter, difference between thermal and photochemical rocesses. Laws of photochemistry; Grothuss-Drapper law, Lambert's law, Lambert-Beer's law, Stark-

Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

4. Energy and Distribution Law **(6 Lecture)**

Degrees of freedom, types of energies in linear and non-linear molecules, derivation and applications of Maxwell-Boltzmann distribution law.

Books Suggested:

Physical Chemistry

1. Atkins P.W., Physical Chemistry, Oxford University Press.
2. Bell D.W., Physical Chemistry, Thomson Press.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi
4. Puri and Sharma and Pathaniya, Principles of Physical Chemistry, Milestone Publisher and Distributors, New Delhi.
5. Bahl and Tuli, Essential of Physical Chemistry, S. Chand & Company, New Delhi.
6. G Joshi, R Verma, R Bahuguna and S Kothiyal, Integrated Instrumental methods in spectroscopic and separation techniques Pragati Publication Meerut

Paper II: Inorganic Chemistry/Organic Chemistry

1. Basics of Bioinorganic Chemistry **(10 Lecture)**

Introduction of bioinorganic chemistry, General properties of biological molecules, physical methods in bio-inorganic chemistry, Binding of metal ions and complexes with biomolecule active centers, Atoms and group transfer chemistry, Electron transfer in Proteins

2. Inorganic Pulymers of Silicones and Phosphates **(8 Lecture)**

Silicones: siloxanes, silicone rubber, polymethylhydrosiloxanes, applications. Phosphazenes, nature of bonding in triphosphazenes. Zeolites.

3. Organo-Metallic Compounds & Organic Synthesis via Enolates **(16 Lecture)**

Organic derivatives of lithium and magnesium – their preparation, properties and reactions. Organocopper intermediates; Organozinc compounds; formation and chemical reactions. Synthetic applications of other transition metals; Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acid, sulphonamides and sulphaguanidine.

Acidity of methylene hydrogen, alkylation of diethylmalonate and ethylacetoacetate. Synthesis of ethylacetoacetate, the Claisen condensation. Keto-enol tautomerism of ethylacetoacetate. Synthetic uses of ethylacetoacetate and diethylmalonate.

4. Synthetic Polymers and Synthetic dyes **(10 Lecture)**

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

Colour and constitution (electronic concept), classification of dyes. Synthesis and uses of Methyl orange, Malachite green, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Books Suggested:

Inorganic Chemistry:

1. J.D. Lee Concise, Inorganic Chemistry, ELVS.
2. Puri, Sharma and Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
4. Selected topics in Inorganic Chemistry, Malik, Tuli and Madan, S. Chand &
5. Company, New Delhi.
6. Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhii. I.L. Finar, Organic Chemistry, Pearson.

Organic Chemistry:

1. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
2. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
3. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
4. Elementary Spectroscopy, Y.R. Sharma, S. Chand,
5. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.

Lab Course B.Sc. V semester (6 hour)

1. Gravimetric estimations of copper-zinc, copper-nickel and silver-copper in their respective solutions 12 marks
2. Separation of binary mixture of organic compounds (solid-solid). 10 marks
3. (i) Determination of equilibrium constant of methyl acetate hydrolysis reaction. 8 mark
   (ii)Potentiometric titration: Acid-base.
   (iii)Order of reaction of I_3^-/Acetate/H^+.
4. Viva 5 marks
5. Record 5 marks

Semester VI (90 lectures)

Paper I: Physical Chemistry

1. Basics of NMR and Mass Spectrometry (10 Lecture)

Principle and Instrumentation of NMR spectroscopy, nuclear shielding and deshielding. Factors affecting chemical shift. Spin coupling. Applications of NMR spectroscopy. Applications of NMR spectroscopy. Introduction and Principle of Mass Spectrometry; Instrumentation of Mass Spectrometer Ion Source or Ionization Chamber Electron-Impact ionisation (EI-MS) Chemical Ionisation (CI-MS); m/z peak; Applications of mass spectroscopy.

2. Introduction to Nuclear Chemistry (14 Lecture)

Nuclear Chemistry: Classification of nuclides, nuclear stability and binding energy, atomic energy. Radioactivity: general characteristics of radioactive decay kinetics, artificial radioactivity, detection and measurement of radioactivity: GM counter.
Nuclear Reactions: Types of nuclear reactions, conservation of linear momentum and mass-energy in nuclear reactions, nuclear reaction cross section. Compound nucleus theory and its experimental verification; nuclear fission process, fission energy;
Interaction of nuclear radiations with matter- charged particle, neutrons and gamma rays. Radiolysis of water and aqueous solutions, radiation dosimetry.

3. Solutions and Colligative Properties **(12 Lecture)**

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solutions, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular mass determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular mass from osmotic pressure. 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.

4. Separation Techniques **(10 Lecture)**

Introduction to Analytical Chemistry and its interdisciplinary nature; Concept of sampling; Importance of accuracy, precision and sources of error in analytical measurements; Presentation of experimental data and results, from the point of view of significant figures; Definition, general introduction on principles of chromatography. Qualitative and quantitative aspects of chromatographic methods of analysis: paper chromatography, TLC etc. IC, GLC, GPC, and HPLC. Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.

Books Suggested:

Physical Chemistry

1. Atkins P.W., Physical Chemistry, Oxford University Press.
2. Bell D.W., Physical Chemistry, Thomson Press.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi
4. Puri and Sharma and Pathaniya, Principles of Physical Chemistry, Milestone Publisher and Distributors, New Delhi.
5. Bahl and Tuli, Essential of Physical Chemistry, S. Chand & Company, New Delhi.
6. Essentials of Nuclear Chemistry, H.J. Arnikar, 4th Edition, (2003) New Age International Publishers, New Delhi
7. G Joshi, R Verma, R Bahuguna and S Kothiyal, Integrated Instrumental methods in spectroscopic and separation techniques Pragati Publication Meerut

Paper II: Inorganic Chemistry/Organic Chemistry

1. Introduction of Supramolecular, Nano & Green Chemistry **(10 Lecture)**

Definition, molecule to supramolecule, molecular aggregate to crystalline aggregate; synthetic methods: choice of building units, reaction condition, design of structures: nano and mega carbon tubes, meso structures, nanoclusters and nanowires; applications. Principles and concepts of green chemistry, Need for Green Chemistry. Goals of Green Chemistry; Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents.

2. Acids and Bases, Hard soft acids and bases & Non aqueous Solvents (14 Lecture)

Various definitions of acids and bases, A generalized acid-base concept, Measurement of acid-base strength, Lewis interactions in non-polar solvents, Systematics of Lewis acid-base interactions, Bond energies, steric effects, solvation effects and acid-base anomalies, 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.

Classification of solvents, their general characteristics, physical properties of the solvents, reaction in nonaqueous solvents-liquid NH3 and SO2 (auto-ionization, precipitation reactions, acid-base reaction, oxidation-reduction reactions, salvation and solvolysis, complex formation), merits and demerits;

3. Spectroscopy and It's use in structure determination of organic molecules

(12 Lecture)

Infrared Spectroscopy, Principle of IR; fundamental vibrational modes; factors affecting vibrational frequencies; energy, selection rules, and transition frequency for harmonic and an-harmonic diatomic oscillator; Instrumentation of IR; Introduction and principle of Ultraviolet and Visible spectroscopy; Beer Lambert Law; energy, selection rules, and transition frequency for diatomic molecule; Instrumentation of UV spectrophotometer; Applications of UV-Vis, IR and NMR in the structure determination of simple organic molecules.

4. Introduction to Medicinal Chemistry (8 Lecture)

Introduction to medicinal chemistry, Drug discovery, design and development; Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim).

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Inorganic Chemistry:

1. J.D. Lee Concise, Inorganic Chemistry, ELVS.
2. Puri, Sharma and Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
3. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
4. Selected topics in Inorganic Chemistry, Malik, Tuli and Madan, S. Chand &
5. Company, New Delhi.

6. Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhii. I.L. Finar, Organic Chemistry, Pearson.
7. J.M. Lehn, Supramolecular Chemistry, VCH
8. Geoffrey A. Ozin, and Andre Arsentte,Neno Chemistry, RSC Publishing
9. Green Chemistry: Environmentally benign reactions V K Ahluvalia 2007

Organic Chemistry:

1. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
2. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
3. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
4. Elementary Spectroscopy, Y.R. Sharma, S. Chand.
5. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.
6. New Trends in Green Chemistry, V K Ahluvaia and M Kidvai, Anamaya Publication New Delhi 2004

Lab Course B.Sc. VI semester (6 hour)

1. Volumetric and gravimetric analysis of inorganic elements. 12 marks

2. Two step organic synthesis : 10 marks

a) Nitrobenzene to metadinotroaniline
b) Benzaldehyde to banzamide
c) Benzaldehyde to Benzil
d) Aniline to p-Bromobenzanilide

3.(i) Conductometric titrations: Acid-base. 8 marks

(ii) Kinetics of catalytic decomposition of H_2O_2.

(iii) Determination of PH of the given solution using glass electrods.

(iv) Surface tension-composition curve for a binary liquid mixture.

4. Viva 5 marks
5. Record 5 marks