B.Sc. Semester: I 2025-26

Discipline Centric Core Course (DCC)

PHYCC14001T: Mechanics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Understand and analyze motion in inertial and non-inertial frames, including rotating systems, using concepts like Coriolis force and center-of-mass collisions.

CO2: Apply Lorentz transformations and relativistic principles to solve problems involving time dilation, length contraction, and energy-momentum relationships..

CO3: Explain and experimentally determine elastic constants, and analyze deformation in solids under bending and torsional stress.

CO4: Formulate and solve equations for simple, damped, forced, and coupled oscillators, interpreting resonance and energy dynamics.

CO5: Derive and apply wave equations to describe and analyze wave propagation, energy transfer, and phase/group velocities in different media.

SYLLABUS

Unit-I: Frames of Reference: Inertial frames, Galilean transformations, Non-inertial frames, fictitious forces, Displacement, Velocity and acceleration in rotating coordinate systems and their transformations, Coriolis force, Focault's pendulum, Motion relative to earth. Centre of Mass, collision of particles in laboratory and C.M. frame.

Unit-II:.Special Theory of Relativity: Invariance of c, Michelson-Morley Experiment, Lorentz transformations, addition of velocities, time dilation and length contraction, conservation of momentum in collision at relativistic speeds and variation of mass with velocity, relativistic energy, mass-energy equivalence, work and energy, transformation equations for momentum, energy and rate of change of momentum.

Unit-III: Elasticity: Young modulus, Bulk modulus and modulus of rigidity, Poisson ratio, relation between elastic constants, Theory of bending of a beam and torsion of a cylinder, experimental determination of Y by loading a beam in the middle and of η by static and dynamic methods, Searle's two bar experiment.

Unit-IV: Oscillations: Qualitative idea of oscillations in an arbitrary potential well, General differential equation for the harmonic motion, mass on a spring, oscillation of two masses connected by a spring, reduced mass, coupled oscillations, normal modes, normal coordinates of two linear coupled oscillators, damped harmonic motion, Forced oscillations and resonances, Resonance width and quality factor.

Unit-V: Waves: General differential equation of one dimensional wave motion and its solution, plane progressive harmonic wave, differential calculus methods for speed of transverse waves on a uniform string and for that of longitudinal waves in a fluid, energy density and energy transmission in waves, superposition of waves, group and phase velocity.

SUGGESTED BOOKS

J.C. Upadhyaya: Mechanics, Ram Prasad & Sons, Agra.
Berkeley: Physics Course, Vol. I, Mechanics, Tata McGraw Hill, New Delhi.
Berkeley: Physics Course, Vol. III, Waves and Oscillations, McGraw Hill, New Delhi.
A. P. French: Physics of Vibration and Waves.
R. S. Gambhir: Mechanics, CBS Publishers.
Mechanics, JPH Publishers.

B.Sc. Semester: I 2025-26

Discipline Centric Core Course (DCC)

PHYCC14001P: Mechanics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Mechanics Lab

1. Determination of Young's modulus by bending of a beam.
2. Determination of Modulus of rigidity by dynamical method using Maxwell needle.
3. Determination of Elastic constants by Searle's method.
4. Determination of low resistance by Carey Foster Bridge.
5. Determination of Modulus of rigidity by statical method using Barton's apparatus. (horizontal mode).
6. Determination of surface tension of water by Jagger's method.

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut

B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi

Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi

Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi

B.Sc. Semester: II 2025-26

Discipline Centric Core Course (DCC)

PHYCC14002T: Electromagnetics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Understand scalar and vector fields and apply vector calculus (Gradient, Divergence, Curl) with Gauss's and Stokes's theorems to physical problems.

CO2: Analyze electrostatic fields and potentials from multipole charge distributions and apply concepts like uniqueness theorem and electrostatic energy.

CO3: Explain polarization in dielectric materials and relate microscopic and macroscopic fields using concepts like Lorentz field and Clausius-Mossotti equation.

CO4: Apply Faraday's laws and inductance concepts to analyze electromagnetic induction, and understand the construction and use of ballistic galvanometers..

CO5: Analyze transient and steady-state behaviour of RC, LR, and LCR circuits, and interpret resonance characteristics in A.C. circuits using complex operators.

SYLLABUS

Unit-I: Vector Analysis: Concept of Field, Scalar and Vector Fields, Gradient of scalar field, Physical significance and formalism of Gradient, Divergence and Curl of a vector field Cartesian co-ordinates system, Gauss law in integral and differential form, Gauss divergence theorem, Stokes theorem,

Unit-II:.Electrostatics: Potential and field due to a quadrupole and an arbitrary charge distribution, concept of multipoles, Electrostatic energy of a uniformly charged sphere. Classical radius of an electron. Conductors in an electric field, uniqueness theorem, potential at a point inside a rectangular box.

Unit-III: Electric field in matter : Atomic and molecular dipoles, polarizability, polarization Vector, electric displacement vector, electrostatic energy of a charge distribution in dielectrics. Lorentz local field and Clausius-Mossotti equation.

Unit-IV: Electromagnetic Induction, Faraday's laws of Electromagnetic induction, integral and differential form, Relation between self and mutual inductance, measurement of self-inductance by (a) Rayleigh method (b) Anderson Bridge, Energy stored in magnetic field. Principle construction and working of ballistic galvanometer and its Applications.

Unit-V: Transient response: Charge and discharge of condenser through resistance, determination of high resistance by method of leakage, growth and decay of current in LR circuit; significance of operator j and its uses in A.C. circuits. Series and parallel LCR circuit, Resonance and Quality factor, Sharpness of resonance.

SUGGESTED BOOKS

Berkeley: Physics Course, Vol. II: Electricity and Magnetism, Tata McGraw Hill.

Laud, B.B.: Electro-magnetics, Wiley Eastern.

Ahmed and Lal: Electricity, Magnetism and Electronics.

D.C. Tayal: Electricity and Magnetism, Himalaya Publishing House

A.S. Mahajan A.A. Rangwala: Electricity and Magnetism, Tata McGraw Hill.

B.Sc. Semester: II 2025-26

Discipline Centric Core Course (DCC)

PHYCC14002P: Electromagnetics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Electromagnetics Lab

1. Determination of unknown capacitance by De-Sauty's Bridge.
2. Determination of unknown inductance of coil by Anderson's bridge
3. Study of variation of magnetic field along the axis of circular coil and determination of diameter of the coil.
4. Study of charging and discharging of R-C (D.C.) circuit.
5. Study of phase relationship of L-C-R circuit.
6. Determination of ballistic constant of a ballistic galvanometer by steady deflection method.
7. Determination of high resistance by method of leakage.
8. Determination of mutual inductance of a coil.
9. Determination of ballistic constant of a ballistic galvanometer using condenser.

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi
Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.
Saxena, Singh, Rawat , Electromagnetics,CBH

B.Sc. Semester: III 2026-27

Discipline Centric Core Course (DCC)

PHYCC15003T: Optics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Apply concepts of magnification, cardinal points, and aplanatism to analyze image formation in lens systems and optical instruments.

CO2: Explain interference by thin films and Newton's rings, and use interferometry (e.g., Fabry- Perot) for precision wavelength and refractive index measurements.

CO3: Understand LASER principles including population inversion and emission processes, and explain holography construction, image reconstruction, and applications.

CO4: Analyze diffraction patterns from multiple slits and evaluate resolving power and spectral characteristics of optical instruments using Rayleigh's criterion.

CO5: Describe various methods of producing polarized light, and analyze optical activity using polarimeter to determine specific rotation of substances.

SYLLABUS

Unit-I: Geometrical Optics: Axial, Lateral and angular magnifications and their inter-relationship, Abbe's Sine condition for spherical surfaces, Aplanatic points for a spherical refracting surface. Cardinal points, Newton's formula and other relations for a lens system using cardinal points, Ramsden's and Huygen's eye pieces.

Unit-II:, **Interference:** Division of Amplitude-Interference exhibited by thin film, Production of colours in thin films, Wedge-shaped film, Newton's rings and determination of wavelength and refractive index of a liquid by Newton's rings.

Fabry-Perot interferometer: Intensity Distribution, Co-efficient of sharpness and half width, measurement of wavelength.

Unit-III: LASER and holography: Difference between ordinary and LASER source, stimulated and spontaneous emission, Einstein A and B coefficients, Population inversion, Principle of He- Ne and Ruby laser,

Basic concepts of holography, construction of hologram and reconstruction of image, important features of hologram and uses of holography.

Unit-IV: Fraunhofer Diffraction: Diffraction at two slits and intensity distribution, Diffraction at N slits. Theory and formation of spectra, width of principal maxima, absent spectra, overlapping of spectral lines, number of spectra, measurement of wave-length of light, Rayleigh's criterion of resolution, Resolving Power of a Prism, Telescope, Microscope and Plane transmission grating.

Unit-V: **Polarization:** Polarization of light: polarization by reflection, Brewster law, polarization by refraction, law of Malus, the phenomenon of double refraction. Circularly and elliptically polarized light by Nicol Prism and Quarter-wave plate. Rotatory Polarization, Fresnel's explanation, specific rotation, half shade and Biquartz Polarimeter, determination of specific rotation and strength of sugar solution.

SUGGESTED BOOKS

Jenkins and White: Optics, McGraw Hill.
Ghatak A.K.: Optics, Tata McGraw Hill.
Khandelwal D.P.: Optics and Atomic Physics, Shivlal Agarwal & Co.
Subramanayam and Brijlal: A text book of Optics, S. Chand, New Delhi.
Saxena, Singh, Rawat & Pareek Optics, CBH
Optics, JPH

B.Sc. Semester: III 2026-27

Discipline Centric Core Course (DCC)

PHYCC15003P: Optics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Optics Lab

1. Verification of Malus's law.
2. Determination of specific rotation of sugar solution by polarimeter.
3. Determination of dispersive power of the material of a prism using spectrometer.
4. Determination of wavelength of monochromatic light (Sodium/ Laser) by Newton's rings.
5. Determination of wavelength of light by plane transmission grating.
6. Determination of resolving power of a plane transmission grating.

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi
Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.

B.Sc. Semester: IV 2026-27

Discipline Centric Core Course (DCC)

PHYCC15004T: Thermal and Statistical Physics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Apply the laws of thermodynamics, Carnot cycle, entropy, and thermodynamic potentials to analyze ideal gas processes and derive Maxwell's relations.

CO2: Understand Joule and Joule-Thomson effects, cooling techniques, and explain transport properties like viscosity, thermal conductivity, and diffusion.

CO3: Analyze particle distributions and statistical probabilities using phase space concepts, binomial distribution, and the principle of equal a priori probabilities.

CO4: Derive thermodynamic properties from the canonical ensemble, partition function, and Boltzmann distribution, and apply them to entropy, free energies, and fluctuations.

CO5: Apply grand canonical formalism and quantum statistics (MB, FD, BE) to systems with variable energy and particle number, and analyze Fermi gas behaviour at 0 K.

SYLLABUS

Unit-I: **Macroscopic Thermodynamics:** Thermodynamic process, The Zeroth Law, First and Second law of thermodynamics , Carnot cycle, Carnot theorem, thermodynamic temperature scale and its identity with perfect gas temperature scale, entropy change in isothermal, and adiabatic expansions of an ideal gas, Thermodynamic potentials, Maxwell's equations ,Cp-Cv, Cp/Cv.

Unit-II:. Temperature changes in Joule and Joule-Thomson expansions, Regenerative cooling, adiabatic demagnetization and production of low temperatures, third law of thermodynamics, negative temperatures.

Transport Phenomena: Mean free path, collision cross-sections, mean free time, viscosity, thermal conductivity and self-diffusion.

Unit-III: Statistical Method: Particle States, distribution of particles in two particle states, Probability of a given distribution, distribution corresponding to maximum probability, relative probability curve with increasing number of particles, binomial distribution, Standard deviation, phase space, micro-states and macro-states of a system, principle of equal 'a priori' probabilities.

Unit-IV: Canonical ensemble, Boltzmann canonical distribution, partition function, a two state system, Boltzmann formula for entropy, average energy and fluctuations, free energy, adiabatic interaction, enthalpy, general interaction, Gibbs free energy, Clausius-Clapeyron equation, Maxwell velocity and speed distributions, partition function, entropy (Sackur-Tetrode relation), Gibbs paradox;

Unit-V: Systems with variable Energy and Particle Number: Chemical potentials, grand canonical distribution, Partition function, number fluctuations, grand potential, equation of state of an ideal classical gas, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics, Fermi gas at 0K temperature;

SUGGESTED BOOKS

Reif : Statistical Physics, Berkeley, Vol. 5, McGraw Hill.

Mandl : Statistical Physics, ELBS and Wiley.

Reif : Fundamentals of Statistical and Thermal Physics, McGraw Hill.

C. Kittel and H. Kroemer : Thermal Physics, CSS.

W.G.V. Rosser: An Introduction to Statistical Physics, Elis Horwood.

Lokanathan and Gambhir: Statistical and Thermal Physics, Prentice Hall

Heat Thermodynamics and Statistical Physics Brij lal Dr,N.Subrahmanyam, P.S.Hemne S.Chand

B.Sc. Semester: IV 2026-27

Discipline Centric Core Course (DCC)

PHYCC15004P: Thermal and Statistical Physics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Thermal & Statistical Lab

1. Experimental verification of the first law of thermodynamics by discharging the condenser through resistance.
2. Determination of the thermodynamic constant $\gamma = \frac{C_p}{C_v}$ using Clement and Desormes method.
3. erification of Rutherford and Soddy's law of radioactive disintegration using dices and statistical board.
4. Determine thermal conductivity of a bad conductor by Lee's method.
5. Study of Gaussian distribution law using statistical board and dices.

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.

B.Sc. Semester: V 2027-28

Discipline Centric Core Course (DSE)

PHYCC16005T1: Electronics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Analyze the behaviour of intrinsic/extrinsic semiconductors, p-n junctions, special diodes, and design rectifier-based power supplies with voltage regulation.

CO2: Apply network theorems and transistor models to analyze BJT configurations, biasing techniques, and small-signal parameters for amplification.

CO3: Understand the construction, characteristics, and voltage-controlled behaviour of JFETs and MOSFETs, and analyze their small-signal models.

CO4: Evaluate the effects of negative and positive feedback in amplifiers and design oscillator circuits using BJTs and UJTs for signal generation.

CO5: Use operational amplifiers for mathematical operations and signal processing, and implement Boolean expressions using basic digital logic gates.

SYLLABUS

Unit-I: Intrinsic and extrinsic semi-conductors, Fermi levels, mass-action law; carrier injection, recombination, diffusion and diffusion length, drift and diffusion currents, continuity equation; p-n junction, potential barrier, biasing, current-voltage relation, space charge and diffusion capacitances; Zener diode; tunnel diode; photovoltaic effect,
Power supplies: Full wave and half wave rectifiers; ripple factor, voltage regulation; filters; Zener regulation.

Unit-II:. Network theorems – Thevenin, Norton, Maximum power transfer and Miller theorems.
Dipolar junction transistors, Ebers-Moll equations; CB, CE and CC configurations, BJT characteristics; biasing and thermal stabilization, self bias; hybrid parameters of a two port network; small signal hybrid equivalent model of a BJT at low frequencies, current, voltage and power gains; input and output impedances**.**

Unit-III: Field effect transistors, JFET, MOSEET, construction and characteristics; FETs as voltage Controlled Devices, small signal model.

Unit-IV: Negative Feedback: Current and voltage negative feedbacks; effect on stability, input and output impedances, distortion, frequency response; emitter follower.
Oscillators: Positive feedback, Barkhausen criterion; RC phase-shift oscillator; Hartley and Colpitts oscillators, UJT and sweep generators using UJT; Transistor as a switch and Astable multi-vibrator.

Unit-V: Operational amplifiers, inverting and non-inverting; differential amplifiers, CMRR; measurement of OP AMP parameters; use of OP AMPs as adder, in analog integration and differentiation. Digital circuits: Laws of Boolean algebra and De-Morgan's theorem, realization of Boolean Expression using logic gates
SUGGESTED BOOKS
J. Millman and CC Halkias: Integrated Electronics : Analog and Digital Circuits and Systems, Tata McGraw Hill. A. Mottertshead: Electronic Devices and Circuits – An Introduction, Prentice Hall India. Anand

B.Sc. Semester: V 2027-28

Discipline Centric Core Course (DSE)

PHYCC16005P1: Electronics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Electronics Lab

1.Study of the characteristics of a given transistor (PNP/NPN) in common emitter configuration and find the value of parameter of given transistor.
2. Study the characteristics of rectifier junction diode and Zener diode.
3. Study of ripple factor for shunt capacitor, series inductor, L-section and π section filters using full wave rectifier circuit.
4. Study the characteristics of field effect transistor (FET).
5. Study of operational amplifier (OP-AMP).
6. Study of series and parallel L-C-R resonance circuit.
7. Design and voltage study of AND, OR, NOT, NAND and NOR gates circuits using diodes and transistors.

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi
Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.

B.Sc. Semester: V 2027-28

Discipline Centric Core Course (DSE)

PHYCC16005T2: Quantum Mechanics and Spectroscopy

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Explain blackbody radiation and photoelectric effects, and understand how Planck's hypothesis resolved the failures of classical physics

CO2: Analyze wave-particle duality using De Broglie relations and apply the uncertainty principle to physical systems.

CO3: Interpret the physical meaning of wave functions, Hermitian operators, parity, and apply basic postulates of quantum mechanics.

CO4: Solve the Schrödinger equation for simple one-dimensional systems and interpret Probability current and Ehrenfest's theorem.

CO5: Understand angular momentum, spin, coupling schemes, and fine structure of spectral lines using vector atom models and quantum numbers.

SYLLABUS

Unit-I: Development of quantum theory: Blackbody radiation and their characteristics, failure of classical physics to explain spectral distribution of blackbody radiation, Planck's quantum Hypothesis, Average energy of Planck oscillator, Planck's radiation formula, Wien's law, Rayleigh-Jean's Law, Stefan-Boltzmann's Law; Failure of classical physics to explain photoelectric effect and Compton effect,

Unit-II: Wave Mechanics and Schrödinger equation: Phase velocity and group velocity of waves, wave particle duality; De Broglie Hypothesis; De Broglie group and phase velocity, wave packet, Heisenberg uncertainty principle, Statement and its equation from wave-packet in space and time; Application of uncertainty principle such as (i) Non-existence of electron in nucleus, (ii) Ground state of H-atom.

Unit-III: operators in Quantum mechanics: Hermitian operators, expectation values, Interpretation of wave-function, symmetric and anti-symmetric wave functions, concept of parity; Probability density, Schrödinger equation, Schrödinger equation for free particle; Arguments in favour of this equation.

Unit-IV: Application of wave Schrödinger equation: Probability current density, Ehrenfest Theorem, Simple solution of Schrodinger equation (Restricted to one dimensional case), Particle in one dimensional infinite well, Particle in one dimensional finite well .

Unit-V: Atomic Spectroscopy: Orbital angular momentum, electron spin and Stern Gerlac experiment, Total angular momentum, Spin-orbit interaction, Vector model of atom and quantum numbers associated with atom, L-S coupling and j-j coupling, Statement of Hund's Rule and Lande Interval Rule (without derivation), Fine structure of spectral lines,

SUGGESTED BOOKS
Semat: Atomic Physics
Alonso and Finn: Fundamental University Physics, Vol. – III.
Beiser: Concepts in Modern Physcis
Waghmare: Quantum Mechanics
Quantum Mechanics by Singh Bagdi
Quantum Mechanics by Sardar Singh CBH

B.Sc. Semester: V 2027-28

Discipline Centric Core Course (DSE)

PHYCC16005P2: Advanced Physics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Advanced Physics Lab

1. Determination of Planck's constant using LED.
2. Determination of specific charge of electron (e/m) by Thomson's method.
3. Charge of electron by Millikan oil drop method.
4. Study of Lissajous patterns.
5. To study the electromagnetic damping of a compound pendulum.
6. Determination of difference in wavelength of the two line of Sodium light.
7. Verification of Stefan's law (Black Body method).

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi
Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.

B.Sc. Semester: VI 2027-28

Discipline Centric Core Course (DSE)

PHYCC16006T1: Solid State physics

(20 CIA + 80 EoSE.= Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Understand crystal structures, lattice types, Miller indices, and X-ray diffraction principles.

CO2 : Analyze interatomic forces, crystal binding energies, and lattice vibrations in different types of solids.

CO3: Explain free electron theory, Fermi-Dirac statistics, and thermal and electrical properties of metals.

CO4: Interpret electronic band structure, Bloch theorem, Brillouin zones, and classification of materials based on band theory.

CO5: Explore theories of magnetism and the fundamental properties and phenomena associated with superconductivity.

SYLLABUS

Unit-I: Crystal structure : Different terms of crystal structure, Fundamental types of lattices, Two and three dimensional lattice types; Seven system of crystals, Characteristics of sc, bcc, fcc, hcp; Miller indices, orientation of planes in cubic lattices; Distribution of Atoms in atomic planes of cubic lattices. Distance between successive planes; Von-Laue's equations of diffraction of X-rays, Bragg's Law,

Unit-II: Crystal binding and lattice vibrations: Inter-atomic forces of solids. Crystal of inert gases, cohesive energy and bulk modulus. Ionic crystals, Madelung energy and bulk modulus. Covalent crystals. Hydrogen bonded crystals, Atomic radii. Concept of phonons Vibration of monatomic lattices, lattice with two atoms per primitive cell.

Unit-III: Free Electron theory of metals : Free electron model, Density of states of electron gas, Fermi- Dirac distribution function, effect of temperature on Fermi-Dirac distribution function, Fermi energy at absolute zero temperature and low temperature. Electron heat capacity. Thermionic emission. Boltzmann transport equation, Sommerfeld theory of electrical conductivity,.

Unit-IV: Band theory: Formation of bands and origin of energy gap, Bloch theorem, Kronig Penney model, crystal momentum and velocity of an electron. Effective mass of electrons. Electrons and holes. Number of states in a band, insulator, semi-conductor and metal. Construction of Brillouin Zones and Fermi-surfaces.

Unit-V: Magnetism: Diamagnetism and Larmor precession, classical theory of diamagnetism, Para magnetism and its classical theory, free electron theory. Molecular theory of ferromagnetism. Experimental Survey of Superconductivity : Zero resistance, persistent currents, effect of magnetic fields, flux exclusion, Intermediate state, Entropy effect, frequency effects, Gyromagnetic ratio, Isotope effect. Occurrence of superconductivity.

SUGGESTED BOOKS

Kittel : Introduction to Solid State Physics, Wiley Eastern.
A.J. Dekker : Solid State Physics, McMillian India.
L. Azaroff : Theory of Solids.
Solid State Physics by S. O. Pillai

B.Sc. Semester: VI 2027-28

Discipline Centric Core Course (DSE)

PHYCC16006P1: Solid State physics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Solid State Physics Lab

1. Determination of specific charge of electron (e/m) by helical method.
2. To study hysteresis loss of transformer by B-H curve using C.R.O.
3. Determination of band gap of a semiconductor using four probe method.
4. Measurement of magnetic field using ballistic galvanometer and search coil.
5. To determine the polarizing angle for the glass prism surface and to determine the refractive index of material of prism using Brewster's law.
6. To determine the energy band gap in a semiconductor using junction diode.

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi
Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.

B.Sc. Semester: VI 2027-28

Discipline Centric Core Course (DSE)

PHYCC16006T2: Nuclear physics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Understand nuclear structure and properties through key experiments like Rutherford scattering, nuclear size determination, and spin concepts.

CO2: Analyze nuclear stability and structure using mass defect, binding energy, liquid drop model, and beta-decay predictions.

CO3: Apply conservation laws and Q-equation in nuclear reactions and understand Radioactive decay and equilibrium processes.

CO4: Comprehend nuclear fission, reactor principles, and energy production mechanisms in nuclear reactors.

CO5: Explore radiation detection methods and understand the classification and conservation principles of elementary particles

SYLLABUS

Unit-I: Rutherford alpha scattering experiment, scattering formula and experimental verification of scattering formula. nuclear charge, Chadwick's determination of nuclear charge, theories of nuclear composition, nuclear mass, Determination of size of nucleus using Mesonic X ray method, Measurement of potential radius from life time of alpha emitters and scattering of fast neutron. nuclear spin.

Unit-II: Mass defect, binding energy and packing fraction of nucleus. Liquid drop model of Nucleus, magic number and evidence of it, WEIZSACHER's Semi Empirical Mass formula, Predication of stability against beta-decay for members of an isobaric family. Types of nuclear reactions,

Unit-III: The balance of Mass and energy in nuclear reactions, conservation law in nuclear reactions, Q equation. Solution of the Q equations, concept of Centre of mass in nuclear reaction, proton-proton collision and neutron-nucleus collision in CM frame.
The law of radioactive decay, statistical nature of radioactivity. Radioactive growth and decay. Ideal equilibrium, transient equilibrium and secular equilibrium,.

Unit-IV: Nuclear Energy: Nuclear induced fission, energy released in fission of U235, Fission chain reaction, stability limits against spontaneous fission, Energetic of Symmetric fission, Neutron cycle in a thermal reactor. Four factor formula. Elementary idea of nuclear reactors, types of nuclear reactor, nuclear reactor in India.

Unit-V: Gas filled ionisation detectors, Detailed description, principle working and uses of (i) proportional counter (ii) Geiger-Muller Counter, dead time, recovery time and paralysis time, Properties of elementary particles, Classification of elementary particles, quantum number of elementary particles, conservation laws.

SUGGESTED BOOKS

Alonso & Finn: Fundamental University Physics – Vol. III, Addision Wesley.
S.N. Ghoshal: Atomic & Nuclear Physics – Vol. II, S. Chand, New Delhi.
Satyapraksh: Nuclear Physics, Pragati Prkashan Meerut
R. R. Roy and B. P. Nigam, Nuclear Physics, New Age Int.(P) Ltd
D.C. Tayal: Nuclear Physics, Himalaya Publishing House

B.Sc. Semester: VI 2027-28

Discipline Centric Core Course (DSE)

PHYCC16006P2: Modern Physics Lab

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

Modern Physics Lab

1. Study of characteristics of a G.M. counter and verification of inverse square law for the same strength of a radioactive source.
2. Determination of dead time of a G.M. counter.
3. Determination of refractive index of ordinary and extra ordinary light using Babinet compensator.
4. To study the electromagnetic damping of a compound pendulum.
5. Determination of self-inductance of a Coil using Ballistic galvanometer (Rayleigh method).
6. Determination of separation of plates of Etalon using spectrometer.

Note: - New experiments may be added on availability of equipment's.

SUGGESTED BOOKS

1. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
2. Advanced Level Practical Physics, M.Nelkon and Ogborn, Heinemann Education Books Ltd., New Delhi
3. Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi
4. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
5. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
6. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.

B.Sc. Semester: VI 2027-28

Discipline Centric Core Course (DSE)

PHYCC16006T3: Relativity and Electrodynamics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO 1: Explain the concept of displacement current and derive Maxwell's equations in differential and integral forms.

CO 2: Derive and solve the electromagnetic wave equation in free space and in conducting media.

CO 3: Interpret the physical meaning of the Poynting vector and apply the Poynting theorem to calculate power flow in EM waves.

CO 4: Analyze the propagation characteristics of plane electromagnetic waves in different media, including wave impedance and skin depth.

CO 5: Describe and categorize different types of polarization states of EM waves.

SYLLABUS

Unit-I: Electromagnetic Waves: Displacement current, Maxwell's equations, Electromagnetic wave equation, Poynting theorem, Plane Electromagnetic waves in free space, wave impedance of free space, Propagation of plane Electromagnetic waves in non-conducting and conducting media, Skin depth. Polarization of Electromagnetic waves.

Unit-II: Interaction of Electromagnetic waves with matter: Normal and anomalous dispersion of light, empirical relations, Lorentz theory of dispersion of gases, experimental demonstration of anomalous dispersion in gases, scattering of electromagnetic waves and scattering parameters, Thomson, resonant and Rayleigh's scattering cross-section, polarization of scattered light.

Unit-III: Reflection and Refraction of Electromagnetic waves: Boundary conditions at the surface of discontinuity, reflection and refraction of Electromagnetic waves at the interface of nonconducting media, Fresnel's equations and their experimental verification, reflection and transmission coefficients, Brewster's Law and degree of polarization,.

Unit-IV: Relativistic Electrodynamics : Invariance of charge, transformation of surface charge density, transformation of volume-charge density and current density, Equation of continuity in the covariant form, Scalar and vector potentials, Transformation of Electromagnetic potentials, Lorentz condition and its covariant form, Electromagnetic field tensor, Covariance of Maxwell's equations.

Unit-V: Relativistic Mechanics: Tensors of second and higher rank, addition, subtraction, contraction, outer and inner product of tensors, covariance of tensor equations, Minkowski space, geometrical interpretation of Lorentz transformation, space like and time like intervals, four vectors, four dimensional gradient, divergence and curl operators, four-velocity, four-acceleration, four-momentum, four-force, relativistic classification of particles.

SUGGESTED BOOKS
S.P. Puri: Electrodynamics, Tata McGraw Hill
J.D. Jackson: Classical Electro-dynamics, John Wisely, New York
B.B. Laud: Electromagnetic, John Wisely, New York
E.C. Jordan: Electromagnetic waves, PHI, New Delhi
D. J. Griffiths: Introduction to Electrodynamics, PHI

B.Sc. Semester: I 2025-26

Discipline Centric Core Course (DCC)

CHECC14001T: Basic Concepts of Chemistry - I

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Explain the concepts of covalent and ionic bonding using Valence Bond Theory, VSEPR theory, hybridization, Similarities and differences between Valence bond and Molecular orbital Theory.

CO2: Analyze molecular orbital diagrams for homonuclear and heteronuclear diatomic molecules and compare Molecular Orbital Theory with Valence Bond Theory.

CO3: Identify and interpret electronic effects, types of bond fission, reactive intermediates, and reagent types in organic chemistry reactions.

CO4: Apply principles of stereochemistry to understand conformations, isomerism, chirality, and nomenclature using various structural representations.

CO5: Describe the physical behavior of real gases using Van der Waals equation, Maxwell's distribution, and Joule-Thomson effect, and explain deviations from ideal behavior.

SYLLABUS

Unit-I: Chemical Bonding-I

Covalent Bond – Valence bond theory, shapes of some inorganic molecules and ions on the basis of VSEPR theory and hybridization (sp, sp^2 and sp^3) with suitable examples, bonding in diborane (3c-2e bonding).

Molecular Orbital theory – Postulates, Molecular orbital diagram of homonuclear (H_2, H_2^+, He_2^+, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, O_2+, O_2^-, O_2^{2-}, O_2^{2+} and heteronuclear (CO and NO) diatomic molecules.

Unit-II: Chemical Bonding-II

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy, solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Landé equation for calculation of lattice energy (statement only), Born-Haber cycle and its applications (for NaCl).

Radius ratio: Radius ratio effect and coordination number, Polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Hydrogen Bonding: Types and impact of inter and intra molecular hydrogen bonding.

Unit-III: Basic Concepts of Organic Chemistry

Electronic displacements: inductive effect, electromeric effect, resonance, necessary conditions for resonance, contribution of resonationg structures, hyperconjugation and its effects. Types of fission: homolytic and heterolytic bond fission. Types of reagents- electrophiles and nucleophiles, Reactive intermediates- carbocations, carbanions, free radicals.

Stereochemistry: Conformations of ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism,

Diastereomerism and Meso compounds. Threo and erythro; D and L; cis- trans nomenclature; CIP Rules: R/S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C-C systems).

Unit-IV: Aliphatic Hydrocarbons

Functional group approach for the following-

Alkanes (Upto 5 Carbons)

Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution (halogenation).

Alkenes (Upto 5 Carbons)

Preparation: Elimination reactions, dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule), cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromination), Addition of HX (Markovnikov's and anti- Markovnikov's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Unit-V: Gaseous State

Deviation from ideal behavior, Vander Waals equation of state and its discussion. Critical Phenomena: PV isotherms of real gases, critical phenomenon continuity of states, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities (no derivation). Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect).

SUGGESTED READINGS

1. Fundamentals of Chemistry-I (Hindi) by Dr. Vikal Gupta, Dr. Arun Arora, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
2. Fundamentals of Chemistry-II (Hindi) by Dr. Vikal Gupta, Dr. Arun Arora, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
3. Chemistry-I (Hindi) by Dr. K. R. Genwa, 2024, RBD, Jaipur
4. *Bhotik Rasayan-I* (Hindi) by **K. R. Genwa**, 2023, RBD, Jaipur.
5. Chemistry (English) by Dr. K.R. Genwa, Dr. Minakshi Jonwal, Dr. R.L. Saini, 2025, RBD, Jaipur
6. **Inorganic Chemistry** by **Satya Prakash** by G.D. Tuli, S.K. Basu & R.D. Madan**,** 19th Indian Edition, S. Chand & Company Ltd.
7. **Inorganic Chemistry** by **R. C. Agarwal, 8th Edition**, Krishna Prakashan Media, S. Chand.
8. **Inorganic Chemistry** by **P. L. Soni,** 20th Revised Edition**,** Sultan Chand & Sons.
9. **Inorganic Chemistry** by **G. C. Shivhare & V. P. Lavania,** 5th & 6th edition, Geeta Book Depot, Meerut.
10. **Advanced Organic Chemistry** by **Mukherjee & Kapoor** (Vol. I & II), New Central Book Agency (NCBA), Kolkata.
11. **A Text Book of Organic Chemistry** by **R. K. Bansal,** 5th Edition, New Age International Pvt. Ltd.
12. **Organic Chemistry** by **R. T. Morrison & R. N. Boyd** (Prentice Hall), **6th Edition**, **Prentice Hall of India.**
13. *The Elements of Physical Chemistry* — **P. W. Atkins,** 6th Edition, Oxford University Press.
14. *Principles of Physical Chemistry* — **B. R. Puri, L. R. Sharma & M. S. Pathania**, Shobhan Lal Naginchand & Co.
15. *Essentials of Physical Chemistry*, **Bahl & Tuli**, S. Chand & Co., by S. Chand.

B.Sc. Semester: II 2025-26

Discipline Centric Core Course (DCC)

CHECC14002T: Basic Concepts of Chemistry - II

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Explain various concepts of acids and bases (Arrhenius, Brönsted-Lowry, Lewis, Usanovich), acid-base titrations, indicators, redox titrations, and the behavior of non-aqueous solvents like liquid ammonia and sulfur dioxide.

CO2: Classify and describe the structure, preparation, and chemical reactions of dienes and alkynes, including mechanisms such as 1,2- and 1,4-additions, Diels-Alder reaction, and hydroboration-oxidation.

CO3: Understand aromaticity using Huckel's rule, describe electrophilic substitution reactions, and analyze the structure, reactivity, and substituent effects in arenes and their derivatives.

CO4: Interpret the principles of chemical kinetics, derive rate laws for various reaction orders, and compare theories of reaction rates including collision theory and transition state theory with numerical problem-solving.

CO5: Analyze the behavior of liquid mixtures using Raoult's law and phase diagrams; explain distillation techniques, azeotropes, and concepts like consolute temperature in partially miscible and immiscible systems.

SYLLABUS

Unit – I Concepts of acids and bases

Arrhenius, Brönsted-Lowry, Lewis and Usanovich concept. Acid base titrations, Theory of indicators, Redox titrations Non aqueous solvents: Physical properties of solvent, types of solvents and their general characteristics. Reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

Unit – II Dienes and Alkynes Nomenclature and classification of dienes: isolated, conjugated and cumulated 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, acidic nature of 1-alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, oxidation and polymerization.

UNIT III: Aromaticity & Arenes:

Aromaticity: Aromaticity: Huckel's rule, aromatic ions. 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. Arenes: Nomenclature of benzene derivatives. Aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

UNIT IV Chemical Kinetics

Chemical kinetics and its scope, rate of reaction, factors influencing rate of reaction. Mathematical characteristics of simple chemical reactions- zero, first, second and pseudo first order reactions, half-life and mean life. Determinations of the order of reaction- differential methods, methods of integration, methods of half-life period and isolation method. Radioactive decay. Theories of Reaction Rate: Simple collision theory and its limitations, transition state theory (equilibrium hypothesis) and derivation of the rate constant, Numericals.

UNIT V: Solutions

Types of liquid mixtures, Raoult's law, Ideal and Non-Ideal mixtures, Vapour pressure of liquid mixtures, vapour pressure-Composition and Boiling point-composition curves of completely miscible binary solutions, Azeotropic mixtures and Distillation of Immiscible liquid mixtures. Partially miscible liquids mixtures-phenol-water, triethylamine-water, nicotine-water-systems, consolute temperature-lower and upper, Effect of impurity on consolute temperature-Phenol-water system, immiscible liquids, Numericals

SUGGESTED READINGS

1. Fundamentals of Chemistry-I (Hindi) by Dr. Vikal Gupta, Dr. Arun Arora, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
2. Fundamentals of Chemistry-II (Hindi) by Dr. Vikal Gupta, Dr. Arun Arora, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
3. Chemistry-I (Hindi) by Dr. K. R. Genwa, 2024, RBD, Jaipur
4. *Bhotik Rasayan-I* (Hindi) by **K. R. Genwa**, 2023, RBD, Jaipur.
5. Chemistry (English) by Dr. K.R. Genwa, Dr. Minakshi Jonwal, Dr. R.L. Saini, 2025, RBD, Jaipur
6. **Inorganic Chemistry** by **Satya Prakash** by G.D. Tuli, S.K. Basu & R.D. Madan**,** 19th Indian Edition, S. Chand & Company Ltd.
7. **Inorganic Chemistry** by **R. C. Agarwal, 8th Edition**, Krishna Prakashan Media, S. Chand.
8. **Inorganic Chemistry** by **P. L. Soni,** 20th Revised Edition**,** Sultan Chand & Sons.
9. **Inorganic Chemistry** by **G. C. Shivhare & V. P. Lavania,** 5th & 6th edition, Geeta Book Depot, Meerut.
10. **Advanced Organic Chemistry** by **Mukherjee & Kapoor** (Vol. I & II), New Central Book Agency (NCBA), Kolkata.
11. **A Text Book of Organic Chemistry** by **R. K. Bansal,** 5th Edition, New Age International Pvt. Ltd.
12. **Organic Chemistry** by **R. T. Morrison & R. N. Boyd** (Prentice Hall), **6th Edition**, **Prentice Hall of India.**
13. *The Elements of Physical Chemistry* — **P. W. Atkins,** 6th Edition, Oxford University Press.
14. *Principles of Physical Chemistry* — **B. R. Puri, L. R. Sharma & M. S. Pathania**, Shobhan Lal Naginchand & Co.
15. *Essentials of Physical Chemistry*, **Bahl & Tuli**, S. Chand & Co., by S. Chand.

B.Sc. Semester: III 2026-27

Discipline Centric Core Course (DCC)

CHECC15003T: Inorganic and Organic Chemistry

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Understand periodic trends and chemical properties of s- and p-block elements, including their compounds and hydrides.

CO2: Explain the electronic configuration, oxidation states, and characteristic properties of transition elements.

CO3: Describe the structure, bonding, nomenclature, and isomerism in coordination compounds and their analytical applications.

CO4: Compare the properties of lanthanides and actinides, including their electronic structure, oxidation states, and magnetic behavior.

CO5: Classify and analyze the structure, preparation, and reactions of alcohols, phenols, and carbonyl compounds.

SYLLABUS

Unit-I: s and p-block elements

s-block Elements

Periodicity in properties of alkali and alkaline earth metals. Complexation tendency, Solvation tendency, Synthesis and applications of important hydrides: NaH, $NaBH_4$, LiH, $LiBH_4$, $LiAlH_4$ and CaH_2.

p-Block Elements: Periodicity in properties of Group 13 (Boron group), Group 14 (Carbon group), Group 15 (Nitrogen group), Group 16 (Oxygen group), Group 17 (Halogens) and Group 18 (Noble gases), Silicates.

Unit-II: Chemistry of Transition Elements

General Characteristics and Periodicity in properties with emphasis on their electronic configuration and multiple oxidation states of 3d, 4d and 5d series elements. Colored ion formation, magnetic, catalytic properties and complex formation tendency in 3d series elements.

Unit-III: Coordination compounds

Werner's coordination theory and experimental verification, Effective Atomic Number concept, chelates, nomenclature of coordination compounds, stereoisomerism in complexes of coordination number 4 and 6. Complexometric titrations and theory of metallochrome indicators.

Unit-IV: f-Block elements

Chemistry of Lanthanides: Electronic structure, oxidation state, ionic radii, colour, spectral and magnetic properties. Lanthanide contraction and its consequences.

Chemistry of actinides: General characteristics, comparative treatment of actinides and lanthanides with respect to ionic radii, oxidation states, magnetic behavior and spectral properties.

Unit-V: Hydroxyl Compounds

Monohydric alcohols: nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols: Methods of formation, chemical reactions of vicinal glycols.

Trihydric alcohols: Methods of formation, chemical reactions of glycerol. Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohol and phenol, resonance stabilization of phenoxide ion. Reactions of phenols: Electrophilic aromatic substitution, acylation and carboxylalion. Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, LedererManasse reaction and Reimer Tiemann reaction.

SUGGESTED READINGS

1. Advanced Chemistry-I (Hindi) by Dr. Vikal Gupta, Dr. Priyanka Purohit, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
2. Advanced Chemistry-II (Hindi) by Dr. Vikal Gupta, Dr. Priyanka Purohit, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
3. Advanced Chemistry-I (Hindi) by Dr. K. M. Gangotri, Dr. Sangeeta Loonker,Dr. K.R. Genwa, RBD, Jaipur.
4. Advanced Chemistry-II (Hindi) by Dr. K. M. Gangotri, Dr. Sangeeta Loonker,Dr. K.R. Genwa, RBD, Jaipur.
5. Inorganic Chemistry by P.L. Soni & M. Katyal
6. *Concise Inorganic Chemistry* by J. D. Lee, **5th Edition**, by **Blackwell Science / Wiley-Blackwell**.
7. Organic Chemistry" by Morrison & Boyd, 6th edition published by **Prentice-Hall.**
8. *Basic Inorganic Chemistry* by F. A. Cotton & G. Wilkinson, **John Wiley & Sons**, **2nd edition.**
9. A Textbook of Organic Chemistry by O.P. Tandon.
10. *Physical Chemistry* by Puri, Sharma & Pathania, **48th edition, Vishal Publishing Company.**

B.Sc. Semester: IV 2026-27

Discipline Centric Core Course (DCC)

CHECC15004T: Organic and Physical Chemistry

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Explain the structure, nomenclature, acidity, and key reactions of carboxylic acids, hydroxy acids, and dicarboxylic acids.

CO2: Describe the preparation, properties, and interconversion of carboxylic acid derivatives, and understand their reaction mechanisms.

CO3: Apply principles of electrochemistry to analyze conductivity, ion migration, transport numbers, and perform related calculations.

CO4: Understand and apply the laws of thermodynamics and thermochemistry to evaluate energy changes, spontaneity, and equilibrium in chemical systems.

CO5: Interpret phase diagrams and apply the phase rule to single and multi-component systems, including partially miscible liquids and azeotropes.

SYLLABUS

Unit-I: Carbonyl Compounds

Nomenclature and structure of the carbonyl group. Physical properties and Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids.

Unit-I: Carboxylic Acid

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- Zelinisky reaction, reduction of carboxylic acids, mechanism of decarboxylation, mechanism of esterification and hydrolysis (acidic and basic).

Nitrogen Compounds

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Amine salts as phase-transfer catalysts.

Unit-III: Basics of Electrochemistry

Conductance, specific conductance and equivalent conductance, variation of equivalent and specific conductance with dilution, migration of ions and Kohlrausch's law, Arrhenius theory of electrolytes, Ostwald's dilution law- its uses and limitations, Debye- Huckel Onsager`s equation for strong electrolytes (elementary treatment only).

Transport number: definition and determination by Hittorf's method and moving boundary method. Applications of conductivity measurements; determination of degree of dissociation, Ka of acids, solubility product of a sparingly soluble salts and conductometric titrations.

Unit-IV: Thermodynamics and Thermochemistry

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, Heat capacity- heat capacities at constant volume and constant pressure and their relationship, Joule's law, Joule-Thomson coefficient and inversion temperature.

Second law of thermodynamics: need for the law, different statements of the law, Carnot cycle and its efficiency, Carnot theorem, Concept of entropy, entropy as a criteria of

spontaneity and equilibrium.
Third law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy, Gibbs and Helmholtz functions- A & G as criteria for thermodynamic equilibrium and spontaneity.
Thermochemistry: Standard state, standard enthalpy of formation- Hess`s Law of heat summations and its applications, heat of reactions at constant pressure and constant volume. Kirchhoff's equation.

Unit-V: Phase Equilibrium

Phase Rule, explaination of the terms- phase, component and degree of freedom, phase equilibria of one component system- water and CO_2 systems, Phase equilibria of two component system- Pb-Ag systems, desilverisation of lead, Liquid- liquid mixtures, Ideal solution, Non-ideal system-azeotropes- minimum boiling point azeotrope- ethanol-water system, Maximum boiling point azeotrope- HCl-H_2O system, Henry's law, Nernst distribution law.

SUGGESTED READINGS

1. Advanced Chemistry-I (Hindi) by Dr. Vikal Gupta, Dr. Priyanka Purohit, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
2. Advanced Chemistry-II (Hindi) by Dr. Vikal Gupta, Dr. Priyanka Purohit, Dr. Sawai Singh Rathore, 2024, Associated Book Company, Jodhpur.
3. Advanced Chemistry-I (Hindi) by Dr. K. M. Gangotri, Dr. Sangeeta Loonker,Dr. K.R. Genwa, RBD, Jaipur.
4. Advanced Chemistry-II (Hindi) by Dr. K. M. Gangotri, Dr. Sangeeta Loonker,Dr. K.R. Genwa, RBD, Jaipur.
5. Organic Chemistry" by Morrison & Boyd, 6th edition published by **Prentice-Hall.**
6. A Textbook of Organic Chemistry by O.P. Tandon.
7. *Physical Chemistry* by Puri, Sharma & Pathania, **48th edition, Vishal Publishing Company.**

B.Sc. Semester: V 2027-28

Discipline Specific Elective Course (DSE)

CHESE16005T1: Analytical Chemistry

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Distinguish between qualitative and quantitative analysis and explain the steps in the analytical process.

CO2: Identify and minimize types of errors in analysis using statistical tools for data treatment.

CO3: Perform systematic qualitative analysis of cations and anions, including handling of interfering radicals.

CO4: Apply gravimetric and volumetric methods for quantitative chemical analysis with accuracy.

CO5: Understand principles and applications of modern instrumental techniques like UV-Vis, AAS, and thermal analysis.

SYLLABUS

Unit-I: Basics of Analytical Chemistry

Introduction: Qualitative vs quantitative analysis, analytical process, Scope and importance.

Errors in chemical analysis: Types of error and their minimization, Accuracy, Precision

Statistical data treatment: Average deviation from mean, Standard Deviation, relative standard deviation, t-test, Q-test

Unit-II: Qualitative Analysis-I

Theoretical basis of qualitative analysis, theory of ionization, theory of precipitation Common-ion effect, complex ion formation, solubility product & their applications. Oxidizing and reducing agents and buffers used in analysis.

Unit-III: Qualitative Analysis-II

Systematic analysis of Acidic and Basic radicals (including interfering radicals, identification of cations and anions, interfering anions and their removal, Chemical reactions involved.

Unit-IV: Quantitative Analysis

Definition, types of quantitative analysis: Gravimetric and volumetric analysis.

Volumetric Analysis: Terms, Basic principle, standard solutions, types of standard solutions(Primary and Secondary),Cautions in Titrimetry.

Gravimetric analysis: Steps involved in gravimetric analysis Precipitation, Digestion, Filtration, Washing, Drying, Ignition, Weighing. Advantages of gravimetric analysis, Cautions in Gravimetry, Co precipitation and Post precipitation.

Unit-V: Optical and Basic Instrumental Techniques

UV-Visible Spectrophotometry: Beer-Lambert law, instrumentation, applications

Instrumentation of Flame Photometry and Atomic Absorption Spectroscopy (AAS), estimation of Na^+ and K^+ .

pH-metry and conductometry.

SUGGESTED READINGS

1. Inorganic Chemistry – I (Hindi & English) by P. Bhagchandani, Sahitaya Bhawan Publication, Agra.
2. Inorganic Chemistry – II (Hindi & English) by P. Bhagchandani, Sahitaya Bhawan Publication, Agra.
3. *Vogel's Textbook of Quantitative Chemical Analysis* – G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney, **6th Edition**, **Prentice Hall.**
4. *Vogel's Textbook of Qualitative Chemical Analysis* – G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney, **6th Edition**, **Prentice Hall.**
5. *Analytical Chemistry* – Gary D. Christian, **7th Edition**, **John Wiley & Sons / Wiley-VCH**.
6. *Instrumental Methods of Chemical Analysis* – B. K. Sharma, **Krishna Prakashan Media / Goel Publications, Meerut.**

B.Sc. Semester: V 2027-28

Discipline Specific Elective Course (DSE)

CHESE16005T2: Spectroscopic Techniques

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Understand the fundamental principles of UV and IR spectroscopy, including absorption laws, types of transitions, molecular vibrations, and spectral regions.

CO2: Analyze UV and IR spectra to identify chromophores, auxochromes, and common organic functional groups through spectral shifts and fingerprint analysis.

CO3: Apply theoretical models of rotational spectroscopy to interpret molecular spectra, determine bond lengths, and understand isotope effects.

CO4: Explain and evaluate vibrational and Raman spectra using concepts like harmonic and anharmonic oscillators, force constants, and polarizability.

CO5: Interpret ^{1}H NMR spectra of simple organic compounds, including analysis of chemical shifts, splitting patterns, coupling constants, and signal intensities.

SYLLABUS

Unit-I: Ultraviolet (UV) absorption spectroscopy

Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones. Numericals.

Infra-Red Spectroscopy: Infrared radiation and types of molecular vibrations, Hooke's law, functional group and finger print region. IR spectra of common organic functional groups. Numericals.

Unit-II: Rotational Spectroscopy

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

Unit-III: Vibration Spectroscopy

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. Numericals.

Unit-IV: Raman Spectroscopy

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

Unit-V: Nuclear magnetic resonance (NMR) spectroscopy

Proton magnetic resonance (1H PMR) spectroscopy , nuclear shielding and de-shielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

SUGGESTED READINGS

1. Organic Chemistry by Dr. K.M. Gangotri, RBD, Jaipur.
2. Organic Chemistry by P. Bhagchandani, Sahitaya Bhawan Publication, Agra.
3. *Elementary Organic Spectroscopy* by Y. R. Sharma, **4th Edition**, published by **S. Chand & Co Ltd**.
4. *Spectroscopy of Organic Compounds* by P. S. Kalsi, **6th Edition** (revised), published by **New Age International Private Limited.**
5. *Molecular Structure and Spectroscopy* by G. Aruldhas, **2nd Edition Prentice Hall India Learning Private Limited.**
6. **Organic Spectroscopy by Jagdamba Singh, Pragati Prakashan.**

B.Sc. Semester: VI 2027-28

Discipline Specific Elective Course (DSE)

CHESE16006T1: Biochemistry

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Explain the role of essential and trace bioinorganic elements (Na, K, Mg, Ca, Fe) in biological systems, including the process of biological nitrogen fixation.

CO2: Classify and analyze the structure, properties, and chemical behavior of amino acids, including their acid-base characteristics, stereochemistry, and analytical techniques.

CO3: Describe the structure, classification, and synthesis of peptides and proteins, and apply methods for structure determination and functional group analysis.

CO4: Illustrate the classification, reactions, and structural features of carbohydrates, including monosaccharides and disaccharides, with emphasis on stereochemistry and interconversion mechanisms.

CO5: Identify and explain the structure, biological functions, and nutritional significance of nucleic acids and vitamins, along with the consequences of their deficiencies.

SYLLABUS

Unit-I: Bioinorganic Chemistry

Essential and trace elements in biological processes, Biological role of alkali (Na, K, Li) and alkaline earth (Mg, Ca) metals. Role of metal ion (Fe) in biological process. Biological Nitrogen fixation.

Unit-II: Amino Acids

Classification, structure and stereochemistry of amino acids; Acid-base behavior, isoelectric point, electrophoresis and separation of amino acids by chromatography. Preparation and reactions of α-amino acids. Distinctive properties of α-, β-, and γ-amino acids. analysis of amino acid. Glycine- preparation, physical & chemical properties.

Unit-III: Peptides and Proteins

Introduction, composition, and nature of proteins. Isolation of proteins. Structure and nomenclature of peptides and proteins. Classification of proteins. selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Peptide structure determination, end group analysis, Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation. Analytical tests and uses of proteins. Estimation of free amino and carboxyl groups

Unit-IV: Chemistry of Carbohydrates

Classification and nomenclature. Monosaccharides, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threodiastereomers. Conversion of glucose into mannose. , mechanism of osazone formation, Formation of glycosides, ethers and esters. Cyclic structure of D(+)-glucose. Determination of ring size of monosaccharides, Mechanism of mutarotation.

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

Unit-V: Nucleic Acids and Vitamins

Nucleic acids: Introduction, constituents of nucleic acids - ribo and deoxy ribonucleosides, nucleotides and structure of DNA and RNA.

Vitamins: Introduction, Biological importance and diseases caused by the deficiency of Vitamin A, B complex, C, D, E and K.

SUGGESTED READINGS

1. Chemistry (Hindi) By R.L. Madan (S. Chand & Co.)
2. K. Hussain Raza – *Textbook of Bioinorganic Chemistry*
3. **Asim K. Das – Bioinorganic Chemistry,** 2nd Edition, Books & Allied (P) Ltd (India)
4. **Morrison & Boyd – Organic Chemistry, 6th Edition (1992)**, **Prentice-Hall**
5. **Finar – Organic Chemistry, Volume 2, Pearson Education / Longman**.
6. J.L. Jain – *Fundamentals of Biochemistry*, **S. Chand & Company**.

B.Sc. Semester: VI 2027-28

Discipline Specific Elective Course (DSE)

CHESE16006T2: Industrial Chemistry

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
4 Credits	4 Hours	60 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Understand and apply basic metallurgical principles and processes (e.g., leaching, magnetic separation, Bessemerisation) for the extraction and refining of metals.

CO2: Analyze the extraction processes and properties of specific metals like copper, platinum, zinc, and uranium, and evaluate their industrial applications.

CO3: Explain the composition, manufacturing, and setting mechanisms of cement and glass, and their industrial relevance.

CO4: Differentiate between various industrial polymers, with a focus on silicone materials, their curing methods, forms, processing, and comparative properties.

CO5: Demonstrate knowledge of oils, fats, waxes, and detergents; their properties, classification, analysis techniques, and industrial applications.

SYLLABUS

Unit-I: Concepts of Metallurgy

Basic principles and main steps of Metallurgy, Magnetic separation, Leaching, Bessemerisation, Reverberatory furnace, Blast furnace, Alumino- thermic process, Refining of metal. Types of metallurgical processes.

Unit-II: Metallurgy of Typical Metals

Metallurgy of Copper and platinum, extraction of Zinc from zinc blende, extraction of uranium from pitch blende, Uses of Uranium,

Unit-III: Cement, Lime and Glass

Classification Of Cement, Raw Materials Used, Manufacture of Portland Cement, Chemical Composition, Importance, Properties of Cement, Setting and Hardening of Cement, Specification of Cement, Analysis of Cement

Lime: Industrial preparation, Properties and Uses.

Glass: Types and properties of glasses, coloring agents, Industrial manufacturing of glass

Unit-IV: Industrial Polymers and Silicon Materials

Industrial polymers, types including natural, synthetic, and elastomeric rubbers, silicone polymers overview.

Industrial Silicone Polymers: Curing mechanisms, special grades, production methods, forms (e.g., sheets, foams, elastomers), and emerging processing techniques like 3D printing.

Key industrial uses of silicone rubber, comparative study with organic (natural and synthetic) rubbers, thermosetting and thermoplastic polymers.

Unit-V: Fats, Oils, Detergents

Introduction to oil, and fats. Mineral oils, essential oils. Extraction, physical and chemical properties of oil and fats. Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Analysis of oil & fats- Saponification value, iodine value, acid value, R/M value. Classification of oils. Difference between animal & vegetable oils.

Soaps & soapless detergents. Soaps- manufacture of soap, toilet soap & laundry soap,

special varieties of soaps, cleansing action of soap, synthetic detergents, alkyl and aryl sulphonates.

SUGGESTED READINGS

1. **Industrial Chemistry –** *R. Gopalan, D. Venkappayya, S. Nagarajan*
2. **Textbook of Polymer Science** – *F.W. Billmeyer,* **3rd Edition, John Wiley & Sons,**
3. **Industrial Chemistry –** *B.K. Sharma,* 20th Edition, Goel Publishing House, Meerut
4. **A Textbook of Engineering Chemistry –** *Jain & Jain***, 17th Edition, Dhanpat Rai Publishing Company**
5. *Textbook of Engineering Chemistry* by C. Parameswara Murthy, C. V. Agarwal & Andra Naidu, Standard (St) Edition, BS Publications

B.Sc. Semester: I 2025-26

Discipline Centric Core Course (DCC)

CHECC14001P: Practical Chemistry - I

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

SUGGESTED LABORATORY EXERCISES

Exercise 1.
Qualitative analysis of inorganic mixture containing 5-radicals (anions and cations), separation and identification of (group 0, I, II, III, IV, V and VI) and anions including interfering radicals and special combination of acidic radicals (CO_3^{2-}, SO_3^{2-}, NO_3^-,NO_2^-, NO_3^- , Br^-, Cl^- , Br^- , I^-, S^{2-} , SO_3^{2-}, SO_4^{2-})

Exercise 2.
Organic Models (Using Ball and Stick Model Box): R and S configuration of optical isomers D and L configuration of optical isomers E/Z configuration of geometrical isomers Conformational isomerism of ethane and n-butane

SUGGESTED READINGS

1. Practical Chemistry by Dr. O.P. Pandey, Dr. S. Giri
2. Practical Chemistry - I^{st} Semester by K.M. Gangotri
3. Practical Chemistry – I^{st} Semester by Dr. Vikal Gupta, Dr. Arun Arora

B.Sc. Semester: II 2025-26

Discipline Centric Core Course (DCC)

CHECC14002P: Practical Chemistry - II

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

SUGGESTED LABORATORY EXERCISES

Exercise 1.
Redox Titrations: (i) To determine the strength of given unknown copper sulphate solution iodometrically using starch as indicator.
(ii) To determine the strength of given unknown potassium dichromate solution iodometrically using starch as indicator.

Exercise 2.
a) Viscosity:
(I) To determine the viscosity of the given organic liquid by Ostwald Viscometer
(II) To determine the % composition of a binary solution by Viscosity measurement.

(b) Surface Tension:
(I) To determine the surface tension of a given organic liquid by Stalagmometer.
(II) To determine the % composition of a binary solution by surface tension measurement.

SUGGESTED READINGS

1. Practical Chemistry by Dr. O.P. Pandey, Dr. S. Giri
2. Practical Chemistry – Ind Semester by K.M. Gangotri
3. Practical Chemistry - IInd Semester by Dr. Vikal Gupta, Dr. Arun Arora

B.Sc. Semester: III 2026-27

Discipline Centric Core Course (DCC)

CHECC15003P: Practical Chemistry - III

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

SUGGESTED LABORATORY EXERCISES

Exercise 1.
Gravimetric analysis (by using Silica / Sintered Crucible)

i. To estimate Barium as barium sulphate.
ii. To estimate copper as cupric oxide/ copper (I) thiocynate.
iii. To estimate Zinc as Zinc oxide.

Exercise 2.
Measurement of pH of different solutions like aerated drinks, fruit juices and shampoos using pH meter.

SUGGESTED READINGS

1. Practical Chemistry by Dr. O.P. Pandey, Dr. S. Giri
2. Practical Chemistry – IIIrd Semester by K.M. Gangotri

B.Sc. Semester: IV 2026-27

Discipline Centric Core Course (DCC)

CHECC15004P: Practical Chemistry - IV

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

SUGGESTED LABORATORY EXERCISES

Exercise 1.

i. To study the hydrolysis of an ester catalyzed by an acid and determine the rate constant and order of reaction.
ii. To study saponification of ester and determine the rate constant and order of reaction.
iii. To study the reaction b/w acetone and iodine with respect to iodine and determine the rate and order of reaction.

Exercise 2.

i. Calibration of Thermometer and determination of M.P. & B.P.: - The following compounds may be used for the calibration purpose naphthalene (M.P. 80–82 °C), acetanilide (M.P. 113.5–114.0 °C), urea (M.P. 132.5–133.0 °C), and benzoic acid (M.P. 122.0 °C).
ii. Qualitative Analysis: - Identification of organic compounds (one liquid or one solid) through the functional group analysis (containing only one functional group).

SUGGESTED READINGS

1. Practical Chemistry by Dr. O.P. Pandey, Dr. S. Giri
2. Practical Chemistry – IVth Semester by K.M. Gangotri

B.Sc. Semester: V 2027-28

Discipline Specific Elective Course (DSE)

CHECC16005P: Practical Chemistry - V

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

SUGGESTED LABORATORY EXERCISES

Exercise 1.
Preparations: Micro cosmic salt
Tetraamminecopper(II) sulphate
Nickel ammonium sulphate
Sodium thiosulphate
Chrome Alum
Ferrous Sulphate
Ferrous Ammonium Sulphate

Exercise 2.
Qualitative Analysis: - Analysis of an organic mixture containing two solid components, using water, $NaHCO_3$ and NaOH for separation.

SUGGESTED READINGS

1. Practical Chemistry by Dr. O.P. Pandey, Dr. S. Giri
2. Practical Chemistry by K.M. Gangotri

B.Sc. Semester: VI 2027-28

Discipline Specific Elective Course (DSE)

CHECC16006P: Practical Chemistry - VI

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
2 Credits	4 Hours	60 Hours

SUGGESTED LABORATORY EXERCISES

Exercise 1.
Synthesis of organic compounds:
(i) Acetylation of salicylic acid, aniline and p-nitroacetanilide
(ii) Preparation of iodoform from ethanol and acetone
(iii) Diazotization/Coupling of primary aromatic amines (aniline)
(iv) Preparation of methyl orange

Exercise 2.
Preparation of sols (i) As_2S_3 Sol (ii) $Fe(OH)_3$ Sol

Distribution law:
To determine the partition coefficient of benzoic acid between water and benzene at R.T.

Adsorption:
To study the adsorption of acetic acid by activated charcoal and verify the Freundlich adsorption isotherm.

SUGGESTED READINGS

1. Practical Chemistry by Dr. O.P. Pandey, Dr. S. Giri
2. Practical Chemistry by K.M. Gangotri

B.Sc. Semester: I

Discipline Centric Core Course (DCC)

MATCC14001T: Algebra

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Understand and apply the concepts of matrix algebra including rank, inverse, linear dependence/independence, eigenvalues, eigenvectors, and the Cayley-Hamilton theorem.

CO2: Analyze and solve polynomial equations using root-coefficient relationships, symmetric functions, transformation techniques, and classical methods like Cardano's and Ferrari's.

CO3: Demonstrate knowledge of group theory including the definition and properties of groups, cyclic groups, permutation groups, subgroups, and their related theorems.

CO4: Apply advanced group theory concepts such as cosets, Lagrange's theorem, group homomorphisms, normal subgroups, quotient groups, and understand the basic structure of rings, fields, and integral domains.

CO5: Define and work with vector spaces and subspaces, evaluate linear combinations, spans, and test for linear dependence and independence of vectors.

SYLLABUS

Unit-I: Rank of a matrix. Inverse of a matrix. Linear dependence and independence of rows and columns of a matrix. Row rank and column rank of a matrix. Eigen values, eigen vectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley-Hamilton theorem (without proof) and its use in finding the inverse of a matrix.

Unit-II: Relations between the roots and coefficients of general polynomial equations in one variable.Symmetric function of roots, Transformation of equations, Descarte's rule of signs, Solution of cubic equations (Cardon's method), Biquadratic equations (Ferrari's Method).

Unit-III Definition and general properties of groups, Order of an element of a group, Cyclic group, Permutation group, Subgroups, Index of a subgroup, Theorems on Subgroups of a cyclic group.

Unit-IV: Cosets, Lagrange's theorem, Group homomorphism, Cayley theorem, Normal subgroups, quotient Groups, Fundamental theorem of homomorphism, Basic concepts of Ring, Field and Integral domain.

Unit-V: Definition and examples of a vector space, subspace, Linear combination and linear span, Linear dependence and independence of vectors.

SUGGESTED READINGS

1. M. Ray: A Text Book of Higher Algebra, S.Chand & Co., New Delhi.
2. J.L. Bansal, S.L. Bhargva, & S.M. Agarwal: Algebra (Hindi Ed.), Jaipur Publishing House, Jaipur.
3. A.R. Vasishta and A.K. Vasistha: Matrices, Krishna Prakashan Ltd. Meerut.
4. G.C. Sharma: Modern Algebra; Ram Prasad & Sons, Agra.
5. R.S. Agarwal.: Text Book on Modern Algebra; S. Chand & Co., New Delhi.
6. D.C. Gokhroo & S.R.Saini: Abstract Algebra (Hindi Ed.); Jaipur Publishing House, Jaipur.

B.Sc. Semester: II

Discipline Centric Core Course (DCC)

MATCC14002T: Calculus

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Understand and apply concepts of polar coordinates, including angle between radius vector and tangent, pedal equations, and properties of curvature such as center and chord of curvature.

CO2: Perform partial differentiation, use Euler's theorem on homogeneous functions, apply chain rule, and solve optimization problems using maxima, minima, and Lagrange multipliers.

CO3: Analyze and sketch curves by studying asymptotes, singular points, envelopes, evolutes, and understand special functions like Beta and Gamma functions, along with rectification of curves.

CO4: Compute volumes and surface areas of solids of revolution using integration techniques, evaluate double and triple integrals, and perform change of order and coordinate transformations in integration.

CO5: Understand vector calculus operators — gradient, divergence, curl — and apply major theorems like Stoke's, Green's, and Gauss's for solving problems in vector fields.

SYLLABUS

Unit-I: Polar Co-ordinates, Angle between radius vector and the tangent, Pedal equation of a curve, Derivatives of an arc, curvature, Centre of curvature and chord of curvature.

Unit-II: Partial differentiation, Euler's theorem on homogeneous functions, chain rule of partial differentiation, Maxima and Minima of functions of two independent variables and of three variables connected by a relation, Lagrange's Method of undetermined multipliers.

Unit-III Asymptotes, Singular points, curve tracing (Cartesian and polar form), Envelopes and Evolutes, Theory of Beta and Gamma functions, Rectification.

Unit-IV: Volumes and Surfaces of solids of revolution, Differentiation and integration under the sign of integration, Double and triple integrals with applications volume and surface area, Dirichlet's integral, Change of order of integration and changing the double integral into polar co-ordinates.

Unit-V: Vector Calculus: Curl, Gradient, Divergence and Identities involving these operators. Stoke, Green and Gauss Theorems (Statement, application and verification only).

SUGGESTED READINGS

1. Gorakh Prasad: A Text Book of Differential Calculus; Pothishala Pvt. Ltd.Allahabad.
2. J.L. Bansal, S.L.Bhargava and S.M. Agarwal : A Text Book of Differential Calculus II (Hindi Ed.) and Integral Calculus, Vol. II (Hindi Ed.); Jaipur Publishing House, Jaipur.
3. D.C. Gokharoo & S.R. Saini: Differential Calculus (Hindi Ed.); Navkar Prakashan, Ajmer.
4. O.P.Tandon, and Sharma, K.C.: Integral Calculus; Jaipur Publishing House, Jaipur.
5. Gupta, Juneja and Tandon: Differential Calculus (English Ed.);Ramesh Book Depot, Jaipur.
6. Gorakh Prasad: Integral Calculus; Pothishala Pvt. Ltd. Allahabad.
7. D.C. Gokhroo, S.R. Saini, S.S.Bhati : Vector Calculus (Hindi Ed.); Navkar Prakashan, Ajmer.
8. S.L.Bhargava, Banwari Lal: Vector Calculus (Hindi Ed.); Jaipur Publishing House, Jaipur.

B.Sc. Semester: III

Discipline Centric Core Course (DCC)

MATCC15003T: Differential Equations

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Solve differential equations of different order.
CO2: Classify the differential equation according to their order and linearity.
CO3: Be able to apply the solution of a differential equation to real-life problems.
CO4: Explain the method of solution with justification.
CO5: Will be able to find solution of various types of linear differential equations.

SYLLABUS

Unit-I: Exact and reducible to exact differential equations of first order and first degree. First order higher degree differential equations solvable for x, y, Clairaut's forms and singular solutions.

Unit-II: Second order linear differential equations with constant coefficients, homogeneous linear equations, non-homogeneous equations, methods of variation of parameters and undetermined coefficients. Simultaneous differential equations of first order and first degree. Total differential equations of the form P dx + Q dy +R dz = 0, method of inspection and method for homogeneous equations.

Unit-III Linear differential equations of second order of the form $\frac{d^2y}{dx^2} + P\frac{dy}{dx} + Q(x)y = R(x)$. Exact Linear differential equations of n^{th} order. Differential equations of the various form e.g., (i) $\frac{d^2y}{dx^2} = f(y)$ (ii) Equations not containing y directly. Equations not containing x directly. Method of variation of parameters to the solution of second order linear differential equations.

Unit-IV: Series solutions of second order linear differential equations, Power series method, Series solution of Bessels and Legendre equations. Partial differential equations of the first order. Lagrange's form. Some special types of equations which can be solved easily by methods other than the genral method. Charpit (general) method of solution

Unit-V: Partial differential equations of second and higher Order. Homogeneous and non homogeneous equations with constant coefficients. Partial differential equations reducible to equations with constant coefficients. Monge's method for the solution of the equation of type Rr + Ss + Tt = V.

SUGGESTED READINGS

1. Sharma, Gupta & Trivedi: Differential Equations, Krishna Prakashan Mandir, Meerut.
2. Gorakh Prasad: Differential Equations, Pothishala Pvt. Ltd., Allahabad.
3. H.T.H. Piaggio: Differential Equations, CBS Publisher, Delhi.
4. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers.
5. R. K. Ghosh and K.C. Maity: Differential Equations, New Central Book Agency (P) Ltd.
6. Zafar Ahsan: Differential Equations and Their Applications, PHI Learning.
7. G. B. Thomas and R. L. Finney: Calculus and Analytic Geometry, Ninth Ed. (Delhi Reprint).
8. Gokhroo, Saini and Omar: Partial differential equations, Jaipur Publishing House, Jaipur.

B.Sc. Semester: IV

Discipline Centric Core Course (DCC)

MATCC15004T: Analysis (Real and Complex)

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Think about the basic proof techniques and fundamental definitions related to the real number system. They can demonstrate some of the fundamental theorems of analysis.

CO2: Identify curves and regions in the complex plane defined by simple expressions.

CO3: Understand basic concepts of complex integration and the ability to compute such integrals.

CO4: Describe basic properties of the complex logarithmic and complex exponential functions.

CO5: Decide when and where a given function is analytic and be able to find its series development.

SYLLABUS

Unit-I: Dedekind's theory of Real numbers, upper and lower bounds, limit points, Bolzano-Weierstrass theorem, derived sets, denumerable sets, enumerable sets, open and closed sets. Theory of Riemann integration, necessary and sufficient conditions for R-integrability. Darboux theorem.

Unit-II: Cauchy's root test, Logarithmic Ratio Test, Raabe's test, De Morgan and Bertrand's test, Cauchy's condensation test, Gauss's test, Alternating series, Leibnitz test (Derivation of above tests not required), Convergent series, tests for convergence of a series: comparison test, D'Alembert's Ratio test.

Unit-III Functions, limits, and continuity. Differentiability. Concept of an analytic function, Cartesian and Polar form of Cauchy-Riemann equations. Harmonic functions. Conjugate functions. Construction of analytic functions. Power Series: Absolute Convergence of Power Series, circle and radius of convergence of power series, sum function of a power series.

Unit-IV: Complex Integration as the sum of two line integrals. Cauchy's integral theorem, Cauchy's integral formula. Cauchy's integral formula for the derivative of an analytic function. Application of Cauchy's integral formula.

Unit-V: Morera's theorem, Liouville's Theorem, Poisson's integral formula, Expansion of an analytic function by Taylor's and Laurent's theorems. Singularities of an analytic function, types of singularities.

SUGGESTED READINGS

1. Shanti Narayan: Real Analysis; S. Chand & Co., New Delhi.
2. G.N. Purohit: Real Analysis; Jaipur Publishing House, Jaipur.
3. S.L. Bharany, S.P. Goyal: Real Analysis (Hindi Ed.); Jaipur Publishing House, Jaipur.
4. Shanti Narayan: A Text Book of Complex Variable; S. Chand & Co., New Delhi.
5. K.P. Gupta: Complex Analysis; Pragati Prakashan, Meerut.
6. D.C. Gokhroo, S.R. Saini & G.R. Yadav: Complex Analysis (Hindi Ed.); Navkar Publication, Jaipur.
7. G.N. Purohit: Complex Analysis; Jaipur Publishing House, Jaipur.
8. S. Ponnusamy: Foundation of Complex Analysis, Narosa Publishing House, Bombay, New Delhi.
9. E.V. Krishnamurthy: Complex Analysis, Narosa Publishing House, New Delhi (2002).

B.Sc. Semester: V

Discipline Specific Elective Course (DSE)

MATSE16005T1: Numerical Analysis

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Apply numerical methods to find roots of algebraic and transcendental equations.
CO2: Solve systems of linear equations using direct methods.
CO3: Understand and implement finite difference calculus and interpolation techniques,.
CO4: Use numerical differentiation formulas and numerical integration methods like trapezoidal and Simpson's rules.
CO5: Solve ordinary differential equations using numerical techniques, and finite difference methods for boundary value problems.

SYLLABUS

Unit-I: Solutions of algebraic and transcendental equations using Bisection method, False position method, Secant method, Fixed point iteration method, Newton's Rapson method.

Unit-II: Solutions of Linear system of equation, Gauss elimination method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and Successive Over-Relaxation(SOR) iterative methods.

Unit-III Calculus of Finite differences, Lagrange and Newton interpolation: linear and higher order, finite difference operators. forward difference, backward difference Derivatives Based on Newton's Forward Interpolation Formula , Derivatives Based on Newton's Backward Interpolation Formula.

Unit-IV: Numerical differentiation: Central Difference Interpolation Formulae Gauss's Forward Interpolation Formula Gauss's Backward Interpolation Formula Bessel's Formula Stirling's Formula
Integration: trapezoidal rule, Simpson's rule, Euler's method.

Unit-V: Solving Differential Equations: **Ordinary differential equations (ODEs):**Initial value problems (Euler's Modified method, Runge-Kutta methods, multistep methods), boundary value problems (finite difference methods).

SUGGESTED READINGS

1. 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.
2. S.S. Sastri, Introductory Method of Numerical Analysis, Fifth Edition, PHI P. Ltd., 2012
3. Goyal, Mittal: Numerical Analysis, Prograti Prakashan, Meerut.
4. J.L.Bansal, S.L. Bhargava & S.M. Agarwal: Numerical Analysis (Hindi Ed.),Jaipur Publishing House, Jaipur.
5. H.C. Saxena : Numerical Analysis; S.Chand & Co., New Delhi
6. D.C. Gokhroo : Numerical Analysis (Hindi Ed.);Navkar Prakashan, Ajmer

B.Sc. Semester: V

Discipline Specific Elective Course (DSE)

MATSE16005T2: Ring Theory and Linear Algebra

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Rings, Subrings, Ideals and Fields.
CO2: Ring Homomorphism and Isomorphism Theorems.
CO3: Vector Space, Subspace, Span and Quotient Space.
CO4: Linearly independent and dependent vectors, Linear transformation and properties and isomorphism of linear transformations.
CO5: The objective of the course is to make the students understand the basic concept of rings, ideals, vector spaces and linear transformations.

SYLLABUS

Unit-I: Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideals, ideal generated by a subset of a ring, factor rings.

Unit-II: Operations on ideals, prime and maximal ideals, ring homomorphism, properties of ring homomorphism, Isomorphism theorems I, II and III.

Unit-III Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span.

Unit-IV: Linear dependence and linear independence, basis and Standard basis, dimension of a vector space.

Unit-V: Linear transformation, Properties of linear transformation, algebra of linear transformations, Matrix representation of a linear transformation, Isomorphism.

SUGGESTED READINGS

1. Joseph A. Gallian, Contemporary Abstract Algebra (10th Edition), Narosa Publishing House, New Delhi, 1999
2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra (4th Edition), Prentice Hall of India Pvt. Ltd., New Delhi, 2004
3. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall of India Pvt. Limited
4. A.R. Vasishta and A.K. Vasistha: Matrices, Krishna Prakashan Ltd. Meerut.
5. .C. Gokhroo, S.R. Saini & G.R. Yadav: Linear Algebra (English/Hindi Ed.); Navkar Publication, Jaipur.
6. Hoffman K., Kunze R., Linear Algebra, Prentice-Hall, Second Edition, 2008.
7. Meyer C.D., Matrix Analysis and Applied Linear Algebra, SIAM, 2001.
8. Horn R., Johnson C. R., Matrix Analysis, Cambridge University Press, New York, 1985.

B.Sc. Semester: VI

Discipline Specific Elective Course (DSE)

MATSE16006T1: Integral Transform

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Understand and derive Fourier series for periodic, odd, even, and discontinuous functions, including half-range expansions using sine and cosine series.

CO2: Define Fourier transform, explore its properties and theorems such as modulation, convolution, and Parseval's identity, and compute Fourier transforms of derivatives.

CO3: Apply Laplace transform techniques to functions, use its properties including differentiation and integration, and perform inverse Laplace transforms.

CO4: Utilize Laplace transforms to solve ordinary differential equations, integral equations, boundary value problems, and systems of differential equations.

CO5: Understand Z-transform, its properties, and apply it to solve difference equations using inverse Z-transform, shifting, and convolution theorems.

SYLLABUS

Unit-I: Fourier Series: Periodic function, Fourier series formula for periodic functions, Fourier series for Odd and Even functions, Fourier series for Discontinuous function, Half range Fourier series, Half range Cosine series, Half range Sine series.

Unit-II: Fourier Transform: Definition and properties of Fourier transform, Inverse Fourier transform, relation between Fourier and Laplace transform, Modulation Theorem, convolution of two functions, Parseval's identity, convolution theorem, Fourier transform of derivative.

Unit-III : Laplace Transform: Definition of Laplace Transform and examples, Properties of Laplace Transform, Differentiation and Integration properties of Laplace Transform, Inverse Laplace Transforms and its examples, Convolution theorem and related examples.

Unit-IV: Applications of Laplace Transform: Solution of Ordinary Differential Equations, Solution of Integral equations, Solution of Boundary Value Problems, Solution of system of differential equations.

Unit-V: Z-transform: Definition, change of scale and shifting property of z-transform, inverse z-transform, Application of z-transform to solution of difference equation, partial sum and convolution theorem of z-transform.

SUGGESTED READINGS

1. L. Debnath, Integral transforms and their Applications, CRC Press, New YorkLondon-Tokyo, 1995.
2. J.K. Goyal, K.P. Gupta & Gupta, Integral Transform, Pragati Prakashan.
3. Dr. D. S. Bodkhe & Dr. G. S. Jagtap, INTEGRAL TRANSFORM AND ITS APPLICATION Novateur Publication.
4. H.K. Dass: Advanced Engineering Mathematics, S.Chand Pvt. Ltd., New Delhi.
5. Goyal, S.P. and Goyal, A.K.: Integral transform, Jaipur publishing House.

B.Sc. Semester: VI

Discipline Specific Elective Course (DSE)

MATSE16006T2: Operations Research

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
6 Credits	6 Hours	90 Hours

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Understand the origin, development, nature, and applications of Operations Research (OR) and the role of modeling and scientific methods in solving OR problems.

CO2: Formulate Linear Programming Problems (LPP) mathematically and solve them using graphical methods, including identifying exceptional cases.

CO3: Apply simplex methods including Big M and Two-Phase methods to solve general linear programming problems in canonical and standard forms.

CO4: Comprehend the concept of duality in linear programming, formulate dual problems, and apply duality theorems including the Complementary Slackness theorem.

CO5: Solve Assignment and Transportation problems using methods such as Northwest Corner, Least Cost, Vogel's Approximation, and the Optimal (u-v) method.

SYLLABUS

Unit-I: Introduction Origin and Development of Operations Research (OR) – Nature and Features of OR – Scientific Methods in OR – Modeling in OR – Advantages and Limitations of Models – General Solution Methods of OR Models – Applications of Operations Research.

Unit-II: Linear Programming Problem. Mathematical Formulation of the Problem – Illustration on Mathematical Formulation of Linear Programming Problems (LPP) – Graphical Solution Method – Some Exceptional Cases.

Unit-III : General Linear Programming Problem Canonical and Standard Forms of LPP Simplex Method. Linear Programming using Artificial Variables – Big M Method– Two Phase Method – Problems.

Unit-IV: Duality in Linear Programming (LP) General Primal and Dual Pair – Formulating a Dual Problem – Primal – Dual Pair in Matrix Form Duality Theorems – Complementary Slackness Theorem.

Unit-V: Assignment and Transportation problems, Northwest Corner Method, Least cost Method, Vogle Approximation Method and Optimium solution Method (u – v Method).

SUGGESTED READINGS

1. Operations Research: KantiSwarup, P.K. Gupta & Man Mohan, S. Chand, 1978.
2. Operations Research: Theory and Applications: J.K. Sharma, Trinity Press, 2016.
3. Operations Research: H.A. Taha, Prentice Hall of India, 2011.
4. Operations Research: R. Bronson,Schaum's Outline Series McGraw Hill, 1982

B.Sc. Semester: I 2025-26

Skill Enhancement Course (SEC)

DIMSC14001T: Digital Marketing

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcome:

- To introduce the key concepts and scope of digital marketing.
- To develop working knowledge of SEO, SEM, email, and social media marketing tools.
- To equip students with practical skills in content creation and campaign strategy.
- To familiarize learners with analytics tools for performance tracking.
- To ensure awareness of legal and ethical practices in digital marketing.

SYLLABUS

Unit I: Fundamentals of Digital Marketing

Introduction to Digital Marketing, Difference between Traditional and Digital Marketing
Key Components: SEO, SEM, Email, Social Media, Content Marketing,Overview of Websites, Domains, and Hosting.

Unit II: Digital Marketing Tools and Techniques

SEO: Keywords, on-page/off-page SEO, meta tags, title tags
SEM: Google Ads, PPC campaigns, search and display ad formats
SMM: Basics of Facebook, Instagram, LinkedIn, YouTube marketing

Unit III: Digital Analytics and Strategy

Google Analytics: Traffic analysis, behaviour tracking, conversion measurement,
Introduction to UTM Parameters for campaign tracking, Legal and Ethical Aspects: GDPR, spam laws, cookies policy

Unit IV: Content Creation and Visual Tools

Developing effective content strategies for digital channels ,Blogging, storytelling, and content calendars, Basics of graphic design using Canvas or similar tools, Video content: Basics of editing and publishing

Unit V: Practical Applications and Project Work

Designing and executing a mini digital marketing campaign, Social media content planning and scheduling, Running a mock Google Ads campaign, Performance analysis and report creation

SUGGESTED BOOKS

Ryan Deiss & Russ Henneberry— A great beginner-level guide covering the whole digital landscape.
Philip Kotler— Focuses on the transformation of marketing in the digital era.
Adam Clarke— Covers the latest SEO practices in a practical format.
Jan Zimmerman & Deborah Ng— Explores marketing strategies on platforms like Facebook, Twitter, and LinkedIn.

Free Online Resources

Google Digital Garage – https://learndigital.withgoogle.com/digitalgarage
HubSpot Academy – https://academy.hubspot.com/

B.Sc. Semester: II 2025-26

Skill Enhancement Course (SEC)

ARISC14002T: Artificial Intelligence

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcome:

- To introduce the basic concepts, history, and real-world applications of Artificial Intelligence.
- To understand problem-solving techniques and search algorithms in AI.
- To explore core concepts of Machine Learning and its practical use cases.
- To gain hands-on experience with beginner-friendly AI tools.
- To identify ethical issues and responsible AI practices

SYLLABUS

Unit I: Foundations of Artificial Intelligence

Definition, goals, and brief history of AI, Real-life applications: Healthcare, education, agriculture, finance, robotics, AI vs. Machine Learning vs. Deep Learning
Intelligent agents: Structure, types, and environments.

Unit II: Problem Solving and Search Techniques

Problem-solving as search in state space , Uninformed (blind) search strategies: Breadth-First Search (BFS), Depth-First Search (DFS) ,Informed (heuristic) search: A* Algorithm, Greedy Search

Unit-III: Introduction to Machine Learning

Types of Machine Learning:
Supervised ,Unsupervised ,Reinforcement learning
Core concepts: Features, labels, training vs. testing data, over fitting
Common applications: Spam detection, Image recognition, Language translation

Unit-IV: Hands-on Tools for AI and ML

Google Teachable Machine – Image/audio recognition without coding
Scratch (AI Extensions) – Visual programming for basic AI tasks
Python & scikit-learn – Introductory ML programming

Unit-V: AI in Practice and Capstone Project

Design and execution of a simple AI project using one of the tools, Analyze and interpret results of ML models (classification, prediction), Ethical reflection on the chosen application (e.g., facial recognition or recommendation systems),

SUGGESTED BOOKS

Stuart Russell & Peter Norvig – Artificial Intelligence: A Modern Approach (simplified excerpts for skill course level)
Elaine Rich – Artificial Intelligence Tom M. Mitchell – Machine Learning
S.J. Purohit – Introduction to Artificial Intelligence (Indian edition, beginner-friendly)

B.Sc. Semester: V 2027-28
Skill Enhancement Course (SEC)
COESC16005T: Communicative English
(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcome:

- To develop students' ability to communicate effectively in English in academic, social, and professional contexts.
- To enhance vocabulary, grammar, pronunciation, and writing skills.
- To improve listening, speaking, reading, and writing (LSRW) proficiency.
- To build confidence in interpersonal, formal, and workplace communication.
- To introduce soft skills for personality development and employability.

SYLLABUS

Unit I: Foundations of Communication

Definition and process of communication, Types: Verbal and non-verbal communication
Barriers to effective communication and strategies to overcome them, Formal vs. informal, oral vs. written communication, Basics of phonetics: Pronunciation, stress, and intonation

Unit II: English for Everyday and Academic Use

Functional English for everyday situations: greetings, requests, complaints, suggestions
Vocabulary enhancement: Synonyms, antonyms, idioms, phrasal verbs,
Grammar focus: Tenses, sentence structures, subject-verb agreement
Paragraph writing, note-taking, and summarizing skills
Formal writing: Email writing, official letters, and applications

Unit III: Professional and Interpersonal Communication Skills

Speaking practice: Group discussions, debates, JAM (Just a Minute) sessions
Interview skills and résumé/CV writing, Presentation techniques: Body language, vocal variety, use of visual aids.

Unit IV: Reading and Writing for Fluency

Skimming, scanning, and reading for detail
Reading comprehension passages from newspapers, blogs, and fiction, Story writing, dialogue writing, report writing, Guided writing tasks and peer feedback.

Unit V: Practical Application and Evaluation

Mock interviews and role-plays, Individual presentations on current topics
Resume and cover letter review, Peer evaluation and feedback sessions

SUGGESTED BOOKS

English for Effective Communication" – Oxford University Press
"Communication Skills" by Sanjay Kumar & Pushp Lata (Oxford)
"Developing Communication Skills" by Krishna Mohan & Meera Banerji
"Functional English" by G. Radhakrishna Pillai & K. Rajeevan

B.Sc. Semester: I 2025-26

Skill Enhancement Course (SEC)

CLPSC14001T: Chemical Safety and Laboratory Practices

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Apply Standard Operating Procedures (SOPs) to ensure consistent and safe laboratory practices.

CO2: Demonstrate understanding and implementation of Good Laboratory Practices (GLP) to maintain quality, reliability, and integrity of experimental work.

CO3: Identify, report, and document laboratory incidents and accidents in compliance with safety regulations and institutional protocols.

CO4: Administer appropriate first aid measures in response to chemical exposures or laboratory-related injuries.

CO5: Evaluate and respond effectively to emergency situations in laboratory settings, ensuring personal and environmental safety

SYLLABUS

Unit-I: Introduction to Chemical Safety

Importance of chemical safety in teaching and research laboratories
Types of hazards: chemical, physical, biological, mechanical
Routes of exposure: inhalation, ingestion, skin contact, injection

Unit-II: Personal Safety Measures

Personal Protective Equipment (PPE): gloves, goggles, lab coats, face shields
Lab ventilation: fume hoods, biosafety cabinets
Emergency equipment: eyewash stations, fire extinguishers, spill kits

Unit-III: Environmental Safety Measures

Good Housekeeping and Hygiene Practices, Safety signage and labels
Green Chemistry principles in laboratory safety

Unit-IV: Safe Handling, Storage, and Disposal of Chemicals

Safe handling practices: transport, pipetting, mixing, heating
Storage of chemicals based on compatibility (flammables, oxidizers, corrosives)
Chemical inventory management
Waste segregation and disposal methods (solid, liquid, hazardous)

Unit-V: Laboratory Practices and Emergency Preparedness

Standard Operating Procedures (SOPs), Good Laboratory Practices (GLP)
Incident and accident reporting, First aid in case of chemical exposure or injury

SUGGESTED READINGS

1. Handbook on Laboratory Safety – Directorate General, CSIR
2. Environmental Chemistry and Pollution Control by S.S. Dara – S. Chand Publishing
3. Laboratory Manual in Organic Chemistry by B.S. Furniss et al., adapted by Indian publishers
4. A Textbook of Practical Chemistry by Vishnoi, Malik & Narang – New Age International

B.Sc. Semester: II 2025-26

Skill Enhancement Course (SEC)

PWMSC14002T: Principles of Waste Management

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Identify various types and sources of waste and understand their impacts on health and environment.

CO2: Demonstrate techniques for waste segregation, storage, and transportation.

CO3: Understand and apply various recycling and waste treatment methods.

CO4: Analyze sustainable waste management practices, including 3Rs and circular economy concepts.

CO5: Design small-scale, eco-friendly waste management/recycling models with community engagement.

SYLLABUS

Unit-I: Fundamentals of Waste Management

Introduction to waste and its classification: biodegradable, non-biodegradable, hazardous, e-waste, biomedical

Sources of waste: domestic, industrial, agricultural, commercial

Health and environmental impacts of improper waste disposal

Unit-II: Waste Collection, Segregation and Transportation

Methods of waste collection and segregation at source, Tools and containers for segregation

Transportation and handling of waste

Unit-III: **Waste Treatment and Disposal Methods**

Composting (aerobic, anaerobic) and vermicomposting, Incineration, landfilling, pyrolysis

Bio-methanation and energy recovery

Unit-IV: Recycling Techniques

Principles of recycling, Recycling of paper, plastic, glass, metal, and e-waste, Energy recovery from waste

Unit-V: Sustainable Waste Management and Community Participation

3Rs: Reduce, Reuse, Recycle, Concepts of circular economy and zero waste

Role of NGOs, startups, and government initiatives (e.g., Swachh Bharat Abhiyan)

Awareness campaigns and community-based projects

SUGGESTED READINGS

1. M.N. Rao & Razia Sultana – Solid and Hazardous Waste Management, CBS Publishers & Distributors Pvt. Ltd.
2. John Pichtel – Waste Management Practices: Municipal, Hazardous, and Industrial, CRC Press.
3. Peavy, Rowe, & Tchobanoglous – Environmental Engineering, McGraw-Hill Education.
4. S. K. Garg – Environmental Engineering Vol. I & II, Khanna Publishers.
5. Central Pollution Control Board (CPCB) Guidelines.

B.Sc. Semester: V 2027-28

Skill Enhancement Course (SEC)

FQASC16005T: Food Quality & Adulteration

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Identify various types of food adulterants and understand their health impacts.

CO2: Perform basic physical detection tests for common adulterants in food items like milk, oils, grains, and spices.

CO3: Interpret food quality parameters and understand the usage of basic instruments like pH meters, refractometers, and spectrophotometers.

CO4: Describe microbial contamination and apply basic methods to detect spoilage or unsafe food.

CO5: Demonstrate awareness of Indian food safety laws and the role of regulatory bodies such as FSSAI in preventing food adulteration.

SYLLABUS

Unit-I: Introduction

Introduction to food adulteration

Adulterants: types, sources and their impact on health.

Criteria of adulterated food. Awareness towards food adulteration.

Unit-II: Detection of Adulterants – I

Physical and Chemical tests of-

Milk and milk products

Oils and fats

Unit-III: **Detection of Adulterants – II**

Physical and Chemical tests of-

Sweetening agents

Food grains

Spices

Unit-IV: Food Quality and Instrumental Testing

Introduction to quality parameters: pH, moisture, shelf-life, Basics of instrumental methods: pH meter, refractometer, spectrophotometer (demo level), Microbial contamination: basic understanding and detection, Sensory evaluation: taste, odor, texture, color

Unit-V: Food Laws and Regulatory Framework

Overview of FSSAI and its role, Food Safety and Standards Act, 2006

Prevention of Food Adulteration Act

SUGGESTED READINGS

1. **"Food Science"** – *B. Srilakshmi,* : New Age International Pvt. Ltd.
2. **"Food Analysis" –** *S. Suzanne Nielsen,* Springer Cham.
3. **"Handbook of Food Analysis" –** *Leo M.L. Nollet,* CRC Press.
4. **"Food Laws and Regulations in India" –** *S. R. Sharma.*
5. **"Food Safety and Quality Control" –** *Dr. V. K. Joshi.*

B.Sc. I Semester: 2025-26

Skill Enhancement Courses (SEC)

MCTSC14001T : Mathematical & Computational Thinking and Analysis

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Understand the basic concepts of logic including statements, truth values, and logical connectives.

CO2: Understand and differentiate between number systems: decimal, binary, octal, and hexadecimal.

CO3: Understand the basic definitions and types of sets, elements, and subsets.

CO4: Collect and organize data for statistical analysis.

CO5: Compute measures of central tendency: Mean, Median, and Mode and basic understanding of Probability

SYLLABUS

Unit-I: Logic, Statement, truth table, quantifiers, connectives and tautology, Mathematical induction.

Unit-II: Number System: Decimal system, binary system, octal system, hexadecimal system, arithmetic, conversion from binary to decimal and decimal to binary.

Unit-III: Set Theory, Sets, subsets, elements, and Venn diagrams, Set-builder and roster notation, Set operations: union, intersection, difference, complement, Power sets and Cartesian products

Unit IV: Statistics, Data collection and presentation using bar chart, column chart, line chart, pie chart, histogram, surface chart. Calculation of frequency. Measure of central tendency, Mean, Median and Mode, Definition of Probability, Elementary properties, addition.

Unit V: Statistics and Probability, Measure of central tendency, Mean, Median and Mode, Definition of Probability, Elementary properties, addition.

SUGGESTED READINGS

1. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
2. Kenneth Rosen Discrete mathematics and its applications Mc Graw Hill Education 7th edition.
3. J. L. Mott, A. Kendel and T.P. Baker: Discrete mathematics for Computer Scientists and Mathematicians, Prentice Hall of India Pvt Ltd, 2008.
4. Sancheti D.C. and Kapoor V.C.: Statistics Theory, Methods and Application Sultan Chand & Sons, New Delhi
5. Patri, Digambar Statistical Methods, Kalyani Publishers, Ludhiana

B.Sc. II Semester: 2025-26

Skill Enhancement Courses (SEC)

LSPSC14002T: Logic, Sets and Probability

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Understand the structure of mathematical propositions and the use of logical connectives ($\wedge$, $\vee$, $\neg$, $\rightarrow$, $\leftrightarrow$).

CO2: Identify tautologies, contradictions, and contingencies in logical expressions.

CO3: Understand and define relations with properties like reflexivity, symmetry, and transitivity.

CO4: Define domain, codomain, and range Define functions, including domain, codomain, and range..

CO5: Distinguish between finite and infinite sets and understand their properties. Understand the concept of cardinality

SYLLABUS

Unit-I: Foundations of Mathematical Logic **;** Propositions and logical connectives ($\wedge$, $\vee$, $\neg$, $\rightarrow$, $\leftrightarrow$), Truth tables and logical equivalence,

Unit-II: Tautologies, contradictions, contingencies, Quantifiers: universal ($\forall$), existential ($\exists$), Logical arguments and validity

Unit-III: Definitions and properties of relations: reflexivity, symmetry, transitivity, Equivalence relations and partitions, Partial and total orders.

Unit-VI: Functions: definitions, domain, codomain, range, Injective, surjective, bijective functions, Composition and inverse functions.

Unit-V: Finite vs. infinite sets, Cardinality of sets: one-to-one correspondence, Countable and uncountable sets, Cantor's diagonal argument, Comparing sizes of infinite sets

SUGGESTED READINGS

1. Arindama Singh, *Logics for Computer Science* (2nd edition)
2. Debjani Chakraborti, Nilangshu Acharya & Samir Kumar Bhandari, Mathematical Logic and Set Theory (Sem III–VI)
3. Shashi Mohan Srivastava, *A Course on Mathematical Logic* (includes set theory foundations)
4. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
5. Kenneth Rosen Discrete mathematics and its applications Mc Graw Hill Education 7th edition.
6. J. L. Mott, A. Kendel and T.P. Baker: Discrete mathematics for Computer Scientists and Mathematicians, Prentice Hall of India Pvt Ltd, 2008.

B.Sc. V Semester: 2027-28

Skill Enhancement Courses (SEC)

FMSSC16005T: Financial Mathematics

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcome: On successful completion of the course, the students will be able to:

CO1: Understand core principles of interest, accumulation, discounting, and annuities.
CO2: Learn pricing of bonds and yield computation.
CO3: Identify and apply basic probability distributions relevant to finance
CO4: Compute and interpret Net Present Value (NPV) and Internal Rate of Return (IRR) for investment decisions.
CO5: Define index numbers and explain their significance in financial and economic analysis.

SYLLABUS

Unit-I: Time Value of Money & Interest Theory; Simple vs. compound interest, Effective and nominal interest rates, force of interest, Present and future values of lump sums, annuities (immediate, due, deferred), perpetuities, Amortization, sinking funds

Unit-II: Bond Valuation & Yield Measures, Bond pricing fundamentals: clean/dirty price, accrued interest, Yield-to-maturity (YTM), current yield,

Unit-III: Basic Statistics; Basic probability distributions relevant to finance, Measures of volatility: calculating and annualizing standard deviation, Estimating correlation and regression basics between asset

Unit-IV: Cash Flow Analysis & Capital Budgeting, Net present value (NPV) and internal rate of return (IRR), Uneven cash flows valuation and decision criteria,

Unit-V: Introduction to Index Numbers; Definition and purpose of index numbers, Types: price index, quantity index, value index Uses in economics and finance (e.g., CPI, WPI, stock indices),

SUGGESTED READINGS

1. Interest Rates and Time Value of Money by Parameswaran (McGraw Hill India, 2006)
2. Bond Valuation and the Pricing of Interest Rate Options in India by Jayanth R. Varma (IIM Ahmedabad faculty)
3. Texts on financial statistics and capital budgetingby Dr. V. Dheenadhayalan
4. Classic texts on price, quantity, value index numbers by T. R. Jain & V. K. Ohri; D. S. Prasada Rao

Multidisciplinary Course (MDC)

BCSMC15003T: Basic Concepts of Science

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Understand the Nature and Methodology of Science.
CO2: Apply Fundamental Concepts of Physics.
CO3: Demonstrate Understanding of Basic Chemistry Concepts.
CO4: Comprehend Biological Systems and Principles.
CO5: Apply Basic Mathematical Skills in Scientific Contexts.

SYLLABUS

Unit-I Nature and Scope of Science
Overview of Science, Scientific Method: Observation, Hypothesis, Experiment, Conclusion, Importance of Science in Daily Life, Science and Society.

Unit-II Fundamentals of Physics
Basic Physical Quantities (mass, length, time, temperature),
Motion and Force (concepts only), Energy: Forms and Conservation,
Electricity in Daily Life (simple ideas).

Unit-III Basics of Chemistry
States of Matter: Solid, Liquid, Gas, Atoms and Molecules (simple introduction),
Acids, Bases, and Salts (everyday examples), Common Chemical Reactions (cooking, rusting, etc.).

Unit-IV Basic Concepts of Biology
Living and non-living things, Cells: Basic Unit of Life,
Human Body Systems (digestive, respiratory, circulatory – overview),
Environment and health (clean air, water, hygiene), Nutrition and Health.

Unit-V: Science in Everyday Life
Common Scientific Tools and Devices (mobile phone, thermometer, etc.),
Health and Hygiene, Waste Management and Clean Energy,
Digital Literacy and Science.

SUGGESTED READINGS

1. New Science in Everyday Life (2020 revised edition; OUP India) – for contextual and daily-life science topics.
2. Fundamentals of Science (8th ed., 2014; Dhanpat Rai) – for physics, chemistry, biology core concepts.
3. Foundation Science for Class X (1st ed., 2015; Cengage Learning India) – for additional structured depth and exercises.
4. Use New Science in Everyday Life (Oxford, 2025 edition, Books 7 & 8) for contextual science, hygiene, tools, environment, and digital literacy (Units I & V).
5. Rely on Fundamentals of Science (S. Chand or Dhanpat Rai) to systematically present physics, chemistry, biology fundamentals (Units II–IV).

Multidisciplinary Course (MDC)

EVSMC15004T: Environmental Science

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Understand the scope, multidisciplinary nature, and importance of environmental studies.
CO2: Demonstrate knowledge of ecological principles and ecosystem dynamics.
CO3: Analyze natural resources and associated environmental issues.
CO4: Identify different types of environmental pollution and propose control measures.
CO5: Explain biodiversity concepts and conservation strategies.

SYLLABUS

Unit-I Introduction to Environmental Studies
Multidisciplinary nature, Scope & importance. Concepts: sustainability, sustainable development.

Unit-II Ecology & Ecosystems
Ecology vs. ecosystem, structure & function, Energy flow: food chains, webs, ecological pyramids, Succession, Case studies: forest, grassland, desert, aquatic (ponds, rivers, oceans, estuaries), mountain ecosystems.

Unit-III Natural Resources
Renewable vs. non-renewable resources, Land: land use change, degradation, soil erosion, Desertification, Forest resources: deforestation, Afforestation, Water resources: overuse, floods, droughts, inter-state/international Issues, Energy resources: conventional (coal, oil, nuclear) and alternative (solar, wind, biogas, geothermal, hydrogen).

Unit-IV Environmental Pollution
Types: air, water, soil, noise pollution; nuclear/thermal hazards, Causes, effects & control measures, Solid and industrial waste—management & disposal, Climate change topics: global warming, ozone depletion, acid rain.

Unit-V Biodiversity & Conservation
Levels of biodiversity: genetic, species, Ecosystem, Biodiversity patterns: hotspots, India as mega-diverse nation .Threats: habitat loss, poaching, human–wildlife conflict, invasive species Conservation strategies: in-situ and ex-situ, ecosystem services (ecological, ethical, economic, social, informational, aesthetic).

SUGGESTED READINGS

1. *Textbook of Environmental Studies for Undergraduate Courses,* **3rd Edition** published by Universities Press (India) Private Limited in **2021 — Erach Bharucha.**
2. Environmental Science — S. C. Santra, 3rd Edition published by New Central Book Agency on 1 January 2011.
3. Fundamentals of Ecology — Eugene P. Odum & Gary W. Barrett, The version released in India is the 5th Edition, copyright 2006.
4. **पर्यावरण अध्ययन** by Dr. Suman Gupta – *1st Edition, 2025,* Sultan Chand & Sons.
5. **पर्यावरण अध्ययन** by Dayashankar Tripathi – *2005 edition,* Motilal Banarsidass.

Multidisciplinary Course (MDC)

FSQMC16005T: Food Safety and Quality Management

(20 CIA + 80 EoSE. = Max. Marks: 100)

ourse Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Understand the fundamentals of food safety and its significance.
CO2: Demonstrate knowledge of national and international food laws and regulations.
CO3: Explain and apply concepts of food safety management systems.
CO4: Apply sampling techniques and perform basic food safety analysis.
CO5: Identify and analyze emerging issues and trends in food safety.

SYLLABUS

Unit-I Introduction to Food Safety

Definition and importance of food safety, Types of food hazards: Biological (bacteria, viruses, parasites), Chemical (pesticides, toxins, heavy metals) &Physical (glass, metal, plastic), & Foodborne illnesses and outbreaks.

Unit-II Food Laws and Regulations

Overview of national and international food laws, Food Safety and Standards Act (FSSA), 2006 (India),FSSAI – structure, roles, and responsibilities, Codex Aliment Arius, WTO – SPS and TBT agreements, BIS, AGMARK, ISO standards.

Unit-III *Food Safety Management Systems*

Total Quality Management (TQM), Risk analysis: risk assessment, risk management, and risk communication, Traceability and recall procedures & Documentation and record-keeping.

Unit-IV *Sampling and Analysis*

Sampling techniques, Statistical quality control, Microbiological and chemical analysis for food safety & Rapid methods in food microbiology.

Unit-V *Emerging Issues and Trends in Food Safety*

Food fraud and adulteration, Food allergens and intolerance, Genetically Modified Foods (GMOs), Novel and functional foods, Climate change and food safety.

SUGGESTED READINGS

1. **Food Safety and Protection: Protecting Our Food from Farm to Table** by V Ravishankar Rai & Jamuna A. Bai.
2. **Food Safety: Theory and Practice** by Paul L. Knechtges.
3. Food Safety and Standards Act, 2006 with Rules & Regulations (FSSAI).
4. **Food Safety Management: A Practical Guide for the Food Industry** by Yasmine Motarjemi & Huub Lelieveld.
5. **Genetically Modified Organisms in Food: Production, Safety, Regulation and Public Concerns** by Ronald L. Herring.

B.Sc. Semester: III 2025-26

Value Added Course (VAC)

ESSVC15003T: Environmental and Sustainability Studies

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Understand and describe the key components of the environment, including biotic and abiotic factors.
CO2: Understand principles of sustainable resource management.
CO3: Understand the impact of environmental factors on public health.
CO4: Explain the causes and consequences of climate change.
CO5: Define sustainability and sustainable development concepts.

SYLLABUS

Unit-I: Introduction to Environment and Ecology
Components of the environment: biotic & abiotic, Ecosystems: structure and function, Biodiversity: types, importance, and threats, Relationship between humans and nature.

Unit-II: Natural Resources and Conservation
Types of natural resources: renewable & non-renewable, Sustainable resource management, Water and forest conservation, Traditional knowledge and uses of resource.

Unit-III: Environmental Pollution and Health
Types of pollution: air, water, soil, noise, Causes, effects, and control measures, Solid waste management and e-waste, Public health and environmental impact.

Unit-IV: Climate Change and Global Issues
Causes and effects of climate change, Carbon footprint and mitigation strategies, International agreements (Paris Agreement, SDGs), Environmental justice and ethics.

Unit-V: Sustainability and Green Practices
Concept of sustainability and sustainable development, Role of individuals and communities, Green technologies and practices, Campus sustainability initiatives.

SUGGESTED READINGS

1. Environmental Studies: From Crisis to Cure **– R. Rajagopalan, 4th Edition (2023)**, **Oxford University Press India.**
2. Environmental Ecology, Biodiversity & Climate Change: Towards Sustainable Development **– H. M. Saxena, 1st Edition (2015), Rawat Publications (Jaipur/New Delhi).**
3. Textbook of Environmental Studies for Undergraduate Courses **– Erach Bharucha, 2nd Edition (2013), Universities Press, Hyderabad.**
4. **पर्यावरण अध्ययन (Environmental Studies)** – Dr. Ratan Joshi, **Edition** Latest (2022), Sahitya Bhawan Publications.

B.Sc. Semester: VI 2025-26

Value Added Course (VAC)

HAWVC16006T: Health and Wellness

(20 CIA + 80 EoSE. = Max. Marks: 100)

Course Credits	No. of Teaching Hours Per Week	Total No. of Teaching Hours
3 Credits	3 Hours	45 Hours

Course Outcomes: On successful completion of the course, the students will be able to-

CO1: Practice basic yoga and mindfulness techniques for improved mental well-being.
CO2: Apply nutritional knowledge to maintain a balanced and healthy lifestyle.
CO3: Understand exercise science principles and develop personalized fitness plans.
CO4: Demonstrate essential first aid and emergency response skills.
CO5: Implement effective stress management and work-life balance strategies.

SYLLABUS

Unit-I: Yoga and Mental Well-being

Fundamentals of Yoga: Asanas, Pranayama, Meditation, Role of Yoga in mental health and emotional balance, Mindfulness and mental resilience techniques, Scientific evidence supporting Yoga for wellness.

Unit-II: Nutrition and Healthy Lifestyle

Basics of human nutrition: Macronutrients and micronutrients, Balanced diet planning and common nutritional disorders, Impact of lifestyle choices on health (sleep, hydration, habits), Nutritional myths and facts.

Unit-III: Physical Fitness and Exercise Science

Principles of physical fitness and types of exercise, Cardiovascular, strength, flexibility, and endurance training, Exercise physiology basics and benefits, Designing a personal fitness routine.

Unit-IV: First Aid and Emergency Care

Basic first aid skills: wound care, burns, fractures, CPR, Handling common emergencies: choking, bleeding, poisoning, Importance of safety and prevention strategies, When and how to seek professional medical help.

Unit-V: Stress Reduction and Work-Life Balance

Understanding stress: causes, symptoms, and effects, Techniques for stress management (relaxation, time management), Building work-life balance: setting priorities, boundaries, Role of hobbies, social support, and positive mind-set.

SUGGESTED READINGS

1. "Yoga for Wellness" – Dr. Renu Mahtani
2. "Nutrition and Dietetics" – Dr. M. Swaminathan
3. "Exercise Physiology: Theory and Application to Fitness and Performance" – Scott Powers & Edward Howley
4. "First Aid Manual" – St. John Ambulance / Red Cross
5. "The Relaxation and Stress Reduction Workbook" – Martha Davis et al.