B. Sc.- Semester I

MECHANICS AND WAVE MOTION

(4 CREDITS)   **PAPER I**   **(40 LECTURES)**

Unit I

Inertial and non-inertial reference frames, radial and transverse components of velocity and acceleration using polar coordinates, Newton's laws of motion. Dynamics of particle in rectilinear and circular motion, Conservative and Non-Conservative forces, conservation of energy, linear momentum, and angular momentum. Collision in one and two dimensions, cross section.

Unit II

Rotational energy and rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, cylinder, rectangular lamina). The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Simple treatment of the motion of a top. Relations between elastic constants, bending of beam and torsion of cylinder.

Unit III

Central forces, Two body central force problem, Reduced mass and its equation of motion, Centre of mass motion, Newton's law of gravitation; Gravitational binding energy, Equivalence of inertial and gravitational mass, Gravitational field and potential at a point inside and outside a hollow and solid sphere. Kepler's laws, motion of planets and satellites, geo-stationary satellites.

Unit IV

Differential equation of Simple Harmonic Motion (SHM) and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures.

Differential equation of wave motion, plane progressive waves in fluid media, reflection of waves, phase change on reflection, Principle of superposition of waves, stationary waves, pressure and energy distribution, phase and group velocity.

B. Sc.- Semester I

CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS
(4 CREDITS)   **PAPER II**   **(40 LECTURES)**

Unit I

Growth and decay of current through inductive resistances (LR circuit), charging and discharging of capacitor through resistance (CR circuit) and inductive resistance (LCR circuit), time constant, Measurement of high resistance by leakage method.

Alternating current in RLC circuits, method of imaginaries, complex impedance, phase diagrams, Q factor, series and parallel resonant circuits, theory of coupled circuits, Transformers, Reflected Impedance and impedance matching, Maximum power transfer theorem. AC bridges: Maxwell, Schering and Wien.

Unit II

Semiconductors: Covalent bonding, Energy bands, Forbidden energy gap, Intrinsic and extrinsic semiconductors, p-type and n-type semiconductors. Formation of the pn junction. Depletion layer, Field and potential at the depletion layer. Unbiased diode, Forward and Reverse biased diodes, Current conduction in a pn junction, majority and minority carriers. Characteristic curves. Static (DC) and Dynamic (AC) resistance.Diode as a rectifier, Half wave, Full wave and Bridge rectifier. Rectification Efficiency and Ripple factor. Zener and Avalanche breakdown. Zener diode as a voltage regulator. Filter Circuits: Choke input filter, Capacitor input filter, L and π type filters; DC Power supply, Bipolar transistors: PNP and NPN transistors, their characteristic curves in common base, common emitter and common collector configurations, Active, Cut-off and Saturation regions, DC alpha and DC beta and relationship between them.

Unit III

Transistor biasing: Need for biasing, Transistor biasing circuits: Base Bias, Emitter Bias, Voltage Divider Bias. Transistor leakage currents, thermal runaway, transistor stabilization, swamping, Stability factor. Load line, DC and AC load line, Operating point. DC and AC equivalent circuits. Low frequency transistor models, small signal amplifiers, Common Base, Common Emitter, Common Collector amplifier, Current and Voltage gain, RC coupled amplifier, Qualitative treatment, Study of frequency response of RC coupled amplifier.

Unit IV

Feedback in amplifiers: Positive and Negative feedback, Input and Output Impedance of Negative feedback voltage amplifiers. Transistor as an oscillator, Tank circuit, Barkhausen criterion, General discussion and theory of Hartley oscillator. Elements of transmission and reception, Basic principle of amplitude modulation and demodulation, principle and design of linear multimeters and their applications, Cathode ray Oscilloscope and its simple applications.

Department of Chemistry
University of Lucknow
Lucknow
B.Sc. Syllabus

Inorganic Chemistry

Semester I   **Paper – 1**   **Max Marks: 100 (80 + 20)**

UNIT I

I.   Atomic Structure: Quantum mechanics based structure of atom in brief, shapes of s, p and d orbitals, aufbau and Pauli exclusion principles, Hund's Multiplicity rules. Electronic configurations of the elements, effective nuclear charge.

II. Periodic Properties and Classification based upon electronic configuration: Diagonalrelationship, inert pair effect, atomic and ionic radii, van der waal radii, ionizationenergy,

III. Electron affinity and electronegativity : definition, method of determination, trends in periodic table and applications in predicting and explaining chemical behaviour.

UNIT II

IV. Chemical Bonding

   (a) Covalent bond: valence bond theory and its limitations, directional characteristic of covalent bond. Hybridization and shapes of simple molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to simple molecules and ions. Molecular Orbital theory for homonuclearand heteronuclear (CO and NO) diatomic molecules, multi-center bonding in electron deficient molecules, bond strength and the bond energy, % ionic character from dipole moment and electro negativity difference.

   (b) Weak interactions: hydrogen bonding, van der Waals forces.

UNIT III

V.   Ionic solid: ionic structures, radius ratio effect and coordination number, limitation of ratio rule, Lattice defects, Lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions. Fajan's rule, Metallic bond free electron, Valence bond and Band theories.

VI. s-Block elements: Comparative study, salient features of hydrides, salvation and complexation tendencies of cations of alkali and alkaline earth matter including their function in biosystems, an introduction to alkyls and aryls of Li & Mg.

VII. Noble Gases: Chemical properties of the noble gases, discovery of $O_2^+PtF_6û$ and O_2XeF_6.Chemistry of xenon, structure and bonding in xenon compounds.

Inorganic Chemistry

Semester I   **Paper – 1**   **Max Marks: 100 (80 + 20)**

UNIT IV

VIII. p-Block Elements:- Comparative study (including diagonal relationship) physical and chemical behaviour of group 13-17 elements, compounds like hydrides, oxides, oxyacids and halides ofgroup 13-16, diborane, boronitride   ,   forms, Fullerenes, silicates(structural principle) andstructures of oxides and oxyacids of phosphorus and sulphur, interhalogens and polyhalides.

Text Books (Theory Courses):
- (a) Concise Inorganic Chemistry, J.D. Lee, Blackwell Science Ltd.
- (b) Inorganic Chemistry, Puri, Sharma, Kalia and Kaushal.
- (c) Pradeep's Inorganic Chemistry, K.K. Bhasin, Pradeep Publication.
- (d) Chemistry for degree students, R. L. Madan

Reference Books:
- (a) Inorganic Chemistry, J.E.Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
- (b) Inorganic Chemistry, D.E.Shriver, P W. Atkins and C.H.L. Langford, Oxford.
- (c) Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
- (d) Concepts of Models of Inorganic Chemistry, B.Douglas, D.McDaniel and J Alexander, John Wiley.
- (e) Inorganic Chemistry, W.W. Porterfield, Addison - Wesley.
- (f) Inorganic Chemistry, A.G. Sharpe, ELBS
- **(g)** Inorganic Chemistry, G.L. Meissler and D.A. Tarr, Prentice-Hall.

Department of Chemistry
University of Lucknow
Lucknow
B.Sc. Syllabus

Organic Chemistry

Semester I   **Paper – 2**   **Max Marks: 100 (80 + 20)**

UNIT I

I.   Structure and bonding: Hybridization, bond lengths, bond angles, bond energy, localised and delocalized   bonds, resonance, inductive and field effects, hydrogen bonding, inclusion compounds, clathrates, charge transfer complexes, van der Waals interaction, hyperconjugation, aromaticity.

II.   Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with arrows, half headed and double-headed arrows, homolytic and heterolytic bond breaking Reactive intermediates-generation, structure, stability and reactions of carbocation, carbanion, free radicals and carbenes, Arynes, Nitrenes.

III.   Types of organic reactions-addition, elimination, substitution, rearrangement, condensation, methods of determination of reaction mechanism (product analysis, intermediates, isotopic effects, kinetic and stereochemical studies). Energy considerations.

UNIT II

IV.   Stereoisomerism

Optical isomerism: Elements of symmetry, molecular chirality, optical activity, stereogenic centres, enantiomers, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configurations. Sequence rules. D, L and R, S nomenclature.

Geometrical isomerism: determination of configuration of geometric isomers. E, Z system, geometrical isomerism in oximes and alicyclic compounds. Conformatioal isomerism-Conformational analysis of ethane and n-butane and cyclohexane, axial and equatorial bonds, Saw-horse and flying wedge formulae, Fischer and Newman projections formulae. Difference between conformation and configuration.

UNIT – III

V.   Alkanes And Cycloalkanes: Methods of formation with special reference to Wurtz, Kolbe, Corey-House reactions and decarboxylation. Physical properties and chemical reactions. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes: Nomenclature, methods of preparation. Baeyer's strain theory and its limitations. Ring strain in (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring and banana bond.

VI.   Alkenes, Cycloalkenes, Dienes: methods of formation. Mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides. Regio-selectivity in alcohol-dehydration. Saytzeff's rule, Hofmann elimination.

Organic Chemistry

Semester I   **Paper – 2**   **Max Marks: 100 (80 + 20)**

Physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- Mechanisms involved in hydrogenation, electrophilic and free-radical additions. Markownikoff's rule. Hydroboration-oxidation, oxymercuration-reduction, epoxidation, ozonolysis, hydrations, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitutions at allylic and vinylic positions of alkenes.

Methods of formation, conformation and chemical resections of cycloalkenes.

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, chemical reaction . 1, 2 and 1, 4 additions, Diels-Alder reaction.

VII.   Alkynes: Structure and bonding in alkynes. Methods of formation, chemical reactions and acidity of alkynes. Mechanism of electrophilic and mucleophilic addition reactions, hydroboration-oxidation, reductions and oxidation reactions.

UNIT IV

VIII. Arenes and Aromaticity: Nomenclature of benzene derivatives. Structure of benzene: molecular formula and Kekule structure. Stability and carbon carbon bond length of benzene, resonance structure, MO picture.

IX.   Aromatic electrophilic substitution- general pattern of the mechanism, Arrhenium ion intermediate. Mechanism of nitration, halogenation, sulfonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activation and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

X.   Alkyl and Aryl Halides: Methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams, chloroform. Aryl halides - Methods of formation, nuclear and side chain reactions. Mechanisms of nucleophilic aromatic substitutions. Synthesis and uses of DDT, BHC.

Text Books (Theory Courses):
      a.   Organic Chemistry, Vol. I, I.L. Finar, Pearson Education.
      b.   Organic Chemistry, M.K. Jain, Shoban Lal& Co.
      c.   Pradeep's Organic Chemistry, S.N. Dhawan, Pradeep Publication.

Reference Books:
      a.   Organic Chemistry, Morrison and Boyd, Prentice Hall.
      b.   Organic Chemistry, L.G. Wade Jr. Prentice Hall.
      c.   Fundamentals of Organic Chemistry Solomons, John Wiley.
      d.   Organic Chemistry, Vol. I, II, III S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
      e.   Organic Chemistry, F.A. Carey, McGraw-Hill Inc.
      f.   Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan.

B.A./B.Sc. I (Semester I)
Mathematics
(Applicable from July 2018)

Paper I (Differential Calculus)

Unit 1

Definition of a sequence, Theorems on limits of sequences, Bounded and Monotonic sequences, Cauchy's convergence criterion, Cauchy sequence, limit superior and limit inferior of a sequence, subsequence, Series of non-negative terms, convergence and divergence, Comparison tests, Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic, de Morgan and Bertrand's tests, Alternating series, Leibnitz's theorem, Absolute and conditional convergence.

Unit II

Limit, Continuity and differentiability of function of single variable, Cauchy's definition, Heine's definition, equivalence of definition of Cauchy and Heine, Uniform continuity, Borel's theorem, boundedness theorem, Bolzano's theorem, Intermediate value theorem, Extreme value theorem, Darboux's intermediate value theorem for derivatives, Chain rule, Indeterminate forms.

Unit III

Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, , Rolle's theorem, Lagrange and Cauchy Mean value theorems, Mean value theorems of higher order, Taylor's theorem with various forms of remainders, Partial differentiation, Euler's theorem on homogeneous function.

Unit IV

Tangent and Normals, Asymptotes, Curvature, Envelops and evolutes, Tests for concavity and convexity, Points of inflexion, Multiple points, Tracing of curves in Cartesian and Polar forms.

Paper II (Integral Calculus)

Unit I

Definite integrals as limit of the sum, Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration.

Unit II

Improper integrals, their classification and convergence, Comparison test, µ-test, Abel's test, Dirichlet's test, quotient test, Beta and Gamma functions, properties and convergence

Unit III

Rectification, Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's theorem for multiple integrals

Unit IV

Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration, Theorems of Gauss, Green, Stokes and related problems