B.Sc. Part-I
SYLLABUS (CHEMISTRY, PHYSICS & MATH),

RAJKAMAL SCIENCE & MANAGEMENT COLLEGE
BAHADRABAD (HψARIDWAR)

CHEMISTRY SYLLABUS

For

UNDER GRADUATE COURSES (B.Sc. Part-I)
(Annual System)

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

Department of Chemistry
Sridev Suman Uttarakhand University Badshahithaul
Tehri-Garhwal - 249001

Chemistry Course for B.Sc. (Annual System) Part-I

B. Sc. Chemistry Syllabus (Part-I)

To teach the fundamental concepts of chemistry and their applications, the syllabus pertaining to B.Sc. (3 year degree course) in the subject of chemistry has been prepared as per provision of UGC module and demand of the academic environment. The syllabus concepts are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills. This B.Sc. course of chemistry consists of three year course (annual system). Total marks: 600(200 per year).

B.Sc. First Year

Paper code	Paper	Course	Max. Marks	Work Hrs
I	CH-101	Inorganic Chemistry	50	60
II	CH-102	Organic Chemistry	50	60
III	CH-103	Physical Chemistry	50	60
	CH-104	Laboratory Practical	50	60
Grand Total			200	180

Note: Examiner should follow the below given pattern covering all the units for each section compulsorily:

a) Twelve compulsory objective type questions of one mark each, 12 x 1 = 12 Marks

b) Examinees to solve six short answer questions out of ten questions (3 marks each) 3x6=18 Marks.

c) Examinees to solve four long answer questions out of seven (5 mark each) 4x5=20 Marks

Distribution of marks for Practical exam will be as follows:

B.Sc. (FIRST YEAR)

(i)	**Inorganic Mixture analysis (six radicals)**	**15**
(ii)	**Organic Experiment**	**12**
(iii)	**Physical Chemistry Experiment**	**10**
(iv)	**Viva-voce****	**05**
(v)	**Annual record**	**08**
	Total	**50**

***Full credit of marks shall be given upto 0.5% error after which for each 0.1% error, two marks shall be deducted in Quantitative analysis experiments.**

****Viva-voce for ex-student shall carry 13 marks.**

Candidate will be required to pass in Theory and Practical Separately.

Paper-I

Inorganic Chemistry (Paper Code: CH-101)

Unit – I

I. Atomic Structure:

Idea of de-Broglie matter waves (dual nature), Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of ψ and ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbitals, Aufbau and Pauli exclusion principles, Hund's multiplicity rule, Electronic configurations of the elements, effective nuclear charge.

Unit – II

II. Periodic Properties:

Atomic and ionic radii, ionization energy, electron affinity and electronegativity definitions, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

Unit – III

III. Chemical Bonding:

(A) Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shall electron pair repulsion(VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl^{-2} and H_2O, MO theory, homonuclear and heteronuclear (CO, NO, CN^+, CO, CN^+, CO^+, CN^-) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electro-negativity difference.

(B) Ionic Solids – Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule, Metallic bond-free electron, valence bond and band theories.

(C) Weak Interactions – Hydrogen bonding, Vander Waals forces.

Unit – IV

IV. *s*-Block Elements:

Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

V. Chemistry of Noble Gases:

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Unit – V

VI. *p*-Block Elements:

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides.

Paper-II

Organic Chemistry (Paper Code: CH-102)

Unit – I

I. Structure and Bonding:

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonances, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

II. Mechanism of Organic Reactions:

Homolytic and heterolytic bond fission, Types of reagents –electrophiles and nucleophiles, Types of organic reactions, Energy considerations.

Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

III. Alkanes and Cycloalkanes:

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atom in alkanes, Isomerism in alkanes, sources methods of formation (with special reference to Wurtz reaction, Kolbe's reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes – Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strain less rings. The case of cyclopropane ring, banana bonds.

Unit – II

IV. Stereochemistry of Organic Compounds:

Concept of isomerism, Types of isomerism, Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity,

properties of enantiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmers, inversion, retention and recemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

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

Conformational isomerism – conformational analysis of ethane and *n*-butane, conformations of cyclohexane, axial and equatorial bonds, conformation of monosubstituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.

Unit – III

V. Alkenes, Cycloalkenes, Dienes and Alkynes:

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halids, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes – mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes, Industrial applications of ethylene and propene.

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

Nomenclature, structure and bonding in alkynes, Methods of formation, Chemical reactions of alkynes, acidity of alkynes, Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

Unit – IV

VI. Arenes and Aromaticity:

Nomenclature of benzene derivatives, the 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,

Aromaticity: The Huckle rule, aromatic ions. Aromatic electrophilic substitution – general pattern of the mechanism, role of □ and □ complexes, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel- Crafts reaction.

Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction;

Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene.

Unit-V

VII. Alkyl and Aryl Halides:

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN^2 and SN^1 reactions with energy profile diagrams;

Polyhalogen compounds: Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions, The addition-elimination and the elimination- addition mechanisms of nucleophilc aromatic substitution reactions, Relative reactivities of alkyl halides *vs* allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.

Paper-III Physical Chemistry (Paper Code: CH-103)

Unit – I

I. Gaseous States:

Postulates of kinetic theory of gases, deviation from ideal behavior, Van der Waals equation of state, Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities: Root mean square, average and most probable velocities, Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, Liquifiction of gases (based on Joule –Thomson effect).

Unit – II

II. Liquid State:

Intermolecular forces, structure of liquids (a qualitative description), Structural differences between solids, liquids and gases, Liquid crystals: Difference between liquid crystal, solid and liquid, Classification, structure of nematic and cholestric phases, Thermography and seven segment cells.

Unit – III

III. Solid States:

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

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IV. Colloidal States:

Definition of colloids, classification of colloids, Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier, Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.

Unit – IV

v. Chemical Kinetics and Catalysis:

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light catalyst, concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half-life and mean life, Determination of the order of reaction – differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon, Experimental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometer. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis, characteristics of catalyzed reactions, classification of catalysis homogeneous and heterogeneous catalysis, enzyme catalysis, miscellaneous examples.

B.Sc. – I (PRACTICAL) 180 hrs (6 Hrs/week)

Atleast three practicals from each specialization should be carried out.

Inorganic Chemistry:

I. Semi micro Analysis – Mixture analysis for six radicals (3 cations & 3 anions), including interfering radicals.

Organic Chemistry:

Laboratory techniques:

II. Calibration of Thermometer- 80-82^0(Naphthalene),113.5-114^0(Acetanilide) 132.5- 133^0(Urea), 100^0(Distilled Water)

III. Determination of melting point:

Naphthalene 80-82^0, Benzoic acid 121.5-122^0, Urea 132.5-133^0, Succinic acid 184.5-185^0, Cinnamic acid 132.5-133^0, Sallicylic acid 157.5-158^0, Acetanilide 113.5-114^0, m-Dinitrobenzene 90^0, p-Dichlorobenzene 52^0, Aspirin 135^0

IV. Determination of boiling point:

Ethanol 78^0, Cyclohexane 81.4^0, Toluene 110.6^0, Benzene 80^0 Mixed melting point determination:

Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

V. Distillation:

Simple distillation of ethanol-water mixture using water condenser, Distillation of nitrobenzene and aniline using air condenser

VI. Crystallization:

Concept of induction of crystallization, Phthalic acid from hot water (using fluted filter paper and steamless funnel) Acetanilide from boiling water, Naphthalene from ethanol, Benzoic acid from water

Decolorisation and crystallization using charcoal:

Decolorsation of brown sugar (sucrose) with animal charcoal using gravity filtration.

Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixes with 0.3 g of Congo Red using 1g decolorizing carbon) from ethanol.

VII. Sublimation (Simple and Vacuum): Camphor, Naphthalene, Phthalic acid and succinic acid. Qualitative Analysis:

VIII. Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.

Physical Chemistry:

IX. Chemical Kinetics:

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at rooms temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of ethyl acetate.
4. To study kinetically the reaction rate of decomposition of iodide by H_2SO_4.

Distribution Law:

1. To study the distribution of iodine between water and CCl_4.
2. To study the distribution of benzoic acid between benzene and water.

X. Viscosity, Surface Tension:

1. To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
2. To determine the viscosity of amyl alcohol in water at different concentration and calculate the excess viscosity of these solutions.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

RAJKAMAL SCIENCE & MANAGEMENT COLLEGE

BAHADRABAD (HARIDWAR)

MATHEMATICS SYLLABUS

For

UNDER GRADUATE COURSES (B.Sc. Part-I)
(Annual System)

(*Applicable w.e.f. the Session 2019-2020)*

Department of Mathematics

Sridev Suman Uttarakhand University Badshahithaul Tehri-Garhwal – 249001

B.Sc.-Part-I Mathematics Syllabus

S.No.	PAPER	PAPER CODE	MAXIMUM MARKS
1	Differential Calculus	BM101	65
2	Integral Calculus &Trigonometry	BM102	65
3	Algebra and Matrices	BM103	70

PAPER-1 SUBJECT CODE: BM-101

COURSE TITLE: Differential Calculus

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

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

BOOKS RECOMMENDED:

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

PAPER-II SUBJECT CODE: BM-102

COURSE TITLE: Integral Calculus &Trigonometry

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

BOOKS RECOMMENDED:

1. G.B. Thomas &R.L. Finney, Calculus, 9thFd. Pearson Education,Delhi,2005
2. H.Anton, I.Bivens & S.Davis. Calculus, John Wiley and Sons(Asia)P.Ltd.2002
3. S.L. Loney Plane Trigonometry (Part I,II).Arihant Publications.
4. M.D. Raisinghania. H.C.Sexena & H.K.Dass: Trigonometry, S.Chand Company Pvt. Ltd. 2002

PAPER-III SUBJECT CODE: BM-103

COURSE TITLE: Algebra and Matrices

I. Sets, Operations on sets, Relations, Equivalence relations and partition functions, Algebraic structures, Group, Examples of groups, Subgroups, Permutations groups.

II. Order of elements, cyclic group, Coset-decomposition, Lagrange's theorem and its consequences.

III. Quotient group, Homomorphism, Isomorphism.

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

V. Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknown up to four. Solution of a system of linear equations using matrices. Eigen values, Eigen vectors and Characteristics equations.Cayley Hamilton theorem and its Applications.

BOOKS RECOMMENDED:

1. John B.Fraleigh, a First Course in Abstract Algebra, 7th Ed. Pearson.2002.
2. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed.Narosa 2002.
3. A.I.Kostrikin, Introduction to Algebra, Springer Verlag 1984.
4. Richard Bronson, Theory and Problems of Matrix Operations, Lata MeGrawHills.1989.

RAJKAMAL SCIENCE & MANAGEMENT COLLEGE

BAHADRABAD (HARIDWAR)

PHYSICS SYLLABUS

For

UNDER GRADUATE COURSES (B.Sc. Part-I)
(Annual System)

(*Applicable w.e.f. the Session 2019-2020)*

Department of Physics

Sridev Suman Uttarakhand University Badshahithaul Tehri-Garhwal – 249001

B.Sc. Part -I PHYSICS

PAPER-I: MECHANICS

UNIT I: Laws of Motion and Conservation Laws

Laws of Motion: Frames of reference, Inertial and Non-inertial frames of reference, Newton's Laws of motion, Dynamics of a system of particles, Centre of Mass, Motion of Centre of mass. Momentum and Energy: Conservation of momentum, Work and energy, Work energy principle, Conservative forces, Conservative force as the negative gradient of potential energy, Conservation of energy, System of variable mass-Motion of rockets.

UNIT II: Rotational Motion

Angular velocity and angular momentum, Torque, Conservation of angular momentum, Equation of motion, Moment of inertia, Theorem of parallel and perpendicular axis, Moment of inertia of rod, rectangular lamina, ring, disc, solid sphere, spherical shell, Kinetic energy of rotation, Rolling along a slope.

UNIT III: Gravitation

Newton's Law of Gravitation, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Gravitational field, potential and potential energy, Gravitational potential and field intensity for spherical shell, Kepler's Laws of planetary motion, Satellite in circular orbit and applications, Geosynchronous orbits, Basic idea of global positioning system (GPS).

UNIT IV: Elasticity:

Hooke's law- Stress-strain diagram, Elastic moduli-Relation between elastic constants, Poisson's Ratio, Expression for Poisson's ratio in terms of elastic constants, Work done in stretching a wire and work done in twisting a wire, Twisting couple on a cylinder, Determination of Rigidity modulus by static torsion, Torsional pendulum, Determination of Rigidity modulus and moment of inertia (Y, η and σ) by Searle's method.

UNIT V: Fluids:

Surface Tension: Synclastic and anticlastic surface, Excess of pressure: Application to spherical and cylindrical drops and bubbles, Variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube, Bernoulli's theorem, Poiseuille's formula, Determination of coefficient of viscosity of a liquid, Variations of viscosity of a liquid with temperature.

Reference Books:

• University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley

• Mechanics Berkeley Physics course, vol1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
• Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
• University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
• Mechanics: D. S. Mathur and P. S. Hemne, S Chand Publications, 2014, New Delhi.
• Mechanics: J. C. Upadhyaya, Ram Prasad and Sons, Agra.
• Mechanics and General Properties of Matter: P. K. Chakrabarti, Books and Allied Pvt. Ltd.

PAPER-II: ELECTRICITY AND MAGNETISM

UNIT I: Vector Field:

Scalar and Vector field, Gradient, Divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors.

UNIT II: Electrostatics:

Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, Electric field and potential as line integral of electric field, electric potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere, Calculation of electric field from potential, Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarization, Displacement vector, Parallel plate capacitor completely filled with dielectric.

UNIT III: Magnetostatics:

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

UNIT IV: Electromagnetic Induction and Alternating current:

Field due to Helmholtz coil, solenoid and current loop, Faraday's laws of Electromagnetic induction, Lenz's law, self and mutual inductance, Self-inductance (L) of single coil, mutual inductance (M) of two coils, Energy stored in magnetic field, Alternating current, Alternating voltage across R-C, L-C, R-L and LCR circuits, condition of resonance.

UNIT V: Maxwell`s equations and Electromagnetic wave propagation:

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

Reference Books:

• Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
• Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
• Electricity and Magnetism, D. C. Tayal, 1988, Himalaya Publishing House.
• University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
• Introduction to Electrodynamics, D. J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.
• Electricity and Magnetism, K. K. Tiwari, 3rd ed., 2007, S. Chand Publications.
•Electricity and Magnetism, Brijlal and Subrahmanyam.
•Electricity and Magnetism, C. J. Smith.
•Principles of Electromagnetics, Matthew N. O. Sadiku, 2015, Oxford Univ. Press.
• Fundamentals of Electricity and Magnetism, D. N. Vasudeva.

PAPER-III: WAVES, OSCILLATIONS AND ACOUSTICS

UNIT I: Wave Motion

Characteristics, Differential equation of wave motion, Transverse waves on a string. Travelling and standing waves on a string. Normal modes of a string, Group velocity and phase velocity. Plane waves, spherical waves. Wave intensity. Fourier's theorem and its applications to square wave, saw tooth wave and triangular wave.

UNIT II: Simple Harmonic Motion:

Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Simple harmonic oscillations in mechanical and electrical systems. Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle, (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods, Lissajous Figures (1:1 and 1:2) and their uses.

UNIT III: Damped Harmonic Oscillations

Damped harmonic oscillations, Differential equation of damped harmonic oscillations and its solutions, power dissipation in damped harmonic oscillator, relaxation time and quality factor, Electrically damped harmonic oscillator (LCR circuit).

UNIT IV: Forced Harmonic Oscillations

Differential equation of Forced harmonic oscillations and its solutions, Forced harmonic oscillations in mechanical and electrical system, Transient and steady state behaviour, Resonance, Sharpness of resonance, Bandwidth, Energy dissipation, Quality factor of forced oscillator, Mechanical and electrical impedances.

UNIT V: Ultrasonics and Acoustics

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

Reference Books:

• Waves and Oscillations, Brijlal and Subrahmanyam, 2nd ed, 2018, Vikas Publishing House.
• The Physics of waves and oscillations, N. K. Bajaj, 2017, McGraw Hill Education.
• Acoustics Waves and Oscillations, S. K. Sen, 2nd ed. 1990, New Age Int. Pvt. Ltd.
• Waves and Oscillations, R. N. Chaudhuri, 2010, New Age Publishers.
• A Textbook of Oscillations, Waves and Oscillations, M. Ghosh, D. Bhattacharya, 2007, S. Chand Publications.

PRACTICAL LIST

(Any Sixteen Experiments as per facilities in the Institution)

1. Measurements of length (or diameter) using vernier calipers, screw gauge, spherometer and
travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Moment of Inertia of an irregular body by Inertia Table Flywheel.
4. To determine the Young's Modulus of a Wire by Bending of Beam Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Modulus of Rigidity of a Wire by Barton's Apparatus (Vertical Pattern).
7. To determine the Modulus of Rigidity of a Wire by Barton's Apparatus (Horizontal Pattern).
8. To determine g by Bar Pendulum.
9. To determine g by Kater's Pendulum
10. To determine the Elastic Constants of a Wire by Searle's method.
11. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g
12. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
13. To determine surface tension of liquid by Jaeger's method.
14. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
15. To compare capacitances using De' Sauty bridge.
16. To study the Characteristics of a Series RC Circuit.
17. To determine a Low Resistance by Carey Foster's Bridge.
18. Conversion of galvanometer into voltmeter.

19. Conversion of galvanometer into ammeter.
20. Comparison of two resistances by potentiometer.
21. Internal resistance by potentiometer.
22. Variation of magnetic field of coil and to find out radius of coil.
23. To verify Kirchoff's law.
24. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
25. To study the series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
26. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
27. To study damping effect of simple harmonic motion using simple pendulum.
28. To determine the frequency of AC main by sonometer.
29. To determine the frequency of AC main by Melde's method.
30. To study Lissajous Figures.

Reference Books:

• Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
• Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
• A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
• Physics Practical: Gupta & Kumar, Pragati Prakashan
• Physics Practical: Goyal, Kedar Nath & Sons