BSc (PCM)

DETAILED SYLLABUS

Semester-IV
Physics

BPH 401	L	T	P	C
Optics	3	0	0	3

Unit I- Geometrical Optics

Optical Path, Fermat's Principle of Least Time or Extremum Path, Examples of Fermat's Principle: (i) Reflection & (ii) Refraction; Transverse Magnification of a Spherically Refracting Surface; Cardinal Points of a Coaxial Optical System; Graphical Construction of Image using Cardinal Points; Deviation produced by a Thin Lens; Equivalent Focal Length of Two Thin Lenses separated by a distance; Thick Lenses; Focal Length of a Thick Lens; Cardinal Points of a Thick Lens.

Unit II- Wave Optics–I (Interference)

Review of wave nature of Light; Interference; Division of Amplitude and Division of Wave front; Lloyd's Mirror and Fresnel's Biprism; Stoke's treatment. Interference in Thin Films: Parallel and Wedge-shaped Films; Newton's Rings: Measurement of Wavelength and Refractive Index; Michelson's Interferometer; Temporal and Spatial Coherence; Coherence Time and Coherence Length.

Unit III- Wave Optics–II (Diffraction)

Fresnel diffraction: - Fresnel's Assumptions; Fresnel's Half-Period Zones for Plane Wave; Theory of a Zone Plate: Multiple Foci of a Zone Plate; Comparison of a Zone plate with a convex lens. Diffraction due to: (i) a Single Slit, (ii) a Double Slit & (iii) a Plane Transmission Grating; Rayleigh's criterion of resolution; Resolving Power and Dispersive Power of a Plane Diffraction Grating.

Unit IV- Polarization

Polarization of light wave; Production of plane polarized light; Brewster's law; Malus law; Double Refraction; Retardation plates; Optical activity. Fiber Optics: Optical fiber, Fiber optic communication system and applications.

REFERENCE BOOKS:

1. Optics by Dr. N. Subrahmanyam Brijlal (S.ChandPublishing,New Delhi).
2. Fundamentals of Optics by Francis Arthur Jenkins and Harvey Elliott White (McGraw- Hil).
3. Optics by AjoyGhatak (Tata McGraw Hill, 2008).
4. Optics by Eugene Hecht and A R Ganesan (Pearson Education, 2002).
5. Light and Optics: Principles and Practices by Abdul Al-Azzawi (CRC Press, 2007).

BPH 402	**L**	**T**	**P**	**C**
Wave and Oscillations	**3**	**0**	**0**	**3**

Unit I- Fundamentals of Vibrations

Simple harmonic oscillator, and solution of the differential equation– Physical characteristics of SHM, compound pendulum, measurement of acceleration due to gravity (g) by torsion pendulum, measurements of rigidity modulus. Combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies, Lissajousfigures.

Unit II- Damped and Forced Oscillations

Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with undamped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance, velocity resonance.

Unit III- Complex Vibrations

Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave functions-square wave, triangular wave, saw-tooth wave.

Unit IV- Wave Motion

Differential equation of wave motion in continuous media, equation for longitudinal and transverse wave and their solution (one dimensional only), energy of simple harmonic progressive wave, energy density and intensity of wave.velocity of a plane longitudinal wave in a fluid, velocity in a homogeneous medium, Laplace's correction, effect of pressure, temperature and density on velocity of sound. Sound intensity loudness, pitch, quality, acoustic intensity level, reverberation time, conditions for good acoustical designs of auditorium

Reference Books:

1. Vibrations and waves", A P French, MIT press 1971.
2. Berkeley Physics Course Volume 3: waves", F S Crawford, Mc Graw Hill 1973.

3. Oscillations Waves and Electromagnetism", Satyaprakash.
4. A Text Book of Sound", Subrahmanyam & Brijlal, S. Chand New Delhi.
5. Oscillation and waves", D. P. Khandelwal, Himalaya Publishing House, Mumbai.

BPH 4L Physics Lab-I	L	T	P	C
	0	0	2	1

List of Experiments

1. To determine the refractive index of the material of the prism for the given colors (Wavelengths) of mercury light with the help of a spectrometer.
2. To determine the dispersive power of the material of the prism by a spectrometer.
3. To determine the focal length of two lenses by nodal slide and to verify the formula $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{x}{f_1 f_2}$.
4. To study the cardinal points by nodal slide assembly.
5. To verify Newton's formula $x_1 x_2 = f^2$ for a system of thin lenses separated by a given distance.
6. To determine the specific rotation of cane sugar solution using half shade polarimeter.
7. To determine the wavelength of spectral lines using plane transmission grating.

Chemistry

BCH-401 Chemistry of transition elements and Coordination Complexes	L	P	T	C
	3	0	0	3

Unit-I: Chemistry of Elements of First Transition Series-I

Chemistry of Elements of First Transition Series Characteristic properties of d-block elements, Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.

Unit-II: Chemistry of Elements of second and third Transition Series

General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

Unit – III: Coordination Complexes

Coordination compounds, Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Unit – IV: Metal-ligand bonding in Transition Metal Complexes

Limitations of valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, factors affecting the crystal-field parameters. II. Thermodynamic and Kinetic Aspects of Metal Complexes A brief outline of thermodynamics stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes.

Unit – V: Magnetic Properties of Transition Metal Complexes

Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μs and μeff values, orbital contribution to magnetic moments, application of magnetic moment data for 3dmetal complexes. IV. Electronic spectra of Transition Metal Complexes Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d1 and d9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

Recommended Books

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).
6. Puri, Sharma and Kalia. *Principles of Inorganic Chemistry,* S. Chand & Co., 2010.

BCH-402 Arenes and Aromaticity	L 3	P 0	T 0	C 3

Unit-I: Arenes and their properties

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.

Unit-II: Aromaticity

The Huckle 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; Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene;

Unit-III: Alkyl and Aryl Halides

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 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, vingl and aryl halides, Synthesis and uses of DDT and BHC.

Recommended Books

1. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
2. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
3. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
4. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

BCH 4L Chemistry Lab-I	L	T	P	C
	0	0	2	1

List of Experiments

1. Simple distillation of ethanol-water mixture using water condenser.
2. Distillation of carbon tetrachloride.
3. Preparation of sodium trioxalato ferrate (III), Na3[Fe(C2O4)3].
4. Crystallisation of benzoic acid and acetanilide from hot water.
5. Determination of mixed melting points (urea + cinnamic acid).
6. Preparation of Acetanilide
7. Preparation of p-Bromoacetanilide
8. Preparation of Salicylic acid from Anthranilic Acid.

Mathematics

BMH-401 Probability and Statistics	L	P	T	C
	3	0	0	3

Unit I:
Sample space and events, algebra of events, axiomatic approaches, conditional probability, basic laws of total probability and compound probability, Byes' theorem, Independence.

Unit- II:
Discrete and continuous random variables, mathematical expectation, variance, moment about a point, central moment, moment generating function, Binomial, Poisson, Normal and Rectangular distributions.

Unit III:
Two-dimensional random variables, joint distribution functions, marginal distributions, covariance, linear regression and correlation, rank correlation, least square method of fitting regression lines.

Unit IV:
Sampling, random sampling, large sample tests of means and proportion. *t*-student, (chi square) and *F* distributions (without derivation) and testing of hypothesis based on them.

BMH-402 Ring Theory	L	P	T	C
	3	0	0	3

Unit I: Rings and their properties, Boolean Ring, Integral domain, Division ring and Field, Subrings, Ideals and their properties, Operations on ideals, Ideal generated by a subset of a ring, Quotient rings.

Unit II: Homomorphism of rings and its properties, Kernel of a homomorphism, Natural homomorphism, Isomorphism and related theorems, Field of quotients.

Unit III: Polynomial rings over commutative rings, Properties of $R[X]$, Division algorithm and its consequences, Factorization of polynomials, Irreducibility test, Eisenstein's criterion for irreducibility.

Unit IV: Factorization in integral domains, prime and irreducible element, Principal Ideal Domain, Euclidean Domain, Unique Factorization Domain and its properties.

Books Recommended:

1. I. N. Herstein, *Topics in Algebra*, Wiley Eastern Ltd., New Delhi.

2. N. Jacobson: *Basic Algebra*, Volume I and II. W. H. Freeman and Co.

3. Surjeet Singh and Qazi Zameeruddin: *Modern Algebra*, Vikas Publication.

4. J.A. Gallian, *Contemporary Abstract Algebra*, Narosa Publication