BSc (PCM)

DETAILED SYLLABUS

Semester-II
Physics

BPH 201	L	T	P	C
Quantum Physics	3	0	0	3

Unit I: The Schrodinger equation

Schrodinger Equation. Conservation of Probability. Probability current density. Expectation values. Ehrenfest theorem. Time independent Schrodinger equation. Stationary States. Eigen function and eigenvalues.

Unit II: One dimensional problems

Particle in potential well - infinite square well and finite square wells. Potential barrier problems - step potential and rectangular potential. The harmonic oscillator problem.

Unit III: Operators and matrices

Hilbert space. Orthonormal bases. Linear operators. Dirac notation. Operators. Eigenvalues and eigenfunction of operators. Observables. Commutators. Generalised Uncertainty relations.

Unit IV: The three-dimensional problem

Spherically symmetric potential. Angular momentum operator and its eigenvalues. Commutation Relations. Spin of the electron. Hydrogen atom and the degeneracy of energy levels.

Reference Books:

1. Concepts in Modern Physics: Beiser
2. Quantum Mechanics: Zettili
3. Quantum Mechanics: Griffiths
4. A text book on Quantum Mechanics : M.C.Jain

BPH 202 Thermal Physics	L	T	P	C
	3	0	0	3

Unit I- Kinetic Theory of Gases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific Heats of Gases.

Unit II- Law of Thermodynamics

Thermodynamically Equilibrium. Zeroth Law of Thermodynamics.Work and Heat Energy.First Law and Various Processes.General Relation between Cp and Cv. Work Done during Isothermal and Adiabatic Processes.Compressibility and Expansion Coefficient.Reversible and Irreversible Changes.Conversion of Work into Heat and Heat into Work.Carnot Cycle.Carnot Engine and its Efficiency.

Unit III- Entropy

Second Law of Thermodynamics, Carnot Theorem.Thermodynamic Scale of Temperature. Change in Entropy. Entropy of a State.Clausius Theorem. Clausius Inequality. Entropy of a Perfect Gas.Entropy of the Universe.Entropy Changes in Reversible and Irreversible Processes.Principle of Increase of Entropy.Impossibility of Attainability of Absolute Zero.Third Law of Thermodynamics.

Unit IV- Thermodynamic Potentials & Maxwell's Thermodynamic Relations

Extensive and Intensive Thermodynamic Variables, Thermodynamic Potentials U, H, F and G & their Definitions, Properties and Applications. Cooling due to adiabatic magnetization. Approach to Absolute Zero. Maxwell's Thermodynamic Relations:- Derivations of Maxwell's Thermodynamic Relations. Applications of Maxwell's Relations: (1)ClausiusClapeyron equation, (2) Values of C_p-C_v, (3) TdS Equations, (4) Joule-Kelvin Coefficient for Ideal and Vander Waal Gases, (5) Energy Equations and (6) Change of Temperature during an Adiabatic Process.

Reference Books:

1. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics, Francis W. Sears & Gerhard L. Salinger, Narosa Publishing House.
2. Statistical and Thermal Physics: an introduction, S. Lokanathan& R.S. Gambhir, P.H.I.
3. Thermal Physics, Garg, Bansal and Ghosh, Tata Mc Graw Hill.
4. Heat and Thermodynamics: An Intermediate Textbook, Mark Waldo Zemansk.

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

List of Experiments

1. To calibrate a Voltammeter using Potentiometer.
2. To calibrate ammeter using Potentiometer.
3. To convert Galvanometer into Voltammeter of different ranges (1.0 V, 0.5 V etc.).
4. To determine of specific resistance of the material of a resistance wire using P.O. Box.
5. To determine the specific resistance of the material of given wire using Carey Foster's bridge.
6. To determine Energy band gap of a PN junction diode.
7. To verify Stefan's law by electrical method.

Chemistry

BCH-201 Thermodynamics, Chemical Kinetics and Equilibrium	L	P	T	C
	3	1	0	4

Unit – I: Thermodynamics

Definitions of thermodynamic terms: System, surroundings etc. Types of systems, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work.

First Law of Thermodynamics : Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure and their relationship, Joule's law – Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isotheral and adiabatic conditions for reversible process.

Unit-II: 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.

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 catalysed reactions, classification of catalysis homogeneous and heterogeneous catalysis, enzyme catalysis, miscellanceous examples.

Unit – III: Chemical Equilibrium

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le Chatelier's principle Reaction isotherm and reaction isochore – Clapeyron-clausius equation and its applications. III. Thermodynamics – II Second Law of Thermodynamics : Need for the law, different statements of the law, Cornot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature. Concept of entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, clausius inequality, entropy as a criteria of spontaneity and

equilibrium, Equilibrium change in ideal gases and mixing of gases. Gibbs and Helmholtz functions: Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy. Nernst distribution law – thermodynamic derivation, applications.

Recommended Books

1. Puri Sharma and Pathania. *Principles of Physical Chemistry*, S. Chand & Co., 2010.
2. K.L. Kapoor. *Textbook of Physical Chemistry*, McGraw Hill, 2004.

BCH-202	**L**	**P**	**T**	**C**
Main Group Chemistry (*s* & *p*-block elements)	**3**	**0**	**0**	**4**

Unit-I: 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.

Unit-II: p-Block Elements-I

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,

Unit-III: p-Block Elements-II

Silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides.

Unit-IV: Chemistry of Noble Gasses

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

Recommended Books

Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.

Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.

Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.

Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.

Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).

Puri, Sharma and Kalia, *Principles of Inorganic Chemistry*, S. Chand & Co., 2010.

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

List of Experiments

1. Detection of extra elements N, S & halogens.
2. Preparation of Ni-DMG complex $[Ni(DMG)_2]$.
3. Preparation of copper tetraammine sulphate complex $[(Cu(NH_3)_4]SO_4$.
4. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at rooms temperature.
5. To study the effect of acid strength on the hydrolysis of an ester.

Mathematics

BMH-201	**L**	**P**	**T**	**C**
Differential Equations	**3**	**0**	**0**	**3**

Unit I

Formation of differential equations, Order and degree of a differential equation, equations of first order and first degree, Homogeneous equations, Linear equations and Bernoulli equations, Exact differential equations, integrating factors, Change of variables.

Unit II

Equations of the first order and higher degree, Equations solvable for *p, y* and *x*, Clairaut's equation, Lagrange's equation, Trajectories.

Unit III

Linear differential equations with constant coefficient, Complementary function and particular integral. Particular integral of differentforms,, and , Homogeneous linear equations.

Unit IV

Linear differential equations of second order, Complete solution in terms of known integral belonging to the complementary function, Normal form, Change of independent variable, Method of undetermined coefficients, Method of variation of parameters.

Books Recommended:

1. C. H. Edwards and D. E. Penny, *Differential Equations and Boundary Value Problems: Computing and Modelling*, Pearson education, India2005.
2. Dennis G. Zill, *A first course in differential equations,*
3. S. L. Ross: *Differential equations,* John Wiley and Sons, 2004.
4. Zafar Ahsan: *Text Book of Differential Equations and their Applications*, Prentice Hall ofIndia.
5. Khalil Ahmad: *Text Book of Differential Equations*, World Education Publishers,2012.
6. M.D. Raisinghania, Ordinary Differential and Partial Differential Equations (19^{th}-Edition), S. Chand Publishers, 2017

BMH-202	**L**	**P**	**T**	**C**
Functions of Several Variables	**3**	**0**	**0**	**3**

Unit I

Functions of several variables, Domain and range, Level curves and level surfaces, Limits and continuity, Partials derivatives, Total differential, Fundamental lemmas, differential of functions of n variables and of vector functions, The Jacobian matrix, derivatives and differentials of composite functions, The general chain rule.

Unit II

Implicit functions, inverse functions, Curvilinear coordinates, Geometrical applications, The directional derivatives, Partial derivatives of higher order, Higher derivatives of composite functions, The Laplacian in polar, Cylindrical and spherical coordinates, Higher derivatives of implicit functions, Maxima and minima of functions of several variables.

Unit III

Vector fields and scalar fields, the gradient field, Divergence and curl of a vector field, Combined operations, Irrotational and solenoidal fields, double, triple and multiple integrals, Change of variable in integrals, Arc length and Surface area.

Unit IV

Line integrals, Integrals with respect to arc length, Basic properties of line integrals, Green's theorem, Simply connected domains, Extension of results to multiply connected domains, Surfaces in space, Orientability, Surface integrals, Divergence theorem and Stoke's theorem, Integrals independent of path.

Books Recommended:

1. Wilfred Kaplan: Advanced Calculus., Adisson-Wasley Publishing Company,1973.

2. E. Swokowski: Calculus with Analytical Geometry, Prindle, Weber & Schmidt,1994
3. E. Kreyzig: Advanced Engineering Mathematics, John Wiley and Sons,1999.
4. David Widder: Advanced Calculus, Prentice Hall of India,1999.
5. S. C Malik and Savita Arora: Mathematical Analysis, New Age International(P)1996