BSc (PCM)

DETAILED SYLLABUS

Semester-V
Physics

BPH 501	L	T	P	C
Atomic and Nuclear Physics	**3**	**0**	**0**	**3**

Unit I- X-rays, Atoms in Electric and Magnetic Fields

X-rays, X -ray diffraction, bragg's law. bohr atomic model, X -rays-spectra: continuous and characteristic X -rays, Moseley law. Electron angular momentum, Space quantization. electron spin and spin angular momentum. larmor's theorem. spin magnetic moment. stern-gerlach experiment. Zeeman effect: electron magnetic moment and magnetic energy, gyromagnetic ratio and Bohr magneton. atoms in external magnetic fields; normal and anomalous Zeeman effect, Paschen back and Stark effect.

Unit II- Many Electron Atoms

Pauli's Exclusion Principle.Symmetric and Antisymmetric Wave Functions.Periodic table.Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model.L-S and J-J couplings.Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

Unit III- Properties of Atomic Nuclei & Decay

Structure of nuclei:- Basic Properties of Nuclei: (1) Mass, (2) Radii, (3) Charge, (4) Angular Momentum, (5) Spin, (5) Magnetic Moment (μ), (6) Stability and (7) Binding Energy. Radioactivity :- Law of Radioactive Decay. Half-life, Theory of Successive Radioactive Transformations. Radioactive Series, Binding Energy, Mass Formula. α-decay :- Range of α-particles, Geiger-Nuttal law and α-particle Spectra. Gamow Theory of Alpha Decay.β-decay :- Energy Spectra and Neutrino Hypothesis. γ-decay :- Origin of γ-rays, Nuclear Isomerism and Internal Conversion.

Unit IV- Nuclear Reactions

Liquid Drop Model.Mass formula. Shell Model. Meson Theory of Nuclear Forces and Discovery of Pion, Types of Reactions and Conservation Laws. Concept of Compound and Direct Reaction.Compound Nucleus. Scattering Problem in One Dimension : Reflection and Transmission by a Finite Potential Step. Stationary Solutions, Attractive and Repulsive Potential Barriers. Scattering Cross-section.Reaction Rate.Q-value of Reaction.Fission and Fusion.

Reference Books:
1. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book Company, 1987)
2. Concepts of nuclear physics by Bernard L.Cohen.(New Delhi: Tata Mcgraw Hill, 1998).
3. Nuclear physics by Irving Kaplan. (Oxford & IBH, 1962).
4. Atomic physics by J.B.Rajam& foreword by Louis De Broglie.(S.Chand& Co., 2007).
5. Atomic Physics by J.H.Fewkes& John Yarwood. Vol. II (Oxford Univ. Press, 1991).

BPH 502	**L**	**T**	**P**	**C**
Mathematical Physics	**3**	**0**	**0**	**3**

Unit I- Theory of Functions of a Complex Variable
Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula, Taylor's series and Laurent's series expansion, Zeros and singular points, Residues, Cauchy's Residue theorem,Evaluation of definite integrals, Principal Value.

Unit II- Fourier Transforms
Fourier transform, Sine, Cosine and Complex transforms with examples, Properties of Fourier Transforms, Transforms of derivatives, Parseval's Theorem, Convolution Theorem, Applications to Partial differential eequations.

Unit III- Laplace Transforms
Laplace transform, Properties and examples of Laplace Transform, Convolution theorem and its applications, Laplace transform method of solving differential equations.

Unit IV- Group Theory
Concept of a group (additive and multiplicative, isomorphism and homomorphism), Matrix representation of a group, Reducible and irreducible representation of a group, The Great Orthogonality Theorem.

References Books:
1. Mathematical Physics by H.K Das, S.Chand Publications-New Delhi.
2. Kreyszig. E., Advanced Engineering Mathematics, Wiley-India.
3. Arfken G.,Mathematical method for Physicists, Academic Press
4. Kreyszig.E., Advanced Engineering Mathematics, Wiley-India

BPH 5L	L	T	P	C
Physics Lab-I	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-501	**L**	**P**	**T**	**C**
Solution, Electrochemistry and Phase equilibrium	**3**	**0**	**0**	**3**

Unit-I: Solutions

Liquid – Liquid mixtures- Ideal liquid mixtures, Raoult's and Henry's law, Nonideal system-azeotropes – HCl-H_2O and ethanol – water systems. Partially miscible liquids- Phenol – water, trimethylamine – water, nicotine-water systems, Immiscible liquids, steam distillation.

Unit – II: Electrochemistry–I

Electrical transport:- Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar equivalent and specific conductance with dilution. Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong 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, determination of Ka of acids, determination of solubility product of sparingly soluble salt, conductometric titrations.

Unit – III: Electrochemistry–II

Types of reversible electrodes – gas-metal ion, metal-ion, metalinsoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells–reversible and irreversible cells, conventional representation of electrochemical cells; EMF of a cell and its measurements, Computation of cell EMF, Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K) Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods; Buffers – Mechanism of buffer action, Henderson-Hazel equation, application of buffer solution, Hydrolysis of salts

Unit-II: Phase Rule

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, $'CO_2'$ and $'S'$ systems Phase equilibria of two component system – solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions – compound formation with congruent melting point (Mg-Zn) and incongruent melting point, $(FeCl_3-H_2O)$ and $(CuSO_4-H_2O)$ system.

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-502	L	P	T	C
Advanced Inorganic-organic Chemistry	**3**	**0**	**0**	**3**

Section A

Unit – I: Organometallics and carbonyls

Definition, Ziese's salt, nomenclature and classification of organometallic compounds, Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn. Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls.

Unit-II: Silicones and Phosphazenes and Bioinorganic Chemistry

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin, Biological role of alkali, alkaline earth and transition metal ions.

Unit-III: Chemistry of Lanthanide and Actinide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses. Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.

Unit-IV: Acids and Bases and Non-aqueous Solvents

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concept of acids and bases and HSAB principle. Physical properties of a solvent, types of solvents and their general characteristics, Reactions in non-aqueous solvents with reference to liquid NH_3 and Liquid SO_2.

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.

Section B

Unit – I: Alcohols and phenols

Classification and nomenclature, Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols - – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacolpinacolone rearrangement. Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol.

Phenols : Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman syntheis, HaubenHoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

Unit – II: Ethers and Epoxides

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Unit-III: Aldehydes and Ketones

Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties. Mechanism of nucleophillic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, LiAlH4 and NaBH4 reductions. Halogenation of enolizable ketones An introduction to α, β unsaturated aldehydes and Ketones.

Unit – IV: Carboxylic Acids and their derivatives

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-Zelinsky reaction, Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids, Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids, Hydroxy acids: malic, trartaric and citric acids. Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

Carboxylic Acid Derivatives Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anyhydrides. Relative stability of acyl derivatives, Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reaction. Mechanisms of esterificaton and hydrolysis (acidic and basic)

Unit-V: Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nuclephilc substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid. Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties.

Amines: Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substituton in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

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 5L	L	T	P	C
Chemistry Lab-I	0	0	2	1

List of Experiments

1. To determine the viscosity of a given liquid.
2. To determine the surface tension of supplied liquid.
3. To determine the solubility and solubility of a sparingly soluble electrolyte conducometrically.
4. To study the saponification of ethyl acetate condutometrically.
5. Estimation of ferrous and ferric by dichromate method.
6. Estimation of copper using thiosulphate.
7. Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime).
8. Estimation of hardness of water by EDTA.
9. Preparation of m-dinitrobenzene.
10. Preparation of p-nitroacetanilide.
11. Preparation of tris(thiourea)copper(I) sulphate dehydrate.
12. Preparation of potassium tris(oxalato)aluminate trihydrate
13. Preparation of potassium tris(oxalato)ferrate(III) trihydrate.
14. Preparation of hexaamminecobalt(III) chloride.

Mathematics

BMH-501	L	P	T	C
Linear Algebra	**3**	**0**	**0**	**3**

Unit I: Definition examples and basic properties of a vector space, Subspaces, Linear Dependence Independence, Linear combinations and span, Basis and dimension, Sum and intersection of subspaces, Direct sum of subspaces.

Unit II: Definition and examples of linear transformations, Properties of linear transformations, Range and kernel, The rank and nullity of a linear transformation, Rank-Nullity Theorem and its consequence, The matrix representation of a linear transformation, Change of basis, Isomorphism.

Unit III: Scalar product in an Inner product spaces. Orthogonality in inner product Spaces, Normed linear spaces, Inner product on complex vector spaces, Orthogonal Complements, orthogonal sets and projections, Gram-Schmidt Orthogonalization process, Bessel's inequality.

Unit IV: Eigenvalues and Eigen vectors, Characteristic equation and polynomial, Eigenvectors and eigenvalues of linear transformations and matrices, The Cayley-Hamilton Theorem. Similar matrices and Diagonalization, Eigenvalues and eigenvectors of symmetric and Hermitian matrices, Orthogonal Diagonalization, Quadratic forms and conic sections.

Books Recommended:

1. David C. Lay: *Linear algebra and its applications (3rd Edition),* Pearson Education, Asia, Indian Reprint, 2007.

2. GeoryNakos and David Joyner: *Linear algebra with Applications*, Brooks/ Cole, Publishing Company, International Thomson Publishing, Asia, Singapore, 1998.

3. Stephen H. Friedberg, Arnold J. Insel and L.E.Space- *Linear Algebra*, 4th dition, PHI Pvt Ltd., New Delhi, 2004.

4. I. V. Krishnamurty, V.P. Mainra, J.L. Arora- *An introduction to Linear Algebra*, East West Press , New Delhi, 2002

BMH-502	L	P	T	C
Numerical Methods	**3**	**0**	**0**	**3**

Unit-I: Absolute, relative and percentage errors, General error formula. Solution of algebraic and transcendental equations: Bisection method, False position method, Fixed-point iteration method, Newton's method and its convergence, Chebyshev method. Solution of system of non-linear equations by Iteration and Newton-Raphsonmethod.

Unit-II: Direct methods to solve the system of linear equations: Gauss elimination method, Gauss Jordan method, LU decomposition method. Indirect methods: Gauss-Jacobi and Gauss- Seidal methods. The algebraic Eigen value problems by Householder and Powermethod.

Unit-III: Finite difference operators and finite differences, Interpolation and interpolating polynomials: Newton's forward and backward difference formulae, Central differences: Sterling's and Bessel's formula. Lagrange's interpolation formula, Divided Differences, their properties and Newton's general interpolation formula. Inverseinterpolation.

Unit-IV: Numerical differentiation of tabular and non-tabular functions. Numerical integration using Gauss quadrature formulae: Trapezoidal rule, Simpson's rules, Romberg formula and their error estimation. Numerical solution of ordinary differential equations by Picard's method, Taylor series, Euler's method and Runge-Kutta methods. Multi-step method: Adams- Moulton method.

Books Recommended:
1. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India,2007
2. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New age International Publisher, India, 5th edition, 2007
3. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, India,7th edition,2008.
4. S. S. Sastry, Introductory Methods of Numerical Analysis (Fifth Ed.), Prentice Hall of India (Ltd.)New Delhi-110001,2012.
5. M. Pal, Numerical Analysis for Scientists and Engineers, Narosa Publisher,2007.
6. N. Ahmad, Fundamental Numerical Analysis with error estimation, Anamaya Publisher

Electives (DSE)

BCH-503	L	P	T	C
Molecules of Life	3	0	0	3

Unit 1: Carbohydrates

Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Unit 2: Amino Acids, Peptides and Proteins

Classification *of Amino Acids,* Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (tbutyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

Unit 3: Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action(Including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Noncompetitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH2 group, double bond and aromatic ring,

Unit 4: Nucleic Acids

Components of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (**nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA(**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Unit 5: Lipids

Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

Unit 6: Concept of Energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

Recommended Texts:
Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.,* W. H. Freeman.
Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

List of Practicals

1. Separation of amino acids by paper chromatography

2. To determine the concentration of glycine solution by formylation method.

3. Study of titration curve of glycine

4. Action of salivary amylase on starch

5. Effect of temperature on the action of salivary amylase on starch.

6. To determine the saponification value of an oil/fat.

7. To determine the iodine value of an oil/fat

8. Differentiate between a reducing/ nonreducing sugar.

BCH-504	L	P	T	C
Chemistry of Cosmetics & Perfumes	**2**	**0**	**0**	**2**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practices

1. Preparation of talcum powder.

2. Preparation of shampoo.

3. Preparation of enamels.

4. Preparation of hair remover.

5. Preparation of face cream.

6. Preparation of nail polish and nail polish remover.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.

2. P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.

3. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).

RSP 101	L	P	T	C
Research Project	**0**	**0**	**0**	**3**