B.Sc. (PCM) Revised Syllabus

1st Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSPCM101	English	40	60	100
BSPCM102	Mechanics and Oscillations	40	60	100
BSPCM103	Conceptual Organic Chemistry	40	60	100
BSPCM104	Calculus	40	60	100
BSPCM105	Mechanics and Oscillations –Lab	60	40	100
BSPCM106	Conceptual Organic Chemistry-Lab	60	40	100
Total		**280**	**320**	**600**

2nd Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSPCM201	General Hindi	40	60	100
BSPCM202	Electricity, Magnetism and EMT	40	60	100
BSPCM203	Physical Chemistry for the Sciences	40	60	100
BSPCM204	Differential Equations	40	60	100
BSPCM205	Electricity, Magnetism and EMT–Lab	60	40	100
BSPCM206	Physical Chemistry for the Sciences-Lab	60	40	100
Total		**280**	**320**	**600**

3rd Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSPCM301	Fundamental of IT	40	60	100
BSPCM302	Thermal Physics and Statistical Mechanics	40	60	100
BSPCM303	Chemical Bonding, Transition Metal & Coordination Chemistry	40	60	100
BSPCM304	Real Analysis	40	60	100
BSPCM305	Thermal Physics and Statistical Mechanics - Lab	60	40	100
BSPCM306	Chemical Bonding, Transition Metal & Coordination Chemistry-Lab	60	40	100
Total		**280**	**320**	**600**

4th Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSPCM401	Environmental Science	40	60	100
BSPCM402	Waves and Optics	40	60	100
BSPCM403	Molecules of Life	40	60	100
BSPCM404	Abstract Algebra	40	60	100
BSPCM405	Waves and Optics - Lab	60	40	100
BSPCM406	Molecules of Life-Lab	60	40	100
Total		**280**	**320**	**600**

5th Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
	Elective-I Physics (Any One)			
BSPCM501A	Solid State Physics	40	60	100
BSPCM501B	Quantum Mechanics			
	Elective-II Chemistry (Any One)			
BSPCM502A	Polymer Chemistry	40	60	100
BSPCM502B	Analytical Methods in Chemistry			
	Elective-III Mathematics (Any One)			
BSPCM503A	Advanced Calculus	40	60	100
BSPCM503B	Logic and Set			
	Practical-I Elective Physics (Any One)			
BSPCM504A	Solid State Physics-Lab	60	40	100
BSPCM504B	Quantum Mechanics-Lab			
	Practical-II Elective Chemistry (AnyOne)			
BSPCM505A	Polymer Chemistry-Lab	60	40	100
BSPCM505B	Analytical Methods in Chemistry-Lab			
Total		**240**	**260**	**500**

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
	Elective-IV Physics (Any One)			
BSPCM601A	Digital, Analog and Instrumentation	40	60	100
BSPCM601B	Elements of Modern Physics			
	Elective- V Chemistry (Any One)			
BSPCM602A	Instrumental Methods of Analysis	40	60	100
BSPCM602B	Novel Inorganic Solids			
	Elective-VI Mathematics (Any One)			
BSPCM603A	Vector Calculus	40	60	100
BSPCM603B	Probability and Statistics			
	Practical-III Elective Physics (Any One)			
BSPCM604A	Digital, Analog and Instrumentation-Lab	60	40	100
BSPCM604B	Elements of Modern Physics Lab			
	Practical-IV Elective Chemistry (Any One)			
BSPCM605A	Instrumental Methods of Analysis -Lab	60	40	100
BSPCM605B	Novel Inorganic Solids -Lab			
Total		**240**	**260**	**500**

English

CONTENTS

Unit I: Introduction: 06

Theory of Communication, Types and modes of Communication, *Mediums and channels of communication, barriers to communication, English as a Global language, the Lingua Franca, Social influences on English*

Unit II: Language of Communication: 06

Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication, *Varieties of English, Language, Accent, Dialect, Colloquialism, Historical influences on English*

Unit III: Speaking Skills: 06

Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech, *Regional influences on English, Convergence and divergence, Linguistic Imperialism,*

Unit IV: Reading and Understanding- 06

Close Reading, *Reading analysis of a text - Audience and purpose, Content and theme, Tone and Mood, stylistic devices, structure* Comprehension- Analysis and Interpretation Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit V: Writing Skills 06

Documenting Report Writing, making notes Letter writing, *Writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters*

Course outcome:

It will enhance Language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as

interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, notetaking etc. While, to an extent, the art of communication is natural to all living beings, intoday's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

Recommended Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.

2. Business English, Pearson, 2008.

3. Language, Literature and Creativity, Orient Blackswan, 2013.

4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, DrRanjanaKaul, DrBrati Biswas

Mechanics and Oscillations

(BSPCM102)

Module -1   **12 Hrs.**

Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

Ordinary Differential Equations:1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.

Module -2   **12 Hrs.**

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

Module -3   **12 Hrs.**

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.

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). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

Module -4   **12 Hrs.**

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

Module -5   **12 Hrs.**

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 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 - q, η and σ by Searles method.

Note: Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.

Reference Books:

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

- Mechanics Berkeley Physics course, v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
- Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Conceptual Organic Chemistry

(BSPCM103)

Unit 1: Stereochemistry (18 Lectures)
Writing of Fischer projection, Newmann and Sawhorse projection and Wedge formulae. Interconversion of one type of structural representation into another type.
Conformations: Restricted rotation about single bonds, Various conformations of ethane, butane, ethane-1,2-diol and cyclohexane. Relative stability of different conformations interms of energy difference is to be discussed for all these compounds.

Geometrical Isomerism: Requirements for a molecule to show geometrical isomerism, Cis-Trans and E/ Z notation along with CIP rules for geometrical isomers.

Optical Isomerism: Optical activity, specific and molar rotation, chirality, enantiomerism, diastereoisomerism, racemic mixtures and their resolution by salt formation method.

Relative and absolute configuration: D / L nomenclature system for configuration of carbohydrates (difference between d/l and D/L notations). Threo and Erythro designation. Rand S- configuration (upto two chiral centres).

Unit 2: Addition Reactions (10 Lectures)
Alkenes and Alkynes: Hydrogenation, addition of halogens, Hydrohalogenation (Markovnikov's and anti-Markovnikov's addition), hydration, hydroxylation (cis and trans), oxymercuration-demercuration, hydroboration-oxidation, ozonolysis. Reactivity of alkenes vs alkynes.

Aldehydes and ketones: (formaldehyde, acetaldehyde, benzaldehyde, acetone) Addition of sodium bisulphite, hydrogen cyanide and alcohols. Addition- elimination reactions with ammonia and its derivatives

Name reactions: Aldol, cross Aldol, Claisen, Knoevengel, Cannizzaro, cross Cannizzaro

Unit 3: Substitution Reactions (15 Lectures)
Free radical substitution reactions: Halogenation of alkanes, allylic compounds and alkyl benzenes.

Nucleophilic substitution reactions: Alkyl, allyl and benzyl halides – substitution of halogen by some common nucleophiles. Mechanism of SN1 and SN2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group)

Benzene diazonium chloride: Replacement of diazo group

Alcohols, amines and phenols: Substitution of active hydrogen, replacement of hydroxyl group in alcohols (using PCl5, SOCl2 and HI)

Carboxylic acid derivatives: Hydrolysis **Ethers**: Cleavage by HI

Electrophilic Substitution Reactions (aromatic compounds): General mechanism of electrophilic substitution reactions (nitration, halogenation, sulphonation, Friedel Crafts alkylation and acylation), directive influence of substituents.

Unit 4: Elimination Reactions (6 Lectures)
Alkyl halides (dehydrohalogenation, Saytzeff's rule), vicinal dihalides (dehalogenation),

alcohols (dehydration), Quaternary ammonium salts (Hofmann's elimination). Mechanism ofE1 and E2 reactions (nature of substrate and base), elimination vs substitution

Unit 5: Oxidation (6 Lectures)

Aromatic side chain: Oxidation with potassium permanganate, potassium dichromate

Alcohols: Oxidation with potassium permanganate, potassium dichromate, catalytic dehydrogenation and Oppenauer oxidation. Oxidation of 1,2–diols with periodic acid and lead tetraacetate.

Aldehydes: Oxidation with potassium permanganate, chromic acid and Tollen's reagent

Ketones: Oxidation with potassium permanganate, sodium hypoiodite (iodoform reaction) and

Baeyer–Villiger oxidation

Reductions (5 Lectures)

Aldeydes and Ketones: Catalytic hydrogenation, reduction with sodium borohydride, lithium aluminium hydride, Clemmensen, Wolff-Kishner

Carboxylic acids and their derivatives: Lithium aluminium hydride, sodium-ethanol and Rosenmund reduction.

Nitro compounds: Acidic, alkaline and neutral reducing agents, lithium aluminium hydride and

electrolytic reduction.

Recommended Texts:

1. I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Pearson Education.
3. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry,* S. Chand
4. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
5. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*; Wiley: London, 1994.
6. T. W. Graham Solomon's *Organic Chemistry,* John Wiley and Sons.
7. P.S. Kalsi, *Stereochemistry, Conformation and Mechanism,* John Wiley and Sons.
8. D. Nasipuri, *Stereochemistry of Organic Compounds,* New Age International Publishers.

Conceptual Organic Chemistry-Lab

(BSPCM106P)

1. Purification of organic compounds by crystallization using the following solvents:
a. Water
b. Alcohol
2. Determination of the melting points of organic compounds (by Kjeldahl method and electrically heated melting point apparatus).
3. Determination of optical activity by using polarimeter

Organic preparations: Carry out the following preparations using 0.5 - 1 g of starting compound. Recrystallize the product and determine the melting point of the recrystallized sample.
4. To prepare acetanilide by the acetylation of aniline.
5. To prepare p-bromoacetanilide.
6. Benzolyation of aniline or β-naphthol by Schotten-Baumann reaction
7. Hydrolysis of benzamide or ethyl bezoate.
8. Semicarbazone derivative of one the following compounds: acetone, ethyl methyl ketone, diethylketone, cyclohexanone, benzaldehyde.
9. Nitration of nitrobenzene.
10. Oxidation of benzaldehyde by using alkaline potassium permanganate.

Recommended Texts:
1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Longman, London & New York.
3. Ahluwalia, V.K.; Dhingra, S. & Gulati, A. *College Practical Chemistry*, Universities
Press.

<div align="center">Calculus</div>

<div align="center">(BSPCM10</div>

<div align="center">4)</div>

Module -I 15
Hours

Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions Asymptotes.

Module -II 15
Hours

Curvature. Tests for concavity and convexity. Points of inflexion. Multiple points. Tracing of curves in cartesian and polar co -ordinates.

Module -III 15
Hours

Definite integrals. Quadrature. Rectification. Volumes and surfaces of solids of revolution.

Module -IV 15
Hours

Linear equation and equations reducible to the linear form. Exact differential equations. First order higher degree equations solvable for x, t, p, Clairaut's form and singular solutions Geometrical meaning of a differential equation. Orthogonal trajectories.

Module -V 15
Hours

Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Linear differential equations of second order. Transformation of the equation by changing the dependent variable / the independent variable. Method of variation of parameters. Ordinary simultaneous differential equations.

Text Books & References:

1. Gorakh Prasad, Differential Calculus, Pothishala Private Ltd. Allahabad.
2. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.

3. D.A. Murray Introductory Course in Differential Equations, Orient Longman (India), 1976.

4. Murray R. Spiegel, Theory and Problems of Advanced Calculus, Schaum's outline series, Schaum Publishing Co. New York.

5. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow.

6. G.F. Simmons, Differential Equations, Tata Mc Graw Hill, 1972.

Mechanics and Oscillations-Lab

(BSPCM105P)

Note: Minimum 8 experiment to be performed.

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine g and velocity for a freely falling body using Digital Timing Technique.
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

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.
- Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.

A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

GENERAL HINDI

1- गद्य संदेश (Prose)

1- साहित्य की साहित्य - महावीर प्रसाद द्विवेदी

2- सच्ची वीरता - सरदार पूर्णसिंह

3- मित्रता - आचार्य रामचंद्र शुक्ल

2- कथालोक (Short Stories)

1- मुक्तिधन - मुन्शी प्रेमचंद

2- पुरस्कार - जयशंकर प्रसाद

3- उसने कहा था -चन्द्रधर शर्मा गुलेरी

3- व्याकरण (Grammar)

1. लिंग, वचन , शब्द. , काल. ,वाच्य. , वाक्यों की शुद्धि, शब्द- विलोम., संधि विच्छेद , उपसर्ग, संधि, प्रत्यय, समास, मुहावरे / लोकोक्तियाँ, पारिभाषिक शब्दावली, संज्ञा, सर्वनाम, विशेषण, क्रिया, क्रिया विशेषण (व्यावहारिक पक्ष), शब्द युग्मों का अर्थ भेद, वाक्यांश के लिए एक शब्द, पर्यायवाची/विलोम शब्द

2. अंग्रेजी - हिन्दी अनुवाद

4- कार्यालयीन हिन्दी (Official Language)

1- परिपत्र
2- कार्यालय ज्ञापन
3- अधिसूचना
4- शब्दावली
5- वाक्यांश अंग्रेजी- हिन्दी शब्दों का वाक्य में प्रयोग

5- निबंध

6- पत्र- लेखन (Letter Writing)

Electricity, Magnetism and Electromagnetic Theory

(BSPCM202)

Module -1   **12 Hrs.**

Vector Analysis: Review of vector algebra (Scalar and Vector product), 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 (statement only).

Module -2   **12 Hrs.**

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformlycharged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.

Module -3   **12 Hrs.**

Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field.

Dielectric medium, Polarization, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

Module -4   **12 Hrs.**

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. 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 ferro-magnetic materials.

Module -5   **12 Hrs.**

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

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& 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.

Physical Chemistry for the Sciences

(BSPCM203)

Unit 1: Chemical Energetics (10 Lectures)
Review of the Laws of Thermodynamics.
Important principles and definitions of thermochemistry. Concept of standard state and standard
enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation
of bond energy, bond dissociation energy and resonance energy from thermochemical data.
Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.
Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit 2: Chemical Equilibrium (20 Lectures)
Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG_o, Le Chatelier's principle. Relationships between
K_p, K_c and K_x for reactions involving ideal gases.

Ionic Equilibria
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Unit 3: Chemical Kinetics (8 Lectures)
The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for
zero and first order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Enzyme kinetics.

Unit 4: Spectroscopy (16 Lectures)
Introduction to spectroscopy: Electromagnetic radiation, fundamental definitions, electromagnetic spectrum, introduction to concepts of absorption and emission spectroscopy, Beer-Lambert law.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations, IR spectrum, fingerprint and group frequency regions and their significance, Hooke's law and vibrational frequency. Factors affecting vibrational frequency.
Characterization of functional groups: alkanes, alkenes, alkynes (only alicyclic systems), aldehydes, ketones, carboxylic acids and their derivatives, hydroxy compounds and amines. Study of hydrogen bonding.
Electronic Spectroscopy: Electronic transitions, singlet and triplet states, dissociation and predissociation.
UV spectroscopy: Types of electronic transitions, UV spectrum, λ_{max}, ε_{max}, chromophores, auxochromes, bathochromic shift, hypsochromic shift (definitions and elementary examples)

and solvent effect. Characteristic UV transitions in common functional groups.
General applications of UV spectroscopy including distinction between cis-trans isomers.
Woodward rules for calculating λ_{max} in the following systems:

- Conjugated dienes: alicyclic, homoannular, heteroannular.
- α,β-Unsaturated aldehydes and ketones.
- Extended conjugated systems: dienes, aldehydes and ketones.

PMR spectroscopy: Basic principles of NMR spectroscopy, PMR scale, chemical shifts (concept of shielding and deshielding), factors influencing chemical shifts, simple spin-spin couplings, coupling constant, chemical shift equivalence, anisotropic effects in alkenes, alkynes, aldehydes and aromatics. Interpretation of PMR spectra of simple compounds.
Application of UV, IR and PMR in solving structures of simple molecules.

Unit 5: Photochemistry (6 Lectures)

Laws of photochemistry. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions.

Photochemical and thermal reactions.

Recommended Texts:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry 9*th Ed., Oxford University Press (2011).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).

Physical Chemistry for the Sciences-Lab

(BSPCM206)

(I) Thermo chemistry

1. Determination of heat capacity of a calorimeter for different volumes.
2. Determination of the enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

3. Determination of integral enthalpy of solution of salts (endothermic and exothermic).

(III) pH-metric and potentiometric measurements

4. Preparation of sodium acetate-acetic acid buffer solutions and measurement of their pH.
5. Potentiometric titrations of (i) strong acid *vs* strong base (ii) weak acid *vs* strong base
6. Determination of dissociation constant of a weak acid.

(IV) Study the kinetics of the following reactions:

7. Initial rate method: Iodide-persulphate reaction
8. Integrated rate method:
a. Acid hydrolysis of methyl acetate with hydrochloric acid.
b. Saponification of ethyl acetate

(V) Colourimetry

9. Verification of Lambert-Beer's Law for potassium dichromate/ potassium permanganate solution.
10. Determination of pK (indicator) for phenolphthalein.
11. Study the kinetics of interaction of crystal violet with sodium hydroxide colourimetrically.

Recommended Texts:

1. Khosla, B.D.; Garg, V.C.; Gulati, A. & Chand, R. *Senior Practical Physical Chemistry*,
New Delhi.

Differential Equations

(BSPCM204)

Module -I   **15 Hrs.**

Series solutions of differential equations. Power series method. Bessel and Legendre functions and their properties-convergence, recurrence and generating relations. Orthogonality of functions. Sturm-Liouville problem. Orthogonality of eigen-functions. Reality of eigen values. Orthogonality of Bessel functions and Legendre polynomials.

Module -II   **15 Hrs.**

Laplace Transformation: Linearity of the Laplace transformation. Existence theorem for Laplace transforms. Laplace transformation of derivatives and integrals. Shifting theorems. Differentiation and integration of transforms. Convolution theorem. Solution of integral equations of differential using the Laplace transformation.

Module -III   **15 Hrs.**

Partial differential equations of the first order. Lagrange's solution. Some special types of equations which can solve easily by methods other than the general method. Charpit's general method of solution.

Module -IV   **15 Hrs.**

Partial differential equation of second and higher orders. Classification of linear partial differential equations of second order. Homogeneous equations with constant coefficients. Partial differential equations reducible to equations with constant coefficient. Monge's methods.

Module -V   **15 Hrs.**

Calculus of Variations: Variation problems with fixed boundaries -Euler's equation for functional containing first order derivative and one independent variable. Externals. Functional dependent on higher order derivatives. Functional dependent on more than one independent variable. Variation problems in parametric in form. Invariance of Euler's equation under co-ordinates transformation.

Variation problems with Moving Boundaries: Functionals on one and two functions. One sided variation. Sufficient conditions for an Extremum-Jacobi and Legendre conditions second variation. Variation principle of least action.

Text Books & References:

1. H.K. Pathak, Differential Equations, Shiksha Sahitya Prakashan, Meerut.
2. D.A. Murray Introductory Course in Differential Equations, Orient Longman (India), 1976.
3. G.F. Simmons, Differential Equations, Tata Mc Graw Hill, 1972.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 1999.
5. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, New Delhi.

Electricity, Magnetism and EMT–Lab

(BSPCM205)

Note: Minimum 8 experiment to be performed.

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
    (i)   Measurement of charge and current sensitivity
    (ii)   Measurement of CDR
    (iii) Determine a high resistance by Leakage Method
    (iv)   To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem
10. To verify the Superposition, and Maximum Power Transfer Theorem

Reference Books

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Engineering Practical Physics, S.Panigrahi&B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

BSCPCM	Total Marks: 100
Semester-I	Internal Marks: 30
Paper Code. BSPCM301	External Marks: 70
Fundamentals of IT	No. of Hours: 40
Objectives: This is a basic course for commerce students to familiarize with computer and it's applications in the relevant fields and exposes them to other related courses of IT.	Total Credits: 03

Unit No.	Details	Nos. of Hours
1	**1.1 Introduction to Computers:** 1.1.1 The evolution of computers – Computer Generation 1.1.2 Classifications of Computers – 1.1.3 Micro 1.1.4 Mini, 1.1.5 Mainframe 1.1.6 Super Computers 1.1.7 Distributed Computer System 1.1.8 Parallel Computers 1.1.9 Computer Hardware – Major Components of a Digital Computer 1.1.10 Block Diagram of Computer 1.1.11 Input devices 1.1.12 Output devices 1.1.13 Description of Computer IPO Cycle 1.1.14 CPU **1.2 Computer Memory:** 1.2.1 Memory Types, 1.2.2 Units of memory 1.2.3 Read Only Memory, 1.2.4 Random Access Memory, 1.2.5 Serial Access Memory, 1.2.6 Physical Devices Used to construct Memories, 1.2.7 Hard disk, 1.2.8 Floppy Disk Drives, 1.2.9 CD, DVD, Flash Drives, 1.2.10 Magnetic Tape Drives.	08
2	**2.1 Number System:** 2.1.1 Decimal, 2.1.2 Binary, 2.1.3 Octal, 2.1.4 Hexa-decimal. 2.1.5 Conversion - Decimal to all other number systems, 2.1.6 Binary to octal and Hexa Decimal, **3.1 Computer Software:** 3.1.1 System software, 3.1.2 Operating Systemconcepts, 3.1.3 Different types of operating systems, 3.1.4 Assemblers, 3.1.5 Compilers, 3.1.6 Interpreters, 3.1.7 linkers, 3.1.8 Application Software, 3.1.9 Firmware Software,	08
3	**3.1 Introduction of Internet and Objectives** **3.2 Basic of Computer Networks** 3.2.1 Local Area Network (LAN) 3.2.2 Wide Area Network (WAN) **3.3 Internet** 3.3.1 Concept of Internet 3.3.2 Applications of Internet 3.3.3 Connecting to the Internet	08

	3.3.4 Troubleshooting		
	3.4 World Wide Web (WWW)		
	3.5 Web Browsing Software		
	3.5.1 Popular Web Browsing Software		
	3.6 Search Engines		
	3.6.1 Popular Search Engines / Search for content		
	3.6.2 Accessing Web Browser		
	3.6.3 Using Favorites Folder		
	3.6.4 Downloading Web Pages		
	3.6.5 Printing Web Pages		
	3.7 Understanding URL		
	3.8 Surfing the web		
	3.8.1 Using e-governance website		

4	**4.1 Word Processor:**
	    4.1.1 Word Processor and its features,
	    4.1.2 Editing of Text,
	    4.1.3 Find and Replace,
	    4.1.4 Bullets and Numbering,
	    4.1.5 Spell Checker,
	    4.1.6 Grammar Checker,
	    4.1.7 Auto Correct,
	    4.1.8 Auto Complete,
	    4.1.9 Auto Text,
	    4.1.10 Header and footer,
	    4.1.11 tables,
	    4.1.12 mail merge,
	    4.1.13 border and shading,
	    4.1.14 page setup,
	    4.1.15 Printing.
	4.2 Spread sheet:
	    4.2.1 Spread sheet and its features,
	    4.2.2 Entering Information in Worksheet,
	    4.2.3 Editing Cell Entry,
	    4.2.4 Moving and Copying Data,
	    4.2.5 deleting or Inserting Cells,
	    4.2.6 Rows and Columns,
	    4.2.7 Custom
	    4.2.8 Numeric Formats,
	    4.2.9 Using Formulas and functions,
	    4.2.10 Creating charts.
			08

5	**5.1 Presentation Software**
	    5.1.1. Presentation Software and its uses,
	    5.1.2. steps for creating Power Point Presentation,
	    5.1.3. PowerPoint Views,
	    5.1.4. Assigning Slide Transitions,
	    5.1.5. Using Preset Animations,
	    5.1.6. Hiding Slides,
	    5.1.7. Slide Show,
	    5.1.8. Controlling the Slide Show with a Keyboard,
	    5.1.9. Setting Slide Show Timings.
			08

Text Books:

1. Alex Leon & Mathews Leon, ―Fundamentals of Information Technology‖, LeonTechworld, 1999.
2. Vikas Gupta, ―Comdex Computer Kit‖, Wiley Dreamtech, Delhi, 2004
3. P. K. Sinha & Priti Sinha , ―Computer Fundamentals‖, BPB Publications, 1992.

Reference Books:

1. V. Raja Raman, ‑Introduction to Computers‖, PHI, 1998.

2. Alex Leon & Mathews Leon, ―Introduction to Computers‖, Vikas Publishing House, 1999.
3. Norton Peter, ―Introduction to computers‖, 4th Ed., TMH, 2001.

BSCPCM	Total Marks: 50
Semester – I	Internal Marks: 20
Paper Code. BSPCM305P	External Marks: 30
Fundamentals of IT LAB	No. of Hours: 30
Objectives: This is a basic course for Commerce students to familiarize with computer and it's applications in the relevant fields and exposes them to other related courses of IT.	Total Credits: 01

nit No.	Details	Nos. of Hours
	MS-WORD	**30**
	1. Text Manipulations	
	2. Usage of Numbering, Bullets, Tools and Headers	
	3. Usage of Spell Check and Find and Replace	
	4. Text Formatting	
	5. Picture Insertion and Alignment	
	6. Creation of Documents Using Templates`	
	7. Creation of Templates	
	8. Mail Merge Concept	
	9. Copying Text and Picture From Excel	
	10. Creation of Tables, Formatting Tables	
	11. Splitting the Screen	
	12. Opening Multiple Document, Inserting Symbols in Documents	
	MS-EXCEL	
	1. Creation of Worksheet and Entering Information	
	2. Aligning, Editing Data in Cell	
	3. Excel Function (Date, Time, Statistical, Mathematical, Financial Functions)	
	4. Changing of Column Width and Row Height (Column and Range of Column)	
	5. Moving, copying, Inserting and Deleting Rows and Columns	
	6. Formatting Numbers and Other Numeric Formats	
	7. Drawing Borders Around Cells	
	8. Creation of Charts Raising Moving	
	9. Changing Chart Type	
	10. Controlling the Appearance of a Chart	
	MS -POWER POINT	
	Working With Slides	
	1. Creating, saving, closing presentation	
	2. Adding Headers and footers	
	3. Changing slide layout	
	4. Working fonts and bullets	
	5. Inserting Clip art: working with clipart,	
	6. Applying Transition and animation effects	
	7. Run and Slide Show	

Fundamentals of IT

UNIT-I: Introduction to Computers and its Component

(Basic information only)

(a)Hardware :CPU (Motherboard ,Microprocessor, The Intel Pentium III,AMD and Cyrix),MMX Technology, system clock address bus ,Data bus(PCI and EISA),cache memory, processing speed Expansion slots(video controller ,sound cards SCSI, network card),Memory-(Unit,RAM,ROM,EDO RAM,SD RAM),input and output devices(Keyboard ,standard keyboard layout),Mouse,printers(Dot-matrix ,ink-jet, laser –jet),Microphone, speakers, modem, scanner, density, formatting, boot record, FAT, Folder Directory),Hard Disk Drive ,CD-ROM Drive(CD -ROM speeds).CD-R Drive, DVD ROM Drive, Tape Drive).

UNIT-II Computers Related Terminology

(Basic information only)

(b)Software: Introduction to programming, languages, System software (Operating systems and Utilities), Application software (word processors, DBMS, presentation Graphics, Browsers, personal information managers) Introduction to multilingual word processors.

(c)Communication and connectivity: Data communication System, Data transmission (Serial, Parallel, bandwidth, protocols), E-mail, Fax, Voice and Video messaging, Video conferencing, online services, user connection (types).networking of computers (node, client, server, lan, wan), Using the network, The Internet and the Web.

UNIT-III: OPERATING SYSTEM

(Working knowledge at Common user Level only)

Overview of important DOS commands, Window 98:installation Scandisk, control panel ,taskbar, Toolbar, Display, settings(Background wallpaper, Screensaver, Desktop themes).Files and Folder Management ,Window Explorer ,Finding files and folders,formatting disk and copying files printer setting Modem installation ,Mouse Installation ,Adding and Removing programs, Active Desktop concepts, WinZip and its Application ,Norton Antivirus and its use, use of calculator ,paintbrush, sin amp ,MPEG player and window help.

UNIT-IV: Application Software

(Working knowledge at Common user Level only)

(a)Word processing ,Software MS Word, Entering, Editing and formatting Text ,Document formats(Page Size and

orientation, Headers and footers ,Columns and Sections, Page layout),Spelling and grammar checkers, Thesaurus, Find

the replace, Cut and paste ,Tables and formatting tables, MailMerge, Styles and Templates.

(b)Spreadsheet Program-MS Excel

Entering Data, Labels, and values, Dates, Formulas, Cell References, Formats, Functions, Templates, Charts and Maps,

Analyzing data in a spreadsheet.

(c)DBMS Microsoft Access

Database ,Entering data in to database ,Creating Database tables, editing data ,Viewing Records, Sorting Records,

Querying a database, generating reports.

UNIT-V: The Internet and Online Resources

(Working knowledge at Common user Level only)

1.How the internet work, introduction to TCP/IP,IP and DNS address .Features of the Internet(E-mail, News, Telnet,

FTP, Chart Channel, WWW, Online Services, Bulletin Board services),Connecting to a PC to the Internet(Setting Dial

up and Internet Connection Wizard),Overviews of Internet Explorer 5 and Feature, Use of Search Engine ,Surfing

,Creating and Use of E-mail, Awareness about E-commerce and its Advantages.

Text Books:-

⬚ Fundamentals of Computers by Rajaraman V. PHI

⬚ Computer Fundamentals by P.K.Sinha Priti sinha.

⬚ Reference book

1. Computer Fundamentals (English) by Anita Goel, Pearson

2. Fundamental of information technology by Deepak Bharlhoks

3. Norton, Peter, "Introduction to Computers, Mc-Graw-Hill.

4. B. Ram, "Computer Fundamentals", New Age International Pvt. Ltd.

Thermal Physics and Statistical

Mechanics (BSPCM302)

Module -1   12 Hrs.

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy- temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Module -2   12 Hrs.

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.

Module -3   12 Hrs.

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Module -4   12 Hrs.

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. (6 Lectures)

Module -5   12 Hrs.

Statistical Mechanics: Phase space, Macro state and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W. Zemasky and R. Dittman, 1981, McGraw Hill.
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears &G.L.Salinger. 1988, Narosa
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

Chemical Bonding, Transition Metal & Coordination Chemistry

(BSPCM303)

Unit 1: The covalent bond and the structure of molecules (10 Lectures)

Valence bond approach, Concept of resonance in various organic and inorganic compounds, Hybridization and structure, equivalent and non-equivalent hybrid orbitals, Bent's rule and its applications, VSEPR model for predicting shapes of molecules and ions containing lone pairs, sigma and pi bonds.

Unit 2: Molecular Orbital Approach (10 Lectures)
LCAO method, symmetry and overlap for s-s ,s-p and p-p combinations, MO treatment ofhomonuclear diatomic molecules of 2_{nd} period (B_2, C_2 ,N_2, O_2 , F_2) and heteronuclear di-atomicmolecules (CO, NO) and their ions.

Intermolecular forces: (8 Lectures)
van der Waals forces, Hydrogen bonding and its applications, effects of these forces on elting point, boiling point and solubility.

Unit 3: Transition Elements (10 Lectures)
General group trends with special reference to electronic configuration, variable valency,colour, magnetic and catalytic properties, ability to form complexes and stability of variousoxidation states (Latimer diagrams) for Mn, Fe and Cu.Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magneticproperties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Unit 4: Coordination Chemistry and Inner Transition Metals (12 Lectures)
Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordinationnumbers 4 and 6.Drawbacks of VBT. IUPAC system of nomenclature.
Coordination compounds in biological systems: Fe, Cu, Co, Mn, Ni, Zn and heavy metal ions.
Inner-Transition Elements: Lanthanide and Actinide Series: General information, physical and chemical properties, uses.
Unit 5: Crystal Field Theory   (10 Lectures)

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitudeof D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonaldistortion of octahedral geometry.Jahn-Teller distortion, Square planar coordination.

Suggested Texts:
1. James E. Huheey, *"Inorganic Chemistry: Principles of structure and reactivity"*, Prentice Hall, IV Edition.
2. D. S. Shriver and P.A. Atkins, *"Inorganic Chemistry"*, Oxford University Press, IV Edition.
3. Alan G. Sharpe, ‒Inorganic Chemistry"*, University of Cambridge, III Edition.
4. J. D. Lee, *"A New Concise Inorganic Chemistry"*, ELBS IV Edition
5. Grey L. Miessler and Donald A. Tarr, *"Inorganic Chemistry"*, Prentice Hall, III Edition.
6. B. Douglas, D. H. McDaniel and J. J. Alexander, *"Concepts and Models of Inorganic Chemistry", John Wiley and Sons, III Edition.*
7. Rodgers, G.E. *Inorganic &Solid State Chemistry,* Cengage Learning India Ltd., 2008.

Chemical Bonding, Transition Metal & Coordination

Chemistry-Lab

(BSPCM307)

Titrimetric Analysis:
Preparations of standard solutions (concept of primary and secondary standards), Different units

of concentration (molarity, molality, normality and formality)

(A) Titrations involving Acids-Bases:

Principles of acid-base titrations, Principle behind selection of an appropriate indicator.
1. Standardization of NaOH solution (standard solution of oxalic acid to be prepared)
2. Determination of concentration of carbonate and hydroxide present in a mixture.
3. Determination of concentration of carbonate and bicarbonate present in a mixture.
4. Determination of concentration of free alkali present in soaps/detergents/shampoos.

(B) Titrations involving redox reactions:
Concept of electrode potential, principle behind selection of an appropriate indicator.
5. Standardization of $KMnO_4$ solution (standard solution of Mohr's salt to be prepared).
6. Determination of concentration of Fe(II) in Mohr's salt and/or $K_2Cr_2O_7$ using diphenylamine/

N-phenylanthranilic acid as internal indicator (standard solution of $K_2Cr_2O_7$ and /or Mohr's salt

to be prepared).
   8. Determination of iron content in ores / alloys using appropriate redox titration.

(C) Complexometric Titrations
Principles of complexometric titrations
8. Determination of concentration of Mg (II) & Zn (II) by titrimetric method using EDTA.
9. Determination of concentration of Ca/Mg in drugs or in food samples.
10. Determination of concentration of total hardness of a given sample of water by complexometric titration.
(At least 2 experiments from each set.)
Recommended Texts:
1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.
 2. Harris, D.C. *&* Freeman, W.H. & Co. *Quantitative Chemical Analysis 7th Ed.,* New York.

Real Analysis

(BSPCM304)

Module -I   **15 Hrs.**

Riemann integral, Inerrability of Continuous and monotonic functions fundamental theorem of integral calculus. Mean value theorems of integral calculus.

Partial derivation and differentiability of real-valued functions of two variables. Schwarz's, Young's theorem. Implicit function theorem.

Module -II   **15 Hrs.**

Improper integrals and their convergence, Comparison tests. Abel's and Dirichlet's tests. Frullani's integral. Integral as a function of a parameter. Continuity, derivability and inerrability of an integral function of a parameter.

Fourier series of half and full intervals.

Module -III   **15 Hrs.**

Complex numbers as ordered pairs. Geometric representation of complex numbers, Stereographic projection.

Continuity and differentiability of Complex functions. Analytic functions. Cauchy-Riemann equations. Harmonic functions.

Mobius transformations. Fixed points. Cross ratio. Inverse points and critic mappings. Conformal mappings.

Module -IV   **15 Hrs.**

Definition and examples and metric spaces. Neighborhoods. Limit points. Interior points. Open and closed sets. Closure and interior. Boundary points. Sub space of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem. Contraction principle.Real numbers as a complete ordered field. Dense subsets. Baire Category theorem. Separable, second countable and first countable spaces.

Module -V   **15 Hrs.**

Continuous functions. Extension theorem. Uniform continuity. Compactness, Sequential compactness. Totally bounded spaces. Finite intersection property. Continuous functions and compact sets. Connectedness.

Text Books & References:

1. H.K. Pathak, Analysis, Shiksha Sahitya Prakashan, Meerut.
2. Shanti Narayan, Elements of Real Analysis, S. Chand Publication., New Delhi.
3. Gabriel Klambauer, Mathematical Analysis, Marcel Dekker, Inc. New York, 1975.

P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis, S. Chand & Co. New Delhi, 2

Thermal Physics and Statistical Mechanics – Lab

(BSPCM306)

Note: Minimum 8 experiment to be performed.

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge.

Reference Books:

- Advanced Practical Physics for students, B.L.Flint&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.
- A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

Environmental Science
(BSPCM201)

Unit 1 : Introduction to Environmental Studies (6 Lecture)

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 2 : Natural Resources : Renewable and Non-•-renewable Resources (6 Lecture)

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over-•-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-•-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 3 : Biodiversity and Conservation (5 Lecture)

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-•-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man-•-wildlife conflicts, biological invasions; Conservation of biodiversity : In-•-situ and Ex-•-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 4 : Environmental Pollution (9 Lecture)

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 5 : Human Communities and the Environment   (4 Lecture)

- Human population growth: Impacts on environment, human health and welfare.

- Resettlement and rehabilitation of project affected persons; case studies.

- Disaster management : floods, earthquake, cyclones and landslides.

- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.

- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.

- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.

4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.

6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,* 339: 36-•-37.

7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29-•-64). Zed Books.

8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.

13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India. Tripathi 1992.*

14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.

15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.

16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.

17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.

20. World Commission on Environment and Development. 1987.*Our Common Future*. Oxford University Press.

ENVIRONMENTAL STUDIES

UNIT- I : The Multidisciplinary nature of environmental studies

⮚ Definition, scope and importance need for public awareness, Environmental knowledge of present day

context.

UNIT – II: Natural Resources

Renewable and non renewable resources:

Natural resources: Use and associated problems.

⮚ Forest resources : Use and over exploitation, deforestation studies .Timber extraction ,mining dams and their

effects on forest and tribal people

⮚ Water resources: Use and over utilization of surface and ground water floods drought, conflicts over water,

dams-benefits and problems.

⮚ Mineral resources: Use and exploitation environmental effects of extracting and using mineral resources, case

studies.

⮚ Food resources: World food problem change caused by agriculture and overgrazing effects of modern

agriculture fertilizer pesticide problem water logging salinity case studies.

⮚ Energy resources: Growing energy need renewable and non renewable energy source use of alternate energy

source case studies.

⮚ Land resources: Land as a resource land degradation man indeed land slides soil erosion and desertification.

Rule of an individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles. (12 hrs)

UNIT –III: Ecosystems

▫ Concept of an ecosystem.

▫ Structure and function of an ecosystem.

▫ Producers, consumers and decomposers.

▫ Energy flow in the ecosystem.

▫ Food chain, food webs and ecological pyramid.

▫ Introduction , types characteristic features, structure and function of the following ecosystem :

(1)Forest ecosystem, tropical , temperate and alpine ecosystem.

(2)Grassland ecosystem and Their types.

(3)Desert ecosystem with emphasis on Thar desert.

(4)Aquatic ecosystem (pond, streams, lakes oceans etc)

UNIT –IV: Biodiversity and its conservation

▫ Introduction : Definition : genetic species and ecosystem diversity

▫ Biogeographically classification of India

▫ Value of biodiversity: consumptive use productive use social, ethical esthetic and option values.

▫ Biodiversity at global, National and local level.

▫ India as a mega-diversity nation

▫ Hot –spot of biodiversity.

▫ Threats to biodiversity: habitat loss poaching of wildlife, man wildlife conflicts.

▫ Endangered and endemic species of India .

▫ Conservation of biodiversity: In –situ and Ex- situ conservation of biodiversity.

▫ Red data book.

UNIT –V Environmental Pollution

Definition

1 Causes, effects and control measures of:

(a)Air pollution (b) Water pollution

(c) Soil pollution (d) Marine pollution

(e)Noise pollution (f) Thermal pollution

(g)Nuclear hazards

2 Solid waste Management: Cause effects and control measures of urban and industrial wastes.

3 Roll of individual of prevention of pollution.

4 Pollution case studies.

5 Disaster management: floods earthquake cyclone and land slides

UNIT –VI: social issues and the environment

1 From unsustainable to Sustainable development

2 Urban problems related to energy

3 Water conservation rain water harvesting watershed management.

4 Resettlement and rehabilitation of people and concerns case studies.

5 Environmental ethics: Issue and possible solution.

6 Climate change global warming acid ozone layer depletion nuclear accidents and holocaust caste studies

7 Wasteland reclamation.

8 Consumerism and waste product.

9 Environmental protection laws in India.

10 Air (prevention and control of pollution)Act.

11 Wild life protection Act.

12 Forest conservation Act.

13 Biological diversity Act.

14 Issued involved of enforcement of environmental legislation.

15 Public awareness.

Unit VII: Human population and the environment

1 Population growth variations among nation.

2 Population explosion family welfare programme.

3 Environment and human health.

4 Human rights

5 Value Education.

6 HIV/AIDS

7 Women and Child welfare

8 Role of information technology in environment and human health.

9 Case studies

Unit VIII: Philosophy of sports

1 Define sports and physical education and classification of sports activities.

2 Sports as a way of life.

3 Development of social and moral values through sports.

4 Sports and personality development.

5 Team work and sports.

6 Physiological changes in body through sports participation.

7 Peace through sports in the world.

Reference Books:-

⬜ Chauhan, Surendra Singh.2001. Biodiversity and Biopolitics: The Global Perspectives, Kalinga Publications,

New Delhi.

⬜ Diwan A.P. and Arora D.K. 1995. Human Ecology Anmol Publication Pvt. Ltd. New Delhi.

⬜ Dubey, R.M. 1992. Human Ecology and Environmental Education, Chough Publications, Allahabad.

⬜ Goudie, Andrew. The Human Impact

⬜ Husain Maxia. 1994 Human Geography, Rawat Publication, Jaipur.

Computational Physics Skills

(BSPCM402)

Module -1   **6 Hrs.**

Introduction: Importance of computers in Physics, paradigm for solving physicsproblems for

solution. Usage of linux as an Editor. Algorithms and Flowcharts:Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Rootsof Quadratic Equation, Sum of two matrices, Sum and Product of a finite series,calculation of sin (x) as a series, algorithm for plotting (1) lissajous figures and (2)trajectory of a projectile thrown at an angle with the horizontal.

Module -2   **6 Hrs.**

Scientific Programming: Some fundamental Linux Commands (Internal and Externalcommands). Development of FORTRAN, Basic elements of FORTRAN: Character Set,Constants and their types, Variables and their types, Keywords, Variable Declarationand concept of instruction and program. Operators: Arithmetic, Relational, Logical

andAssignment Operators. Expressions: Arithmetic, Relational, Logical, Character andAssignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted),Executable and Non-Executable Statements, Layout of Fortran Program, Format ofwriting Program and concept of coding, Initialization and Replacement Logic. Examplesfrom physics problems.

Module -3   **6 Hrs.**

Control Statements: Types of Logic (Sequential, Selection, Repetition), BranchingStatements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE andELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO,Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays,DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines(Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN,CALL, COMMON and EQUIVALENCEStatements), Structure, Disk I/O Statements,open a file, writing in a file, reading from a file. Examples from physics problems.

Programming:

1. Exercises on syntax on usage of FORTRAN38
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using exp(x) series evaluated at x=1

Module -4 **6 Hrs.**

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor,preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX,Compiling LaTeX File, LaTeX tags for creating different environments, DefiningLaTeX commands and environments, Changing the type style, Symbols from otherlanguages. Equation representation: Formulae and equations, Figures and otherfloating bodies, Lining in columns- Tabbing and tabular environment, Generating tableof contents, bibliography and citation, Making an index and glossary, List makingenvironments, Fonts, Picture environment and colors, errors.

Module -5 **6 Hrs.**

Visualization: Introduction to graphical analysis and its limitations. Introduction toGnuplot. importance of visualization of computational and computational data, basicGnuplot commands: simple plots, plotting data from a file, saving and exporting,multiple data sets per file, physics with Gnuplot (equations, building functions, userdefined variables and functions), Understanding data with Gnuplot

Hands on exercises: **9 Hrs**

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.

7. Plotting trajectory of a projectile projected making an angle with the horizontally.

8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.

9. To find the roots of a quadratic equation.

10. Motion of a projectile using simulation and plot the output for visualization.

11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.

12. Motion of particle in a central force field and plot the output for visualization.

Reference Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 77‖. V. Rajaraman (Publisher:PHI).
- LaTeX–A Document Preparation System‖, Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999).
- A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
- Elementary Numerical Analysis, K.E. Atkinson, 3rdEdn., 2007, Wiley India Edition.

Basic Analytical Chemistry

(BSPCM401B)

Module –I   **6 Hrs.**

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements.

Presentation of experimental data and results, from the point of view of significantfigures.

Module -II   **6 Hrs.**

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

a. Determination of pH of soil samples.

b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.

b. Determination of dissolved oxygen (DO) of a water sample.

Module -III   **6 Hrs.**

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

b. Analysis of preservatives and colouring matter.

Module -IV   **6 Hrs.**

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).

b. To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Module -V **6 Hrs.**

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Practical:

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases.

b. To analyze arson accelerants.

c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.

b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in

Soft Drink.

Reference Books:

- Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA,1988.

- Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

- Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., SaunderCollege Publishing, Fort Worth (1992).

- Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.

- Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.

- Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.

- Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y.USA (1982).

- Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16(1977).

- Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.

- Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.

- Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc.,New York (1995).

Boolean Algebra

(BSPCM401C)

Module-I   **6 Hrs.**

Boolean algebra definition with examples. Properties of Boolean algebra. Sub algebra.

Module-II   **6 Hrs.**

Isomorphic Boolean Algebra, Boolean functions, Minimal forms of Boolean polynomials, Disjunctive and conjunctive normal forms. Principal of duality.

Module-III   **6 Hrs.**

Quinn-McCluskey method, Karnaugh diagrams, Design of switching circuits, Simplification o Boolean functions using K-map.

Module-IV   **6 Hrs.**

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements. Infimum and supremum.

Module-V   **6 Hrs.**

Lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices.

Text Books & References:

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Rudolf Lidl and Günter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

Waves and Optics

(BSPCM402)

Module -1   **12 Hrs.**

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 with equal an unequal frequency and their uses.

Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

Module -2   **12 Hrs.**

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 - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge – Detection of leakage.

Module -3   **12 Hrs.**

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

Module -4   **12 Hrs.**

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism.

Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes).

Newton's Rings: measurement of wavelength and refractive index.

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Module -5   **12 Hrs.**

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffractiongrating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

Reference Books:

- Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
- University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley

Molecules of Life

(BSPCM403)

Module-I

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.

(10 Lectures)

Module-II

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 (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

(12 Lectures)

Module-III

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 Non- competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure – activity relationships of drugmolecules, binding role of –OH group,-NH_2 group, double bond and aromatic ring,

(12 Lectures)

Module-IV 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.

(10 Lectures)
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).

(8 Lectures)

Module-V

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.

(8 Lectures)

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.

Molecules of Life-Lab

(BSPCM406P)

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.
9. Extraction of DNA from onion/ cauliflower
10. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Recommended Texts:

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
2. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,*Universities Press.

Abstract Algebra

(BSPCM404)

Module -I   **15 Hrs.**

Group-Automorphism, inner automorphism. Automorphism groups. Contumacy relation and centralizer. Normalize, Counting principle and the class equation of a finite group. Cauchy's theorem and Sylow's theorems for finite abelian groups and non-abelian groups.

Module -II   **15 Hrs.**

Ring theory-Ring homomorphism. Ideals and Quotient Rings. Field of Quotients of an Integral Domain. Euclidean Rings, Polynomial Rings, Polynomials over the Rational Field. Polynomial Rings over Commutative Rings. Unique factorization domain.

Module -III   **15 Hrs.**

Definition and examples of vector space. Sub space, Sum and direct sum of subspaces. Linear space. Linear dependence, independence and their basic properties. Basis Finite dimensional vector space. Existence theorem for bases, Invariance of the number of elements of a basis set. Dimension, Existence of complementary sub space of a sub space of a finite dimensional vector space. Dimension of sums of sub space, Quotient space and its dimension.

Module -IV   **15 Hrs.**

Linear transformations and their representation as matrices. The Algebra of linear transformations. The rank nullity theorem. Change of basis. Dual space, Bidual space and natural isomorphism. Adjoint of a linear transformation. Eigen values and eigenvectors of a linear transformation. Diagonalisation, Bilinear, Quadratic and Hermitical forms.

Module -V   **15 Hrs.**

Inner Product Spaces Cauchy-Schwarz inequality Orthogonal vectors. Orthogonal complements. Orthonormal sets and bases. Bessel's inequality for finite dimensional spaces. Gram-Schmidt Orthogonalization process.

Text Books & References:

1. H.K. Pathak, Abstract Algebra, Shiksha Sahitya Prakashan, Meerut.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2 Edition) Cambridge University Press, Indian Edition, 1997.
3. Shanti Narayan, A Text Book of Modern Abstract Algebra, S. Chand & Co. New Delhi.
4. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
5. D.S. Malik, J.N. Mordeson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw-Hill International Edition, 1997.

Waves and Optics – Lab

(BSPCM405P)

Note: Minimum 8 experiment to be performed.

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
3. To study Lissajous Figures
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using Mercury Light
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Basic Instrumentation Skills
(BSPCM501A)

Module -1   **6 Hrs.**

Basic of Measurement: Instrument's accuracy, precision, sensitivity, resolution rangeetc.Errors in measurements and loading effects. Multimeter: Principles of measurementof dc voltage and dc current, ac voltage, ac current and resistance. Specifications of amultimeter and their significance.

Electronic Voltmeter: Advantage over conventional multimeter for voltagemeasurement with respect to input impedance and sensitivity. Principles of voltage,measurement (block diagram only). Specifications of an electronic Voltmeter/Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters:Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter,specifications and their significance.

Module -2   **6 Hrs.**

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT,Electron gun, electrostatic focusing and acceleration (Explanation only– nomathematical treatment), brief discussion on screen phosphor, visual persistence &chemical composition. Time base operation, synchronization. Front panel controls.

Module -3   **6 Hrs.**

Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Specialfeatures of dual trace, introduction to digital oscilloscope, probes. Digital storage.

Oscilloscope: Block diagram and principle of working.

Signal Generators and Analysis Instruments: Block diagram, explanation andspecifications of low frequency signal generators. pulse generator, and functiongenerator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Module -4   **6 Hrs.**

Impedance Bridges & Q-Meters: Block diagram of bridge. working principles of basic(balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & workingprinciples of a Q- Meter. Digital LCR bridges.

Digital Instruments: Principle and working of digital meters. Comparison of analog &digital instruments. Characteristics of a digital meter. Working principles of digitalvoltmeter.

Module -5   **6 Hrs.**

Digital Multimeter: Block diagram and working of a digital multimeter. Workingprinciple of time interval, frequency and period measurement using universal counter/frequency counter, time- base stability, accuracy and resolution.

The test of lab skills will be of the following test items: **9 Hrs.**

1.   Use of an oscilloscope.
2.   CRO as a versatile measuring device.
3.   Circuit tracing of Laboratory electronic equipment,
4.   Use of Digital multimeter/VTVM for measuring voltages
5.   Circuit tracing of Laboratory electronic equipment,
6.   Winding a coil / transformer.
7.   Study the layout of receiver circuit.
8.   Trouble shooting a circuit
9.   Balancing of bridges

Laboratory Exercises: **9 Hrs.**

1.   To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2.   To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3.   To measure Q of a coil and its dependence on frequency, using a Q- meter.
4.   Measurement of voltage, frequency, time period and phase angle using CRO.

5. Measurement of time period, frequency, average period using universal counter/frequency counter.

6. Measurement of rise, fall and delay times using a CRO.

7. Measurement of distortion of a RF signal generator using distortion factor meter.

8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments: **2 Hrs.**

1. Using a Dual Trace Oscilloscope

2. Converting the range of a given measuring instrument (voltmeter, ammeter)

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.

<p align="center">**Intellectual Property Rights (IPR)**</p>

<p align="center">**(BSPCM501B)**</p>

Course Objectives

- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, Copyrights, Trademarks and registration aspects in India and abroad
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
- To create awareness of protecting the scientificdiscoveries, with commercial potential and enforcement of intellectual property rights.
- The purpose of this course is to apprise the students about the multifaceteddimensions of this issue and current trends in IPR and Govt. steps in fostering IPR

Module I

Introduction to Intellectual Property:

Historical Perspective, Different Types of IP, Importance of protecting IP.

Copyrights

Introduction, How to obtain, Differences from Patents.

Trade Marks

Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc.Differences from Designs.

Module II
Patents

Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

Geographical Indications

Definition, rules for registration, prevention of illegal exploitation, importance to India.

Module III
Industrial Designs

Definition, How to obtain, features, International design registration.

Layout design of integrated circuits Circuit Boards

Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade, Integrated Chips for industries **Trade Secrets**

 Secret Protection.

Module IV

Different International agreements

(a) Word Trade Organization (WTO):
(i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement
(ii) General Agreement on Trade related Services (GATS)
(iii) Madrid Protocol
(iv) Berne Convention

(v) Budapest Treaty

(b) Paris Convention
WIPO and **TRIPS, IPR** and Plant Breeders Rights, IPR and Biodiversity

Module V

IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

Reference Books:

- N.K. Acharya: *Textbook on intellectual property rights*, Asia Law House (2001).
- Manjula Guru & M.B. Rao, *Understanding Trips: Managing Knowledge in Developing Countries*, Sage Publications (2003).
- P. Ganguli, Intellectual Property Rights: *Unleashing the Knowledge Economy,* Tata McGraw-Hill (2001).

- Arthur Raphael Miller, MichealH.Davis; *Intellectual Property: Patents, Trademarks and Copyright in a Nutshell,* West Group Publishers (2000).
- JayashreeWatal, *Intellectual property rights in the WTO and developing countries,* Oxford University Press, Oxford.

Course Outcomes:

- The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works
- During their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations
- Pave the way for the students to understand the role of Intellectual Property(IP) in a. R&D b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

Graph Theory
(BSPCM501C)

Module-I   **6 Hrs.**

Definition, examples and basic properties of graphs, Regular graphs, pseudographs, complete graphs, bi- partite graphs, isomorphism of graphs. Homeomorphic graphs.

Module-II   **6 Hrs.**

Walk, Paths and circuits, Eulerian circuit and Euler graph, Hamiltonian path and circuits.

Module-III   **6 Hrs.**

Matrix representation of graphs, weighted graph, travelling salesman's problem, Operations on graphs.

Module-IV   **6 Hrs.**

Shortest path, Dijkstra's algorithm, Floyd- Warshall algorithm.Graph colouring.

Module-V   **6 Hrs.**

General tree, directed tree, ordered Tree, rooted tree, binary tree, complete binary tree, full binary tree, traversing binary tree.

Text Books & References:

1.   Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.

2.   Rudolf Lidl and Günter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

Elective -I Physics- Solid State Physics

(BSPCM502A)

Module -1   **12 Hrs.**

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

Module -2   **12 Hrs.**

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T3 law

Module -3   **12 Hrs.**

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

Module -4   **12 Hrs.**

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons.

Module -5   **12 Hrs.**

Elementary band theory: Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.

2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.

4. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning.

5. Solid State Physics, Rita John, 2014, McGraw Hill.

6. Solid-state Physics, H. Ibach and H Luth, 2009, Springer.

7. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India.

8. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.

Elective-I Physics-Quantum Mechanics

(BSPCM502B)

Module -1   **12 Hrs.**

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

Module -2   **12 Hrs.**

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wave packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.

Module -3   **12 Hrs.**

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method.

Module -4   **12 Hrs.**

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d. shells (idea only).

Module -5   **12 Hrs.**

Atoms in Electric and Magnetic Fields: 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. 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. Spin-orbit coupling in atoms-L-S and J-J couplings.

Reference Books:

- A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Ed., 2010, McGraw Hill.
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rd Ed. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press Additional Books for Reference.
- Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
- Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education.
- Quantum Mechanics, Walter Greiner, 4thEdn., 2001, Springer.

Module –I   **12 Hrs.**

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization.Bi-functional systems, Poly-functional systems.

Module –II   **12 Hrs.**

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerizationtechniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers-Structure Property relationships.

Determination of molecular weight of polymers (Mn, Mw, etc) by end groupanalysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.Polydispersity index.

Module –III   **12 Hrs.**

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Module- IV   **12 Hrs.**

Nature and structure of polymers-Structure Property relationships.

Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.Polydispersity index.

Glass transition temperature (Tg) and determination of Tg, Free volume theory,WLF equation, Factors affecting glass transition temperature (Tg).

Module –V   **12 Hrs.**

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper criticalsolution temperatures.

Properties of Polymers (Physical, thermal, flow & mechanical properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyderesins (Bakelite, Novalac), polyurethanes, siliconepolymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphidepolypyrrole,polythiophene)].

TEXT AND REFERENCE BOOKS

1. Seymour, R.B. &Carraher, C.E. Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981.
2. Odian, G. Principles of Polymerization, 4th Ed. Wiley, 2004.
3. Billmeyer, F.W. Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971.
4. Ghosh, P. Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. Lenz, R.W. Organic Chemistry of Synthetic High Polymers. IntersciencePublishers, New York, 1967.

Elective-I Chemistry

Analytical Methods in Chemistry

(BSPCM503B)

Qualitative and quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. **(5 Lectures)**

Optical methods of analysis:

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. *UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beaminstrument; *Basic principles of quantitative analysis:* estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. *Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope

substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniquesof atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples. **Thermal methods of analysis:** Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

(5 Lectures)
Electroanalytical methods:

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.

Techniques used for the determination of pK_a values.

(10 Lectures)
Separation techniques:

Solvent extraction: Classification, principle and efficiency of the technique.
Mechanism of extraction: extraction by solvation and chelation.

Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.Chromatography: Classification, principle and efficiency of the technique.

Mechanism of separation: adsorption, partition & ion exchange.
Development of chromatograms: frontal, elution and displacement
methods.

Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation ofEnantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).

Role of computers in instrumental methods of analysis.

(15 Lectures)
Reference Books:

• Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.

• Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988. Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.

• Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
• Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
• Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
• Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
• Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Module-V   **12 Hrs.**

Catalysis:

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications,Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts.

Chemical explosives:

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books:

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

2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.

3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,*Wiley Publishers, New Delhi.

4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, NewDelhi.

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

6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.

7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

Elective-I Mathematics- Advanced Calculus

(BSPCM504B)

Module -I   15 Hrs.

Definition of a sequence. Theorems on limits of sequences. Bounded and monotonic sequence. Cauchy's convergence criterion. Series of non-negative terms. Comparison tests. Cauchy's integral tests. Ratio tests, Raabe's, logarithmic, de Morgan and Bertrand's tests. (Without proofs) Alternating series, Leibnitz's theorem. Absolute and conditional convergence.

Module -II   15 Hrs.

Continuity of single variables Sequential continuity. Properties of continuous functions. Uniform continuity. Chain rule of differentiability. Mean value theorems and their geometrical interpretations. Darboux's intermediate values theorem for derivatives.

Module -III   15 Hrs.

Limit and continuity of functions of two variables. Partial differentiation. Change of variables. Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables Jacobeans.

Module -IV   15 Hrs.

Envelopes, Evolutes, Maxima, Minima and saddle point of functions of two variables. Lagrange multiplier method. Indeterminate forms.

Module -V   15 Hrs.

Beta and Gamma functions. Double and triple integrals. Dirichlet's integrals, change of order of integration in double integrals.

Text Books & References:

1.   H.K. Pathak, Advanced Calculus, Shiksha Sahitya Prakashan, Meerut.
2.   Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
3.   Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd., Allahabad.
4.   Murray R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing Co., New York.
5.   B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, New Delhi.

Elective-I Mathematics-Logic and Set

(BSPCM504C)

Module -V **15**

Hrs.

Set Theory: Introduction, Size of sets and Cardinals, Venn diagrams, Combination of sets, Multisets, ordered pairs and Set Identities.

Relation: Definition, Operations on relations, Composite relations, Properties of relations, Equality of relations, Equivalence relations, Partial order relation.

Functions: Definition, Classification of functions, Operations on functions, recursively defined functions.

Module -II 15 Hrs.

Posets and Lattices: Introduction, Partial ordered sets, Combination of Partial ordered sets, Hasse diagram, Maximal and minimal element, Upper bounds, Lower bounds, least upper bounds, Greatest lower bounds, Introduction of lattices, Properties of lattices – Bounded, Complemented, Modular and Complete lattice.

Module -III **15**
Hrs.Propositional: Propositions, Truth tables, Tautology, Contradiction, Algebra of Propositions, Theory of Inference and Natural Detection.

Predicate Logic: Theory of Predicates, First order predicate, Predicate formulas, Quantifiers, Inference theory of predicate logic.

Module -IV **15**
Hrs.

Number theory: Primes, divisibility, greatest common divisor, Euclidean algorithm, Fundamental Theorem of Arithmetic, Congruences, Chinese remainder theorem, divisibility tests, Fermat's Little Theorem, Euler ϕ function and other multiplicative functions (e.g., the σ and μ functions), Euler's Theorem.

Natural Numbers: Introduction, Piano's axioms, Mathematical Induction, Strong Induction and Induction with Nonzero Base cases.

Module -V **15**
Hrs.

Recurrence Relation & Generating functions: Introduction and properties of Generating Functions. Simple Recurrence relation with constant coefficients and Linear recurrence relation

without constant coefficients. Methods of solving recurrences.

Combinatorics: Introduction, Counting techniques and Pigeonhole principle, Polya"s Counting theorem.

Text Books & References:

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw Hill, 2006
2. Swapankumar Sarkar, "A Textbook of Discrete Mathematics‖, S. Chand & Company PVT. LTD.V
3. B. Kolman, R.C Busby and S.C Ross, "Discrete Mathematics Structures", Prentice Hall ,2004.
4. Liptschutz, Seymour, "Discrete Mathematics", McGraw Hill.
5. Kenneth H. Rosen, Elementary Number Theory and Its Applications, 6th edition, McGraw Hill
6. Y.N. Singh, "Discrete Mathematical Structures", Wiley- India, First edition, 2010
7. Krishnamurthy, "Combinatorics Theory & Application", East-West Press Pvt. Ltd., New Delhi.
8. J.P. Trembley&R.Manohar, "Discrete Mathematical Structure with application to Computer Science", McGraw Hill

Elective-I Physics

Quantum Mechanics Lab

(BSPCM505P(B))

Note: All experiments are mandatory.

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like:

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$$\frac{d^2y}{dt^2} = A(r)u(r), A(r) = \frac{2m}{\hbar}[V(r) - E] \text{ where } V(r) = -\frac{e^2}{r}$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is $\approx -13.6\ eV$. Take $e = 3.795\ (eV\text{Å})^{\frac{1}{2}}, \hbar c = 1973\ (eV\text{Å})$ and $m = 0.511 \times 10^6 eV/c^2$.

2. Solve the s-wave radial Schrodinger equation for an atom:

$$\frac{d^2y}{dt^2} = A(r)u(r), A(r) = \frac{2m}{\hbar}[V(r) - E]$$

Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = -\frac{e^2}{r}e^{-r/a}$$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take $e = 3.795\ (eV\text{Å})^{1/2}$, $m = 0.511x10^6 eV/c^2$, and $a = 3$ Å, 5 Å, 7 Å. In these units $\hbar c = 1973\ (eV\text{Å})$. The ground state energy is expected to be above $-12\ eV$ in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$\frac{d^2y}{dt^2} = A(r)u(r), A(r) = \frac{2m}{\hbar}[V(r) - E]$$

For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$$

for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $m = 940\ MeV/c^2, k = 100\ MeV\ fm^{-2}, b = 0, 10, 30\ MeV\ fm^{-3}$ In these units,

$\hbar c = 197.3\ MeV\ fm$. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$$\frac{d^2y}{dt^2} = A(r)u(r), A(r) = \frac{2m}{\hbar}[V(r) - E]$$

where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D(e^{-2ar'} - e^{-ar'}), r' = \frac{(r - r_0)}{r}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: $m = 940 \times 10^6 eV/c^2$, $D = 0.755501\ eV, \alpha = 1.44, r_o = 0.131349\ Å$.

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.

6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting

7. To study the quantum tunnelling effect with solid state device, e.g., tunnelling current in backward diode or tunnel diode.

Reference Books:

- Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw- Hill Publications.
- Numerical Recipes in C: The Art of Scientific Computing, W.H.Press et al., 3rdEdn., 2007, Cambridge University Press.
- Elementary Numerical Analysis, K.E.Atkinson, 3rd Ed. , 2007 , Wiley India Edition.
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Ed., Cambridge University Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernández.2014 Springer ISBN: 978-3319067896
- Scilab by example: M. Affouf2012ISBN: 978-1479203444
- Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company, New Delhi ISBN: 978-8121939706
- Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978-6133459274A
- Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

Elective-I Chemistry

Polymer Chemistry Lab

(BSPCM506P(A))

1. **Polymer synthesis**

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate(MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
a. Purification of monomer
b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile(AIBN)
2. Preparation of nylon 66/6
1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
a. Preparation of IPC
b. Purification of IPC
c. Interfacial polymerization
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
(a) Polyacrylamide-aq.$NaNO_2$ solution
(b) (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of –head-to-head‖ monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis
*at least 7 experiments to be carried out.

Reference Books:

• M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
• H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*,3rd ed. Prentice-Hall (2003)
• F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984)
• J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003)
• P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nded. John Wiley &

Sons (2002)
- L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005)
- M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher,
- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

<center>Elective-I Chemistry</center>

<center>**ANALYTICAL METHODS IN CHEMISTRY-Lab**</center>

<center>(BSPCM506P(B))</center>

I. Separation Techniques
1. Chromatography:
(a) Separation of mixtures
(i) Paper chromatographic separation of Fe_{3+}, Al_{3+}, and Cr_{3+}.
(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.
(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.
(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC
II. Solvent Extractions:
(i) To separate a mixture of Ni_{2+}
& Fe_{2+}
by complexation with DMG and extracting the Ni_{2+}-

DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.
3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.
5. Analysis of soil:
(i) Determination of pH of soil.
(ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate
6. Ion exchange:
(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
(ii) Separation of metal ions from their binary mixture.
(iii) Separation of amino acids from organic acids by ion exchange chromatography.
III Spectrophotometry

1. Determination of pK_a values of indicator using spectrophotometry.
2 Structural characterization of compounds by infrared spectroscopy.3 Determination of dissolved oxygen in water.

4 Determination of chemical oxygen demand (COD).
5 Determination of Biological oxygen demand (BOD).

6 Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex byJob's method.

Reference Books:

• Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
• Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of*

Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

• Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

• Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.

• Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

• Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*

Cengage Learning India Ed.

- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
  - Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

Elective-I Chemistry

Inorganic Materials of Industrial Importance Lab

(BSPCM506P(C))

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of calcium in calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Reference Books:

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

• R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.

• W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.

• J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.

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

• R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.

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

Fuel and Pesticide Chemistry

(BSPCM601B)

Unit-I

Fuel Chemistry

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Unit-II

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Unit-III
Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Modern Fuel

Unit-IV

Pesticide Chemistry

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Reference Book:

•Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).

• Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi.

• Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York, 1978.

Integral Calculus

(BSPCM601C)

Module-I   **6 Hrs.**

Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals.

Module-II   **6 Hrs.**

Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

Module-III   **6Hrs.**

Integral as the limit of a sum, Length of curves, Areas of cartesian curves,

Module-IV   **6Hrs.**

Volumes of revolution, surface areas of revolutions

Module-V   **6Hrs.**

Double and Triple integrals.

Text Books & References:

1.   G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.

2.   H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd., 2002.

Elective-II Physics

Digital, Analog and Instrumentation

(BSPCM602A)

Module -1 Digital Circuits **12 Hrs.**

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

Module -2 **12 Hrs.**

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Binary Addition. Binary Subtraction using 2's Complement Method). Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.

Module -3 Semiconductor Devices and Amplifiers **12 Hrs.**

Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell.

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit.

Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Class A, B, and C Amplifiers.

Module -4 Operational Amplifiers (Black Box approach) **12 Hrs.**

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non- inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.

Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations. Determination of Frequency of RC Oscillator

Module -5 Instrumentations **12 Hrs.**

Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.

Timer IC: IC 555 Pin diagram and its application as Astable & Monostable Multivibrator.

Reference Books:

- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
- Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.
- Modern Electronic Instrumentation & Measurement Tech., Helfrick&Cooper,1990, PHI Learning.
- Digital Principles & Applications, A.P. Malvino, D.P. Leach & Saha, 7th Ed.,2011, Tata McGraw Hill.
- Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
- Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
- OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

Elective-II Physics

Digital, Analog and Instrumentation-**Lab**

(BSPCM605P(A))

Note: Minimum 8 experiment to be performed.

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To minimize a given logic circuit.
4. Half adder, Full adder and 4-bit Binary Adder.19
5. Adder-Subtractor using Full Adder I.C.
6. To design an astable multivibrator of given specifications using 555 Timer.
7. To design a monostable multivibrator of given specifications using 555 Timer.
8. To study IV characteristics of PN diode, Zener and Light emitting diode
9. To study the characteristics of a Transistor in CE configuration.
10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
13. To study a precision Differential Amplifier of given I/O specification using Op-amp.
14. To investigate the use of an op-amp as a Differentiator
15. To design a Wien Bridge Oscillator using an op-amp.

Reference Books:

- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

Elective-II Physics

Elements of Modern Physics

(BSPCM602B)

Module -1   **12 Hrs.**

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson Germer experiment.

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

Module -2   **12 Hrs.**

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Module -3   **12 Hrs.**

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

Module -4   **12 Hrs.**

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

Module -5   **12 Hrs.**

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

Reference Books:

- Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
- Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A. Dubson,2009, PHI Learning
- Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
- Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
- Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning
- Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

Elective-II Physics

Elements of Modern Physics-Lab

(BSPCM605P(B))

Note: Minimum 8 experiment to be performed.

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
9. To determine the value of e/m by magnetic focusing.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books:

- Advanced Practical Physics for students, B.L. Flint & 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.

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

(BSPCM603A)

Unit-I

Introduction to spectroscopic methods of analysis:

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methodsand the types of instrumental methods. Consideration of electromagnetic radiation.

Unit-II

Molecular spectroscopy:

Infrared spectroscopy:

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

Unit-III

Separation techniques

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. *mmunoassays and DNA techniques*

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

Unit-IV

Elemental analysis:

Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

Unit-V

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications.

Electroanalytical Methods: **P**otentiometry & Voltammetry

Radiochemical Methods

X-ray analysis and electron spectroscopy (surface analysis)

Reference books:

□ Skoog, D.A. Holler F.J. & Nieman, T.A.*Principles of Instrumental Analysis*, Cengage Learning India Ed.
□ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A.*Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
□ P.W. Atkins: Physical Chemistry.
□ G.W. Castellan: Physical Chemistry.
□ C.N. Banwell: Fundamentals of Molecular Spectroscopy.
□ Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
□ W.J. Moore: Physical Chemistry.

Elective-II Chemistry

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS-Lab

(BSPCM606A)

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC
12. Potentiometric Titration of a Chloride-Iodide Mixture
13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do ‒presumptive tests‖ to identify blood or other body fluids.
16. Use of ‒presumptive tests‖ for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

At least 10 experiments to be performed.

Reference Books:

• Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
• Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

Elective-II Chemistry

Noval Inorganic Solids

BSPCM603B

Unit-I

Synthesis and modification of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalationmethods.

Inorganic solids of technological importance: Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals.

Unit-II
Nanomaterials:
Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites.

Unit-III
Introduction to engineering materials for mechanical construction: Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.

Composite materials: Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.

Unit-IV
Speciality polymers: Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.

Unit-V
Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.**Inorganic Chemicals:** Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt,borax,

bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

ReferenceBooks:

• Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, 32 Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)

• Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.

• Poole, C.P. & Owens, F.J. Introduction to Nanotechnology John Wiley & Sons, 2003.

• Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

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

• R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.

• J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

• S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.

• K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.

• S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.
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• S.E. Manahan, Environmental Chemistry, CRC Press (2005).

• G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).

• A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

Noval Inorganic Solids-Lab

BSPCM606

1. Determination of cation exchange method
2. Determination of total difference of solids.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of silver and gold metal nanoparticles.
5. Determination of dissolved oxygen in water.
6. Determination of Chemical Oxygen Demand (COD).
7. Determination of Biological Oxygen Demand (BOD)
8. Percentage of available chlorine in bleaching powder.
9. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
10. Estimation of total alkalinity of water samples (CO32-, HCO3-) using double titration method.
11. Measurement of dissolved CO2.

Preparation of borax/ boric acid.

Reference Books:

- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

(18 Lectures)

Reference Books:

- James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity,* Pearson Publication.
- G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry,* Pearson Publication.
- J.D. Lee: *A New Concise Inorganic Chemistry,* E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.
- I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S.
- John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds,* Prentice Hall.
- R.M. Silverstein, G.C. Bassler & T.C. Morrill*: Spectroscopic Identification of OrganicCompounds*, John Wiley & Sons.
- R.T. Morrison & R.N. Boyd: *Organic Chemistry,* Prentice Hall.
- Peter Sykes: *A Guide Book to Mechanism* in *Organic Chemistry,* Orient Longman.
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand.

Elective-II Mathematics
Vector Calculus
(BSPCM604A)

Module -I   **15 Hrs.**

Scalar and vector product of three vectors. Product of four vectors. Reciprocal vectors. Vector differentiation. Gradient, divergence and curl.

Module -II   **15 Hrs.**

Vector integration. Theorems of Gauss. Green. Stokes and problems based on these.

Module -IIII   **15 Hrs.**

General equation of second degree. Tracing of conics. System of conics. confocal Conics. polar equation of a conic.

Module -IV   **15 Hrs.**

Equation of cone with given base. Generators of cone, condition for three Mutually for three mutually perpendicular generators. Right circular cone. Equation of cylinder and its properties.

Module -V   **15 Hrs.**

Central Conicoids. Paraboloids. Plane sections of Concord. Generation lines. Confocal Conicoids.

Text Books& References:

1.   H.K. Pathak, Vector Analysis and Geometry, Shiksha Sahitya Prakashan, Meerut.
2.   Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Co., New Delhi.
3.   Gorakh Prasad and H.C. Gupta, Text Book on Coordinate Geometry, Pothishala Pvt. Ltd., Allahabad.
4.   N. Saran and S.N. Nigam, Introduction to vector Analysis, Pothishala Pvt. Ltd. Allahabad
5.   R.J.T. Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan India Ltd. 1994.
6.   P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of two Dimensions, Wiley Eastern Ltd., 1994.
7.   P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of three Dimensions, Wiley Eastern Ltd., 1999.

8.   N. Saran and R.S. Gupta, Analytical Geometry of three Dimensions, Pothishala Pvt. Ltd. Allahabad.

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Elective-II Mathematics
Probability and Statistics

(BSPCM604B)

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Module -I   12 Hrs.

Frequency distribution- Measures of central tendency, mean, median, mode, G.M., H.M., partition values, measures of dispersion- range, inter quartile range, mean deviation, standard deviation, moments, skewness and kurtosis.

Module -II 12 Hrs.

Probability- Event, sample space, probability of an event, addition and multiplication theorems, Baye's theorem, continuous probability-probability density function and its applications for finding the mean, mode, median and standard deviation of various continuous probability distributions. Mathematical expectation, expectation of sum and product of random variables, moment generating function.

Module -III   12 Hrs.

Theoretical distribution- Binomial, Poisson, normal, rectangular and exponential distributions, their properties and uses.

Module -IV   12 Hrs.

Methods of least squares, curvefitting, correlation and regression, partial and multiple correlations (up to three variables only).

Module -V   12 Hrs.

Sampling - Sampling of large samples, Null and alternative hypothesis, Errors of first and secondkinds,level of significance. critical region, tests of significance, Chi- square test, t-test, F-test.

Text Books &References:

1.   S.P. Gupta, Business Statistics, Sultan Chand & Sons, New Delhi.
2.   Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
3.   Spiegel, Probability and Statistics, McGraw Hill.
4.   B.S. Grewal, Higher Engineering Mathematics, Khanna Publication, New Delhi