Kalinga University Atal Nagar (C.G.)

SCHEME OF EXAMINATION
&
SYLLABUS
Of

B.Sc. (PCM)

UNDER

Faculty of Science

w.e.f. Session 2021-22

B.Sc. (PCM)					
First Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
	(Choose Any One) 101A/101B	2	15	35	50
BPCM101A	English				
BPCM101B	NCC				
BPCM102	Mechanics and Oscillations	4	30	70	100
BPCM103	Conceptual Organic Chemistry	4	30	70	100
BPCM104	Calculus	4	30	70	100
BPCM105-P	Mechanics and Oscillations –Lab	2	20	30	50
BPCM106-P	Conceptual Organic Chemistry-Lab	2	20	30	50
		18	**145**	**305**	**450**

B.Sc. (PCM)					
Second Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
	(Choose Any One) 201A/201B	2	15	35	50
BPCM201A	Environmental Science				
BPCM201B	NCC				
BPCM202	Electricity, Magnetism and EMT	4	30	70	100
BPCM203	Physical Chemistry for the Sciences	4	30	70	100
BPCM204	Differential Equations	4	30	70	100
BPCM205-P	Electricity, Magnetism and EMT–Lab	2	20	30	50
BPCM206-P	Physical Chemistry for the Sciences-Lab	2	20	30	50
		18	**145**	**305**	**450**

B.Sc. (PCM)					
Third Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BPCM301	Fundamental of IT	3	30	70	100
BPCM302	Thermal Physics and Statistical Mechanics	4	30	70	100
BPCM303	Chemical Bonding, Transition Metal & Coordination Chemistry	4	30	70	100
BPCM304	Real Analysis	4	30	70	100
BPCM305-P	Fundamental of IT-Lab	1	20	30	50
BPCM306-P	Thermal Physics and Statistical Mechanics - Lab	2	20	30	50
BPCM307-P	Chemical Bonding, Transition Metal & Coordination Chemistry-Lab	2	20	30	50
		20	**180**	**370**	**550**

B.Sc. (PCM)					
Fourth Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
	SEC-II (Choose Any One)	4	30	70	100
BPCM401A	Computational Physics Skills				
BPCM401B	Basic Analytical Chemistry				
BPCM401C	Boolean Algebra				
BPCM402	Waves and Optics	4	30	70	100
BPCM403	Molecules of Life	4	30	70	100
BPCM404	Abstract Algebra	4	30	70	100
BPCM405-P	Waves and Optics - Lab	2	20	30	50
BPCM406-P	Molecules of Life-Lab	2	20	30	50
		20	**160**	**340**	**500**

B.Sc. (PCM)					
Fifth Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
	SEC-III (Choose Any One)	4	30	70	100
BPCM501A	Basic Instrumentation Skills				
BPCM501B	Intellectual Property Rights (IPR)				
BPCM501C	Graph Theory				
	Elective-I Physics (Any One)	4	30	70	100
BPCM502A	Solid State Physics				
BPCM502B	Quantum Mechanics				
BPCM502C	Nuclear and Particle Physics				
	Elective-I Chemistry (Any One)	4	30	70	100
BPCM503A	Polymer Chemistry				
BPCM503B	Analytical Methods in Chemistry				
BPCM503C	Inorganic Materials of Industrial Importance				
	Elective-I Mathematics (Any One)	4	30	70	100
BPCM504A	Linear Programming				
BPCM504B	Advanced Calculus				
BPCM504C	Logic and Set				
	Practical-I Elective Physics (Any One)	2	20	30	50
BPCM505P(A)	Solid State Physics-Lab				
BPCM505P(B)	Quantum Mechanics-Lab				
BPCM505P(C)	Nuclear and Particle Physics-Lab				
	Practical-I Elective Chemistry (Any One)	2	20	30	50
BPCM506P(A)	Polymer Chemistry-Lab				
BPCM506P(B)	Analytical Methods in Chemistry-Lab				
BPCM506P(C)	Inorganic Materials of Industrial Importance-Lab				
		20	**160**	**340**	**500**

B.Sc. (PCM)					
Sixth Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
	SEC-IV (Choose Any One)	4	30	70	100
BPCM601A	Renewable Energy and Energy harvesting				
BPCM601B	Fuel and Pesticide Chemistry				
BPCM601C	Integral Calculus				
	Elective-II Physics (Any One)	4	30	70	100
BPCM602A	Digital, Analog and Instrumentation				
BPCM602B	Elements of Modern Physics				
BPCM602C	Embedded System: Introduction to Microcontroller				
	Elective-II Chemistry (Any One)	4	30	70	100
BPCM603A	Instrumental Methods of Analysis				
BPCM603B	Novel Inorganic Solids				
BPCM603C	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy				
	Elective-II Mathematics (Any One)	4	30	70	100
BPCM604A	Vector Calculus				
BPCM604B	Probability and Statistics				
BPCM604C	Network Analysis and Decisions Theory				
	Practical-II Elective Physics (Any One)	2	20	30	50
BPCM605P(A)	Digital, Analog and Instrumentation-Lab				
BPCM605P(B)	Elements of Modern Physics Lab				
BPCM605P(C)	Embedded System: Introduction to Microcontroller Lab				
	Practical-II Elective Chemistry (Any One)	2	20	30	50
BPCM606P(A)	Instrumental Methods of Analysis -Lab				
BPCM606P(B)	Novel Inorganic Solids -Lab				
BPCM606P(C)	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy-**Lab**				
BPCM607P	Project/Dissertation	4	30	70	100
		24	**190**	**410**	**600**

English

(BPCM101A)

Course Objective

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

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

(BPCM102)

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. 2^{nd} 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

(BPCM103)

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 in terms 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 of E1
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

(BPCM106P)

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.

Calculus

(BPCM104)

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

(BPCM105P)

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.

Environmental Science
(BPCM201A)

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.

Electricity, Magnetism and Electromagnetic Theory

(BPCM202)

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, uniformly charged 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

(BPCM203)

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

(BPCM206P)

(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

(BPCM204)

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

(BPCM205P)

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. BPCM301	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. BPCM305P	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	No s. of Hours
	MS-WORD 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	**30**

Thermal Physics and Statistical Mechanics

(BPCM302)

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

(BPCM303)

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 2nd 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 coordinationumbers 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

(BPCM307P)

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

(BPCM304)

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

(BPCM306P)

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

Computational Physics Skills

(BPCM401A)

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 EQUIVALENCE Statements), 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, 3rd Edn., 2007, Wiley India Edition.

Basic Analytical Chemistry

(BPCM401B)

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 significant figures.

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 (Fe3+ and Al3+).

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

(BPCM401C)

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

(BPCM402)

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 & Diffraction grating. 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

(BPCM403)

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

(BPCM406P)

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

(BPCM404)

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

(BPCM405P)

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

(BPCM501A)

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.

Intellectual Property Rights (IPR)

(BPCM501B)

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

(BPCM501C)

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

(BPCM502A)

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

(BPCM502B)

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.

Elective-I Physics-Nuclear and Particle Physics

(BPCM502C)

Module -1 **12 Hrs.**

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Module -2 **12 Hrs.**

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

Module -3 **12 Hrs.**

Radioactivity decay:(a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: energy kinematics for β -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.

Module -4 **12 Hrs.**

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation, Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si & Ge) for charge particle and photon detection (concept of charge carrier and mobility).

Module -5 **12 Hrs.**

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

Particle physics: Particle interactions; basic features, types of particles and its families.

Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Reference Books:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons.
5. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi.
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
7. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
8. Theoretical Nuclear Physics, J.M. Blatt & V.F. Weisskopf (Dover Pub.Inc., 1991).

Elective-I Chemistry-Polymer Chemistry

(BPCM503A)

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, silicone polymers, 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. InterscicencePublishers, New York, 1967.

Elective-I Chemistry

Analytical Methods in Chemistry

(BPCM503B)

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 beam instrument; *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. Techniques of 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 of Enantiomeric 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.

Elective-I Chemistry-Inorganic Materials of Industrial Importance

(BPCM503C)

Module-I **12 Hrs.**

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses).Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre. *Cements:* Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Module-II **12 Hrs.**

Fertilizers:

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oilpaints, additives, Metallic coatings (electrolytic and electroless), metal spraying andanodizing.

Module-III **12 Hrs.**

Batteries:

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Module-IV **12 Hrs.**

Alloys:

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-Linear Programming

(BPCM504A)

Module -I **15 Hrs.**

Basics of Operational Research: Origin & Development of Operational Research, Definition and Meaning of Operational Research, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Modeling of Real-Life Problems.

Module -II **15 Hrs.**

Introduction to Linear Programming Problem, Linear Programming (LP) as a tool of Operational Research (OP), Basic Feasible solution, Extreme points, Linear Programming Problem Formulation, solution by Graphical Method, Theory of Simplex Method.

Module -III **15 Hrs.**

Duality, Dual simplex method, Two-Phase simplex method, Big-M method. Degeneracy in Linear programming

Module -IV **15 Hrs.**

Transportation problem-initial basic feasible solution, Solution by Matrix minima method and Vogel's approximation method, Optimal solution, degeneracy in transportation problems.

Module -V **15 Hrs.**

Assignment Problems: Hungarian Method for solution. Traveling-Salesman problems.

Text Books & References:

1. H.A Taha, Operations Research-An Introduction, Macmillan Publishing INC., New York.
2. Kanti Swarup, P.K. Gupta & Man Mohan, Operations Research, Sultan Chand & sons, New Delhi.
3. F.S. Hillier & G.J. Lieberman, Introduction to Operations Research, (Sixth-edition) McGraw Hill International Edition.
4. S.D. Sharma Operations Research, Kedar Nath Ram Sons & Co. Publisher Meerut (thirteenth-edition)

Elective-I Mathematics- Advanced Calculus

(BPCM504B)

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

(BPCM504C)

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

Solid State Physics Lab

(BPCM505P(A))

Note: Minimum 8 experiment to be performed.

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method).
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR).
6. To determine the refractive index of a dielectric layer using SPR.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four probe method (from room temperature to 150^{o}C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

Elective-IPhysics

Quantum Mechanics Lab

(BPCM505P(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:

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

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 $a = 3\,\text{Å}, 5\,\text{Å}, 7\,\text{Å}$. 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

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

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 Physics

Nuclear and Particle Physics Lab

(BPCM505P(C))

Note: Minimum 8 experiment to be performed.

1. To determine the Rydberg constant for Hydrogen.
2. To study absorption spectra of Iodine vapor and to determine the dissociation energy and force constant.
3. To estimate the temperature of sodium flame by studying the reversal of the spectral line (D-line).
4. To draw the plateau curve of a given GM counter.
5. X-Ray Diffraction – Determination of lattice parameters of a crystalline solid.
6. UV-Vis Spectrophotometer – Determination of absorption coefficient and band gap.
7. FTIR Spectrometer – Determination of vibration levels in a compound.
8. Superconductivity – Determination of transition temperature.
9. Thin Film Deposition and Measurement of Electrical Conductivity four probe method.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

Elective-I Chemistry

Polymer Chemistry Lab

(BPCM506P(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.

Elective-I Chemistry

ANALYTICAL METHODS IN CHEMISTRY-Lab

(BPCM506P(B))

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 by Job'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

(BPCM506P(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).

Renewable Energy and Energy Harvesting

(BPCM601A)

Module -1 **6 Hrs.**

The aim of this course is not just to impart theoretical knowledge to the students but toprovide them with exposure and hands-on learning wherever possibleFossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, theirlimitation, need of renewable energy, non-conventional energy sources. An overview ofdevelopments in Offshore Wind Energy, Tidal Energy, Wave energy systems, OceanThermal Energy Conversion, solar energy, biomass, biochemical conversion, biogasgeneration, geothermal energy tidal energy, Hydroelectricity.

Module -2 **6 Hrs.**

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater,flat plate collector, solar distillation, solar cooker, solar green houses, solar cell,absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PVmodels and equivalent circuits, and sun tracking systems.

Module -3 **6 Hrs.**

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and differentelectrical machines in wind turbines, Power electronic interfaces, and gridinterconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristicsand Statistics, Wave Energy Devices.

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy,Osmotic Power, Ocean Bio-mass.

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impactof hydro power sources.

Module -4 **6 Hrs.**

Piezoelectric Energy harvesting: Introduction, Physics and characteristics ofpiezoelectric effect, materials and mathematical description of piezoelectricity,Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energyharvesting applications, Human power.

Module -5 **6 Hrs.**

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models,recent applications.

Carbon captured technologies, cell, batteries, power consumption.

Environmental issues and Renewable sources of energy, sustainability.

Demonstrations and Experiments –

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

Reference Books:

- Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
- Solar energy - M P Agarwal - S Chand and Co. Ltd.
- Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
- Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
- Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
- J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

Fuel and Pesticide Chemistry

(BPCM601B)

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

(BPCM601C)

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

(BPCM602A)

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**

(BPCM605P(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

(BPCM602B)

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

(BPCM605P(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.

Elective-II Physics

Embedded System: Introduction to Microcontroller

(BPCM602C)

Module -1 **12 Hrs.**

Embedded system introduction: Introduction to embedded systems and general-purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges and design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers.

Review of microprocessors: Organization of Microprocessor based system, 8085μp pin diagram and architecture, concept of data bus and address bus, 8085 programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts.

Module -2 **12 Hrs.**

8051 microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions.

Module -3 **12 Hrs.**

8051 I/O port programming: Introduction of I/O port programming, pin out diagram of8051 microcontroller, I/O port pins description and their functions, I/O port programming in 8051, (Using Assembly Language), I/O programming: Bit manipulation.

Programming of 8051: 8051addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic & logic instructions, 8051 programming in C:- for time delay and I/O operations and manipulation, for arithmetic & logic operations, for ASCII and BCD conversions.

Timer and counter programming: Programming 8051 timers, counter programming.

Module -4 **12 Hrs.**

Serial port programming with and without interrupt: Introduction to 8051 interrupts, programming timer interrupts, programming external hardware interrupts and serial communication interrupt, interrupt priority in the 8051.

Interfacing 8051 microcontroller to peripherals: Parallel and serial ADC, DAC interfacing, LCD interfacing.

Programming Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging.

Module -5 **12 Hrs.**

Embedded system design and development: Embedded system development environment, file types generated after cross compilation, disassembler/ decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.

Reference Books:

- Embedded Systems: Architecture, Programming & Design, R. Kamal, 2008, Tata McGraw Hill.
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
- Embedded Microcomputor System: Real Time Interfacing, J.W. Valvano, 2000, Brooks/Cole.
- Embedded Systems and Robots, Subrata Ghoshal, 2009, Cengage Learning.
- Introduction to embedded system, K.V. Shibu, 1st Edition, 2009, McGraw Hill.
- Microcontrollers in practice, I.Susnea and M.Mitescu, 2005, Springer.
- Embedded Systems: Design & applications, 1/e S.F. Barrett, 2008, Pearson Education India.
- Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011,Cengage Learning.

Elective-II Physics

Embedded System: Introduction to Microcontroller

(BPCM605P(C))

Note: Minimum 8 experiment to be performed.

Following experiments using 8051:

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
5. Program to glow first four LED then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

Reference Books:

- Embedded Systems: Architecture, Programming & Design, R. Kamal, 2008, Tata McGraw Hill.
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
- Embedded Microcomputor System: Real Time Interfacing, J.W. Valvano, 2000, Brooks/Cole.
- Embedded System, B.K. Rao, 2011, PHI Learning Pvt. Ltd.

Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011,Cengage Learning.

Elective-II **Chemistry**

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

(BPCM603A)

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 methods and 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: Potentiometry & 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

(BPCM606P(A))

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

(BPCM603B)

Unit-I

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

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.
42
• 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).

Elective-II **Chemistry**

Noval Inorganic Solids-Lab

(BPCM606P(B))

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

Elective-II Chemistry

Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy

(BPCM603C)

Module-I

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

(6 Lectures)

Module-II

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metalcarbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

(12 Lectures)

Module-III

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

(12 Lectures)

Section B: Organic Chemistry-4 **(30 Lectures)**

Module-IV

Polynuclear and heteronuclear aromatic compounds:

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

(6 Lectures)

Active methylene compounds:

Preparation: Claisen ester condensation. Keto-enol tautomerism. *Reactions:* Synthetic uses of ethylacetoacetate (preparation of non-heteromoleculeshaving upto 6 carbon).

(6 Lectures)

Module-V

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules.Electromagnetic radiations, electronic transitions, λ_{max} & ε_{max}, chromophore, auxochrome, bathochromic andhypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β– unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR 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 **Chemistry**

Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy-Lab

(BPCM606P(C))

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the R_f value in each case.(Combination of two ions to be given) Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}

2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate

(ii) tetra ammine copper (II) sulphate

(iii) potassium tri oxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$.

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing

Mono functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,*Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman,1960.

Elective-II Mathematics
Vector Calculus
(BPCM604A)

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.

Elective-II Mathematics
Probability and Statistics

(BPCM604B)

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.

Elective-II Mathematics

Network Analysis and Decisions Theory

(BPCM604C)

Module -I **15 Hrs.**

Network Analysis: Project, Project planning and Scheduling, Basic Components of Network, Fulkerson's Rule for Numbering Events, Rules for Drawing Network Diagram, Common Errors in Drawing Networks. Activity on node diagram. Merit and demerit of AON diagram.

Module -II **15 Hrs.**

PERT & CPM: Critical path Analysis, Forward and backward analysis, Critical path, Floats of an activity and event. Difference between Pert and CPM. Project cost, Time cost optimization algorithm.

Module -III **15 Hrs.**

Problem of sequencing: Basic terms in sequencing, Process of n- jobs through two machines, Processing n jobs through k machines., Processing 2 jobs through k machines.

Module -IV15 Hrs.

Replacement problem: Replacement policy when value of money does not change with time, Replacement policy when value of money changes with time. Replacement of equipment that fails suddenly. Recruitment and promotion policy. Equipment renewal problem.

Module -V **15 Hrs.**

Decision theory: Decision making problem and process, Decision under uncertainty, Decision under risk, Basic terms of game theory, The maximin-minimax principal, Games without saddle points- Mixed strategies, Graphical solution of 2 x n and m x 2 games. Dominance property.

Text Books &References:

1. Kanti Swarup, P.K. Gupta & Man Mohan, Operations Research, Sultan Chand & sons, NewDelhi.
2. Hira & Gupta, Operation Research, S. Chand & Company PVT. LTD. New Delhi.
3. S.D. Sharma Operations Research, Kedar Nath Ram & Sons & Co. Publisher Meerut. (Thirteenth-edition).