Total Marks= 800/900 **Total Credits= 23/24**

1st Semester			Contact Hrs.			Marks			Credits
Subject Code	**Subject**		**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-101	Inorganic Chemistry-I		4	-	-	40	60	100	4
BCHMS1-102	Physical Chemistry-I		4	-	-	40	60	100	4
BCHMS1-103	Inorganic Chemistry-I **Lab**		-	-	4	60	40	100	2
BCHMS1-104	Physical Chemistry-I **Lab**		-	-	4	60	40	100	2
BHSMC0-042	Ability Enhancement Compulsory Course	English	2	-	-	40	60	100	2
Generic Elective I (Select any two with lab/tutorial as applicable)[a,b]									
BPHYS1-101	Electricity and Magnetism		4	-	-	40	60	100	4
BMCAS1 - 102	Introduction to Information Technology		3	1	-	40	60	100	4
BMATH5-101	Mathematics I*		3	1	-	40	60	100	4
BMATH5-102	Basic Mathematics I*								
BPHYS1-104	Electricity and Magnetism **Lab**			-	2	60	40	100	1
BMCAS1-105	Software Lab.-I (Based on BMCAS1-102)			-	2	60	40	100	1
Total#				-	-	**380/440**	**420/460**	**800/900**	**23/24**

Note: (a): Each student has to opt two papers with lab/tutorial from the category of generic electives in each semester starting from semester I till semester IV from any two disciplines (mathematics, Physics, Computer Science). The disciplines once opted will remain same throughout the course.

*Students from Medical stream will study Basic Mathematics – I and Students from Non-Medical stream will study Mathematics – I

Depends on combination of electives selected by student.

Total Marks= 900/1000 **Total Credits= 24/25**

2nd Semester			Contact Hrs.			Marks			Credits
Subject Code	**Subject**		**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-201	Organic Chemistry-I		4	-	-	40	60	100	4
BCHMS1-202	Physical Chemistry-II		4	-	-	40	60	100	4
BCHMS1-203	Organic Chemistry-I **Lab**		-	-	4	60	40	100	2
BCHMS1-204	Physical Chemistry-II **Lab**		-	-	4	60	40	100	2
BHSMC0-041	Ability Enhancement Compulsory Course	Environmental Sciences	3	-	-	40	60	100	3
BMNCC0-041		Drug abuse: problem, management and prevention	2	0	0	100	00	100	0
Generic Elective II (Select any two with lab/tutorial as applicable)[a,b]									
BPHYS1-201	Thermal Physics		4	-	-	40	60	100	4
BMCAS1- 403	Linux Operating System		3	1	-	40	60	100	4
BMATH5-201	Mathematics II*		3	1	-	40	60	100	4
BMATH5-202	Basic Mathematics II*								
BPHYS1-204	Thermal Physics Lab		-	-	2	60	40	100	1
BMCAS1- 406	Software Lab.-VIII (Based on BMCAS1-403)		-	-	2	60	40	100	1
Total#			-	-	-	**480/540**	**420/460**	**900/ 1000**	**24/25**

*Students from Medical stream will study Basic Mathematics – II and Students from Non Medical Stream will study Mathematics - II

Total Marks= 800/900 **Total Credits= 23/24**

3rd Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-301	Organic Chemistry-II	4	-	-	40	60	100	4
BCHMS1-302	Physical Chemistry-III	4	-	-	40	60	100	4
BCHMS1-303	Organic Chemistry-II **Lab**	-	-	4	60	40	100	2
BCHMS1-304	Physical Chemistry-III **Lab**	-	-	4	60	40	100	2
Skill enhancement course (Select any one)								
BCHMD1-311	Chemistry of cosmetics and perfumes	2	-	-	40	60	100	2
BCHMD1-312	Green Methods in Chemistry							
Generic Elective III(Select any two with lab/tutorial as applicable)[a,b]								
BPHYS1-302	Elements of Modern Physics	4	-	-	40	60	100	4
BMCAS1-104	Programming in C Language	3	1	-	40	60	100	4
BMATH5-301	Mathematics III	3	1	-	40	60	100	4
BPHYS1-306	Elements of Modern Physics Lab	-	-	2	60	40	100	1
BMCAS1-106	Software Lab.-II (Based on BMCAS1-104)	-	-	2	60	40	100	1
Total[#]		-	-	-	**380/440**	**420/460**	**800/900**	**23/24**

Total Marks= 800/900 **Total Credits= 23/24**

4th Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-401	Inorganic Chemistry-II	4	-	-	40	60	100	4
BCHMS1-402	Organic Chemistry-III	4	-	-	40	60	100	4
BCHMS1-403	Inorganic Chemistry-II **Lab**	-	-	4	60	40	100	2
BCHMS1-404	Organic Chemistry-III **Lab**	-	-	4	60	40	100	2
Skill enhancement course (Select any one)								
BCHMD1-411	Fuel Chemistry	2	-	-	40	60	100	2
BCHMD1-412	Pharmaceutical Chemistry							
Generic Elective IV (Select any two with lab/tutorial as applicable)[a,b]								
BPHYS1-202	Waves and Optics	4	-	-	40	60	100	4
BMCAS1-204	Object Oriented Programming Language in C++	3	1	-	40	60	100	4
BMATH5-401	Mathematics IV	3	1	-	40	60	100	4
BPHYS1-205	Waves and Optics Lab	-	-	2	60	40	100	1
BMCAS1-207	Software Lab.-IV (Based on BMCAS1-204)	-	-	2	60	40	100	1
Total[#]		**-**	**-**	**-**	**380/440**	**420/460**	**800/900**	**23/24**

Total Marks= 1000 Total Credits= 26

5th Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-501	Inorganic Chemistry-III	4	-	-	40	60	100	4
BCHMS1-502	Organic Chemistry-IV	4	-	-	40	60	100	4
BCHMS1-503	Physical Chemistry-IV	4	-	-	40	60	100	4
BCHMS1-504	Inorganic Chemistry-III **Lab**	-	-	4	60	40	100	2
BCHMS1-505	Organic Chemistry-IV **Lab**	-	-	4	60	40	100	2
BCHMS1-506	Physical Chemistry-IV **Lab**	-	-	4	60	40	100	2
Discipline Specific Elective – I (Select any two with lab)								
BCHMD1-511	Applications of Computers in Chemistry	3	0	0	40	60	100	3
BCHMD1-512	Instrumental methods of analysis	3	0	0	40	60	100	3
BCHMD1-513	Novel Inorganic Solids	3	0	0	40	60	100	3
BCHMD1-514	Applications of Computers in Chemistry **Lab**	-	-	2	60	40	100	1
BCHMD1-515	Instrumental methods of analysis **Lab**	-	-	2	60	40	100	1
BCHMD1-516	Novel Inorganic Solids **Lab**	-	-	2	60	40	100	1
Total		**-**	**-**	**-**	**500**	**500**	**1000**	**26**

Total Marks= 1000 **Total Credits= 26**

6th Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-601	Physical Chemistry – V	4	-	-	40	60	100	4
BCHMS1-602	Inorganic Chemistry – IV	4	-	-	40	60	100	4
BCHMS1-603	Organic Chemistry – V	4	-	-	40	60	100	4
BCHMS1-604	**Physical Chemistry – V Lab**	-	-	4	60	40	100	2
BCHMS1-605	**Inorganic Chemistry – IV Lab**	-	-	4	60	40	100	2
BCHMS1-606	**Organic Chemistry V – Lab**	-	-	4	60	40	100	2
Discipline Specific Elective – I (Select any two with lab)								
BCHMD1-611	Polymer Chemistry	3	0	0	40	60	100	3
BCHMD1-612	Molecular modelling and drug design	3	0	0	40	60	100	3
BCHMD1-613	Inorganic materials of Industrial Importance	3	0	0	40	60	100	3
BCHMD1-614	Polymer Chemistry Lab	-	-	2	60	40	100	1
BCHMD1-615	**Molecular modelling and drug design lab**	-	-	2	60	40	100	1
BCHMD1-616	Inorganic materials of Industrial Importance Lab	-	-	2	60	40	100	1
Total		**-**	**-**	**-**	**500**	**500**	**1000**	**26**

Semester	Marks	Credits
1st	800/ 900	23/24
2nd	900/ 1000	24/25
3rd	800/ 900	23/24
4th	800/ 900	23/24
5th	1000	26
6th	1000	26
Total	5300/5700	145/149

INORGANIC CHEMISTRY-I

SUBJECT CODE–BCHMS1-101 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives

1. To familiarize with atomic structure, quantum numbers and shapes of orbitals
2. To understand periodic table and periodicity of elements and their effect on various properties of elements
3. To understand the concept of various bonding theories
4. To understand importance of redox reactions

Course Outcomes: The completion of this course will make student to acquire the knowledge of:

1. Wave mechanics, atomic theories and shapes of orbitals
2. Periodic table and various periodic properties
3. Ionic bond, covalent bond, metallic bond and various weak chemical forces
4. Redox reactions and applications of redox reactions

Unit I (14 Lectures)

Atomic Structure:

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: deBroglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f*orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Unit II (16 Lectures)

Periodicity of Elements:

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* &*p*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
(b) Atomic radii (van der Waals)
(c) Ionic and crystal radii.
(d) Covalent radii (octahedral and tetrahedral)
(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(f) Electron gain enthalpy, trends of electron gain enthalpy.
(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

Unit III (12 Lectures)

Chemical Bonding I:

(i) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points.
(ii) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Unit IV **(18 Lectures)**

Chemical Bonding II:

(i) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach).Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ioniccharacter from dipole moment and electronegativity difference.

(ii) *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

Oxidation-Reduction:

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

Reference Books:

• Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
• Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry,Oxford, 1970
• Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
• Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

PHYSICAL CHEMISTRY I

SUBJECT CODE–BCHMS1-102 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives

1. To familiarize with the basic phenomenon/concepts of equation of state and properties of liquids and solids.

2. To understand the nature of solid state, crystal systems and defects in crystals.

3. To understand the concept of ionisation, pH and hydrolysis.

4. To familiarise with the role of equilibrium in electrolytic action.

Unit I **(8 Lectures)**

Gaseous stateI:
Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation;collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Unit II **(10 Lectures)**

Gaseous stateII:
Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding
states.

Unit III **(6 Lectures)**

Liquid state:
Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Solid state: **(16 Lectures)**
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law. Detailed discussion of defects in crystals. Glasses and liquid crystals.

Unit IV **(20 Lectures)**

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; dissociation constants of mono-, di-and triprotic acids (exact treatment).

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants

Course Outcomes: On completion of this course students will be able to:

1. Comprehend the kinetic modular model of gases, behaviour of ideal and real gases.
2. Apply the concept of equilibrium to understand the behaviour of ions in solution.
3. Analyse a solid and its defects for their applications.
4. Relate different states of matter with their observable properties.

Reference Books:

• Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press13(2006).
• Ball, D. W. Physical Chemistry Thomson Press, India (2007).
• Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
• Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

INORGANIC CHEMISTRY LAB I

SUBJECT CODE-BCHMS1-103 **L T P C** **(60 Lectures)**
0 0 4 2

Course Objectives

1. To develop basic understanding of various lab practices including safety measures.
2. To familiarize with solution preparation.
3. To understand acid-base and oxidation reduction titrimetry.

EXPERIMENTS

(A) Titrimetric Analysis

(i) Calibration and use of apparatus
(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Course Outcomes: The students will acquire knowledge of:

1. Preparation of solutions
2. Estimation of carbonates, bicarbonates and free alkalis in solution with acid base titrations
3. Estimation of Fe(II) and oxalic acid with oxidation reduction titrimetry

Reference text:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

PHYSICAL CHEMISTRY LAB-I

SUBJECT CODE-BCHMS1-104 **L T P C** **(60 Lectures)**
0 0 4 2

Course Objectives

1. To develop basic understanding of various lab practices including safety measures.
2. To familiarize with basics of the phenomenon of surface tension and viscosity.
3. To understand the principle of pH metric titrations.
4. To familiarize with preparation of buffer solutions of different pH values.

1. Surface tension measurements.

a. Determine the surface tension by (i) drop number (ii) drop weight method.
b. Study the variation of surface tension of detergent solutions with concentration.
2. **Viscosity measurement using Ostwald's viscometer**.
a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
b. Study the variation of viscosity of sucrose solution with the concentration of solute.
3. Indexing of a given powder diffraction pattern of a cubic crystalline system.
4. pH metry
a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
b. Preparation of buffer solutions of different pH
i. Sodium acetate-acetic acid
ii. Ammonium chloride-ammonium hydroxide
c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
d. Determination of dissociation constant of a weak acid.

Course Outcomes: The students will be able to:

1. Carry out measurement of surface tension and viscosity of solutions.
2. Prepare buffer solutions of different pH values.
3. Handle pH meter.
4. Apply pH metric titrations for various determinations.

Reference Books

• Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
• Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed*.; McGraw-Hill: New York (2003).
• Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003

ENGLISH

SUBJECT CODE– BHSMC0-042 **L T P C** **(30 Lectures)**
2 0 0 2

Course Objectives

1. To remove the phobia of conversing in English.
2. To make the learners enable to express themselves among peers & teachers.
3. To enable learners, improve their vocabulary.
4. To introduce them with basic communicative skills in real life situations.
5. To enhance learner's writing ability.

UNIT-I (8 Hours)

Communication Skills: Introduction, Definition, the Importance of Communication,
The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context
Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

UNIT-II (7 Hours)

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment.
Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

UNIT-III (7 Hours)

Communication Styles: Introduction, The Communication Styles Matrix with example for each Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.
Basic Listening Skills: Introduction, Self-Awareness, Active Listening, becoming an Active Listener, Listening in Difficult Situations

UNIT-IV (8 Hours)

Interview Skills: Purpose of an interview, Do's and Don'ts of an interview
Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery
Group Discussion: Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion.

Course Outcomes:
The student will acquire mastery in English
including writing; formal writing, letters, e'Dcoumentation and Reading. Especially in Communication Skills through G.D's, Public speaking and Situational Dialogues.

Reference Books:

1. Ruther Ford A. J., 'Basic Communication Skills for Technology', 2nd Edition, Pearson Education,2011.
2. Kumar S. and Pushplata, 'Communication Skills', 1st Edition, Oxford Press,2011.
3. Stephen P. Robbins, 'Organizational Behaviour', 1st Edition, Pearson,2013.
4. Gill H., 'Brilliant-Communication Skills', 1st Edition, Pearson Life,2011.
5. Gopalawamy R., 'The Ace of Soft Skills: Attitude, Communication and Etiquettefor Success', 5thEdition, Pearson, 2013.
6. Dalley D., Burton L. and Margaret G., 'Developing your Influencing Skills', Green Hall, 1 st Edition, Universe of Learning LTD,2010.
7. Konarnira, 'Communication Skills for Professionals', 2nd Edition, PHI,2011.

8. Mitra B. K., 'Personality Development and Soft Skills', 1st Edition, Oxford Press,2011.
9. 'Soft Skill for Everyone', Butter Field, 1stEdition, Cengage Learning India Pvt. Ltd., 2011.
10. Francis Peters S.J., 'Soft Skills and Professional Communication', 1st Edition, McGrawHillEducation, 2011.
11. John A., 'Effective Communication', 4th Edition, Pan MacMillan, 2009.
12. Aubrey D., 'Bringing out the Best in People', 2nd Edition, McGraw Hill,1999

ELECTRICITY AND MAGNETISM

Subject Code: BPHYS1-101 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective:

To understand the basic concepts of electricity and magnetism.

To provide knowledge of Dielectric, Magnetic properties of matter and Electromagnetic induction and Electric circuits.

Course Outcomes:

1. Understanding the concepts of electric field, magnetic field, potentials, dielectric and magnetic properties of matter, electromagnetic induction and electric circuits.
2. Skill enhancement to solve numerical problems related with Electricity and Magnetism.
3. Apply knowledge of Electricity and Magnetism to go for higher studies in diverse fields.
4. To inculcate and develop the ability to think abstractly.

UNIT-I (15 Hours)

Electric Field and Electric Potentials

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor.

UNIT-II (15 Hours)

Magnetic Field and Electric Potentials

Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements.

UNIT-III (15 Hours)

Dielectric and Magnetic Properties of Matter

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

UNIT-IV(15 Hours)

Electromagnetic induction and Electric circuits

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and Band Width. Parallel LCR Circuit. Network theorems: Ideal Constant-voltage and Constant-current Sources. Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem.

Recommended Text Books / Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education.
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education.
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
6. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

INTRODUCTION TO INFORMATION TECHNOLOGY

Subject Code: BMCAS1--102 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives:

1. To understand the basics of Computer Languages,Computer Network and Communication.
2. To define the memory types,input/output devices,storage devices,computer generations.
3. To get familiar with Operating System,Word processing and number system
4. To understand the Internet Applications and Presentation Graphics Software

Course Outcomes: The completion of this course will make student to acquire the knowledge of:

1. Working on different software for word processing, powerpoint presentation, spreadsheets and communicate ideas electronically.
2. Designing page layouts for digital and electronic publications by combining different media elements.
3. Basic concepts and terminology of information technology.
4. Personal computers and their operations.

UNIT- I (14 Lectures)

Computer Fundamentals: Block structure of a computer, characteristics of computers, problem solving with computers, generations of computers, and classification of computers on the basis of capacity, purpose, and generation.

Number System: Bit, byte, binary, decimal, hexadecimal, and octal systems, conversion from one system to the other, representation of characters, integers and fractions.
Binary Arithmetic: Addition, subtraction and multiplication.

UNIT-II (15 Lectures)

Memory Types: Magnetic core, RAM, ROM, Secondary, Cache, Bubble Memory.
Input and Output Units: Keyboard, Mouse, Monitor (CRT and LCD): Light pen, joystick, Mouse, Touch screen; OCR, OMR, MICR
Overview of storage devices: Floppy disk, hard disk, compact disk, tape. Printers: Impact, non-impact, working mechanism of Drum printer, Dot Matrix printer, Inkjet printer and Laser printer.
Computer Languages: Machine language, assembly language, higher level language, 4GL. Introduction to Compiler, Interpreter, Assembler, Assembling, System Software, Application Software.

UNIT- III (17 Lectures)

Operating System: Batch, multi-programming, time sharing, network operating system, on-line and real time operating system, Distributed operating system, multi-processor, Multi-tasking.
Graphical OS: Fundamentals of windows, types of windows, anatomy of windows, windows explorer, customizing windows, control panel, taskbar setting, Network Neighborhood.
Word processing: Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge and equation editors.
Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs.
Presentation Graphics Software: Templates, views, formatting slide, slides with graphs, animation, using special

features, presenting slide shows.

UNIT –IV **(14 Lectures)**

Computer Network and Communication: Network types, network topologies, network communication devices, physical communication media.

Internet and its Applications: E-mail, TELNET, FTP, World Wide Web, Internet chatting; Intranet, Extranet, Gopher, Mosaic, WAIS.

Recommended Books:

1. D. H. Sanders, 'Computers Today', 4th Edn., McGraw Hill, **1988**.
2. V. Rajaraman, 'Fundamentals of Computers', 2nd Edn., Prentice Hall of India, New Delhi, **1996**.
3. Satish Jain, 'Information Technology', BPB, Paperback Edn., **1999**.
4. David Cyganski, John A. Orr, 'Information Technology Inside and Outside', Pearson Education, Paperback Edn., **2002**.
5. B. Ram, 'Computer Fundamentals', 3rd Edn., Wiley, **1997**.
6. ChetanSrivastva, 'Fundamentals of Information Technology', 3rd Edn., KalayaniPublishers.
7. Larry long & Nancy long, 'Computers', 12th Edn., PrenticeHall, **1999**.

MATHEMATICS-I

SUBJECT CODE –BMATH5-101 **L T P C** **(60 Lectures)**
31 0 4

Course Objective:

Define and interpret the concepts of Matrices and Determinants
To learn Vector Calculus, Vector Differentiation, Vector Integration.

Course Outcome

Students will be able to assess:

1. To implement the idea of system of linear equations
2. Use vector and scalar product in terms of area and volume
3. To implement the idea of vector differentiation, divergence and curl of vector field
4. To implement the idea of vector integration with its theorems

UNIT-I **(15 Lectures)**

Algebra of matrices, Inverse and rank of a matrix, System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II **(14 Lectures)**

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar triple product and their interpretation in terms of area and volume respectively, Scalar and Vector fields.

UNIT-III **(16 Lectures)**

Vector Differentiation: Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector field, Del and Laplacian operators, Vector identities.

UNIT-IV **(15 Lectures)**

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Notion of infinitesimal line, surface and volume elements, Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes Theorems (Without proofs) and their applications.

References Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
3. Murray R. Spiegel, Vector Analysis, Schaum publishing Company, New York.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
6. Peter Baxandall , Hans Liebeck , 'Vector Calculus', Dover Publications; 2008 edition.

BASIC MATHEMATICS-I

Subject Code: BMATH5-102 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objective:

To explain the concepts of limit and continuity, function
To learn Maxima and Minima, Rules of Differentiability integration.

Course Outcome:

Students will be able to assess:

1. Get knowledge about the basic concept of limit continuity,Differentiability ,nth derivative of well-known functions
2. To determine Rolle's theorem, Mean Value Theorems and various type of Tracing of curves
3. Tracing of Cartesian curves, parametric and polar curves
4. Able to solve applications of definite integral

.

UNIT-I **(15 Lectures)**

Basic concept of limit and continuity, Properties of limit and classification of discontinuities, Properties of continuous functions, Differentiability and differentials, Successive differentiation and Leibnitz theorem, Derivatives of higher order, nth derivative of well-known functions.

UNIT-II **(13 Lectures)**

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x , log(l+x), $(l+x)^m$, Maxima and Minima, Indeterminate forms, Curvature, Asymptotes, Singular points, Tracing of curves, tracing of curves in polar and Parametric forms.

UNIT-III **(16 Lectures)**

Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial

fractions, Integration by parts, properties of definite integral.

UNIT-IV **(16 Lectures)**

Applications of Definite Integrals, Plane Area, Arc Length, Areas between Curves, Centroids, Moments of Inertia, Volumes, Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic function and of their combinations.

Course Outcome: On successful completion of the course, students will be able to assess properties implied by the Properties of continuous functions, Differentiability and differentials, Tracing of curves, tracing of curves in polar and Parametric forms, Method of Partial fractions, Applications of Definite Integral.

Books Recommended

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
3. Zafar Ahsan: Differential Equations and Their Applications, Second Edition, PrenticeHall of India Private Limited, New Delhi.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Erwin Kreyszig: Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

ELECTRICITY AND MAGNETISM LAB

ubject Code: BPHYS1-104 **L T P C** **Duration: 30 Hrs.**
21

Course Objective:

To learn practically the various concepts of electricity and magnetism.

The course will provide hands- on training to the students for handling various electrical instruments.

Course Outcome:

- Able to verify the concepts/laws of Electricity and Magnetism.
- To inculcate and develop scientific aptitude by performing the various experiments.
- Skill enhancement by solving experimental problems.
- To inculcate the spirit of team work.

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

List of Experiments:-

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.

8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

Recommended Text Books / Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
5. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

SOFTWARE LAB-I (BASED ON BMCAS1--102)

Subject Code: BMCAS1--105 **L T P C** **(30 Lectures)**
0 0 21

Course Objectives:

1. To introduce IT in a simple language to students.
2. To help students to pursue specialized programs leading to technical and professional careers and certifications in the IT industry
3. To introduce skills relating to IT basics, computer applications, programming, interactive medias and Internet basics
4. To understand the concept of Computer's Input/output devices, the concept of dynamic memory, data types, loops, functions, array, pointers, string, structures and files.

Course Outcomes:

After completion of the course students will be able to:

1. Understand basic concepts and terminology of information technology.
2. Understand the working of spreadsheets and create their own powerpoint presentations
3. Know about Ms-Word and its features.
4. Work with the latest tools of information technology.

ORGANIC CHEMISTRY-I

SUBJECT CODE -BCHMS1-201 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives

1. To understand the concepts behind basics of organic chemistry
2. To familiarize with the general mechanisms of organic reactions and bonding between organic molecules
3. To comprehend the applicability of organic reactions and organic molecules
4. To make the students apprehend the recognition of organic compounds and organic reaction mechanism

Unit I **(6 Lectures)**

Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, influence of hybridization on bond properties.

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit II **(18 Lectures)**

Stereochemistry:

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers,Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemicmixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Unit III **(16 Lectures)**

Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Unit IV **(20 Lectures)**

Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with theirmechanism. Directing effects of the groups.

Course Outcomes:

Students will be able to:

1. Understand the basics of organic chemistry
2. Analyze the general mechanisms of organic reactions and bonding between organic molecules
3. Comprehend the applicability of organic reactions and organic molecules
4. Recognise the type of organic compounds and organic reaction mechanism

Reference Books:

• Morrison, R. N. & 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: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
• Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
• Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

PHYSICAL CHEMISTRY-II

SUBJECT CODE–BCHMS1-202 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives

To familiarize the student with the basic concepts of thermodynamics.
To elaborate the system of variable composition and their properties.
To understand the concept of chemical equilibrium.
To understand the concept of solutions and colligative properties.

Unit I **(18 Lectures)**

Chemical Thermodynamics I:
Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.
First law: Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.
Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Unit II **(18 Lectures)**

Chemical Thermodynamics II:
Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.
Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.
Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Unit III **(16 Lectures)**

Systems of Variable Composition:
Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical Equilibrium:
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants *Kp*, *Kc* and *Kx*. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Unit IV **(8 Lectures)**

Solutions and Colligative Properties:
Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Course Outcomes: On completion of this course, students will be able to:
1. Identify and describe energy exchange processes.
2. Manipulate physical parameters to favour a particular process.
3. Compare the system properties with variation in composition.
4. Explain the behaviour of solutions.

Reference Books

• Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.*, Oxford University Press (2011).
• Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
• Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
• McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
• Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
• Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
• Metz, C.R. *2000 solved problems in chemistry*, Schaum Series (2006)

ORGANIC CHEMISTRY LAB I

SUBJECT CODE-BCHMS1-203 **L T P C** **0 0 4 2** **(60 Lectures)**

Course Objectives

1. To understand the concepts behind calibration and purification by crystallization method.
2. To familiarize with the procedures to determine the physicochemical properties and effect of impurities on these properties
3. To understand the basics of chromotagraphic methods of separation of mixtures.

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
a. Water
b. Alcohol
c. Alcohol-Water
3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)
6. Chromatography
a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
b. Separation of a mixture of two sugars by ascending paper chromatography
c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Course Outcomes:
After completion of course students will be able to:

1. Purify organic compounds using various solvent combinations and calibrate small instruments.
2. Determine melting and boiling points of various organic compound
3. Separate organic mixtures using chromatographic techniques

Reference Books

• Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
• Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)

PHYSICAL CHEMISTRY LAB II

SUBJECT CODE-BCHMS1-204 **L T P C** **(60 Lectures)**
0 0 4 2

Course Objectives

1. To understand the determination of heat capacity.
2. To familiarize with the enthalpy of a reaction.
3. To understand the use of a calorimeter for determination of heat capacity.
4. To correlate physical phenomena with their heat exchange.

Thermochemistry

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
(c) Calculation of the enthalpy of ionization of ethanoic acid.
(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
(e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
(f) Determination of enthalpy of hydration of copper sulphate.
(g) Study of the solubility of benzoic acid in water and determination of ΔH.

Course Outcomes: The students will be able to:

1. Handle calorimeter.
2. Determine the heat capacity.
3. Determine enthalpy of different processes.
4. Determine heat of neutralization of an acid with a base.

Reference Books

• Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
• Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).

ENVIRONMENTAL SCIENCE

Subject Code: BHSMC0-041 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives:

1. To familiarize the student with the basic concept of Environmental and Environmental Chemistry.
2. To elaborate the ecosystem and their properties.
3. To understand the concept of Environmental Pollution and its diverse effect of pollution.
4. To understand the concept of sustainable and unsustainable development and its importance.

Course Outcomes: On completion of this course, students will be able to:

CO1: Understand the basics of Environment chemistry
CO2: Analyze the general concept of ecosystem and their components.
CO3: Comprehend the applicability of social issues and Environment.
CO4: Recognize the Environment Pollution and control measures of urban and industrial wastes.

Unit-I (08 Hours)

The Multidisciplinary nature of environmental studies, Natural Resources: Renewable and non-renewable resources

Unit-II (15 Hours)

Natural resources and associated problems: a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-III (12 Hours)

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Introduction, types, characteristic features of the ecosystems (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit- IV (10 Hours)

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books:

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India.
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
5. Clark R.S., Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd. 8. Down of Earth, Centre for Science and Environment

DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION

Subject Code: BMNCC0-041 **L T P C** **Duration: 30Hrs.**
2 0 0 0

UNIT-I (6 Hours)

Meaning of Drug Abuse: Meaning: Drug abuse, Drug dependence and Drug addiction. Nature and extent of drug abuse in India and Punjab.

UNIT-II (8 Hours)

Consequences of Drug Abuse: Individual: Education, Employment, Income. Family: Violence. Society: Crime. Nation: Law and Order problem.

UNIT-III (8 Hours)

Prevention of Drug Abuse: Role of Family: Parent-child relationship, Family support, supervision, shipping values, active scrutiny. School: Counselling, Teacher as role-model, Parent-teacher-health professional coordination, Random testing on students.

UNIT-IV (8 Hours)

Treatment and Control of Drug Abuse: Medical Management: Medication for treatment and to reduce withdrawal effects. Psychological Management: Counselling, Behavioural and Cognitive therapy. Social Management: Family, Group therapy and Environmental intervention. Treatment: Medical, Psychological and Social Management. Control: Role of Media and Legislation.

Recommended Books:

1. Ram Ahuja, 'Social Problems in India', Rawat Publications, Jaipur, 2003.
2. 'Extent, Pattern and Trend of Drug Use in India', Ministry of Social Justice and Empowerment, Govt. of India, 2004.
3. J.A. Inciardi, 'The Drug Crime Connection', Sage Publications, Beverly Hills, 1981.
4. T. Kapoor, 'Drug Epidemic among Indian Youth', Mittal Publications, New Delhi, 1985.
5. Kessel, Neil and Henry Walton, 'Alcoholism, Harmond Worth', Penguin Books, 1982.
6. Ishwar Modi and Shalini Modi, 'Addiction and Prevention', Rawat Publications,Jaipur, 1997.
7. 'National Household Survey of Alcohol and Drug Abuse', Clinical Epidemiological Unit, All India Institute of Medical Sciences, New Delhi, 2003 &2004.
8. Ross Coomber and Others, 'Key Concept in Drugs and Society', Sage Publications, New Delhi,2013.
9. Bhim Sain, 'Drug Addiction Alcoholism, Smoking Obscenity', Mittal Publications, New Delhi,1991.
10. Ranvinder Singh Sandhu, 'Drug Addiction in Punjab: A Sociological Study', Guru Nanak Dev University, Amritsar, 2009.
11. Chandra Paul Singh, 'Alcohol and Dependence among Industrial Workers', Shipra,Delhi, 2000.
12. S.Sussman and S.L. Ames, 'Drug Abuse: Concepts, Prevention andCessation', Cambridge University Press, 2008.
13. P.S. Verma, 'Punjab's Drug Problem: Contours and Characteristics', Vol. LII, No. 3, P.P. 40-43, Economic and Political Weekly, 2017. 1
14. 'World Drug Report', United Nations Office of Drug and Crime, 2016.

'World Drug Report', United Nations Office of Drug and Crime,2017

THERMAL PHYSICS

Subject Code: BPHYS1-201 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective:

To provide a detailed knowledge of laws of thermodynamics,
T understand the applications of laws of thermodynamics, and Maxwell's thermodynamic relations.

Course Outcomes:

To understand the concepts related to Thermal Physics and their applications.
Skill enhancement to solve numerical problems related with the laws of thermodynamics, entropy, and Maxwell's thermodynamic relations.
Apply knowledge of Thermal Physics to go for higher studies in diverse fields.
To inculcate and develop the ability to think abstractly.

UNIT-I (15 Hours)

Laws of Thermodynamics

Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem.

UNIT-II (15 Hours)

Applications of laws of thermodynamics

Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

UNIT-III (15 Hours)

Entropy

Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

UNIT-IV (15 Hours)

Thermodynamic Potentials and Maxwell's relations

Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations (6) Change of Temperature during Adiabatic Process.

Reference Books:
1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Statistical Physics and Thermodynamics, V.S. Bhatia, 1990, Shoban Lal Nagin Chand.
3. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University.
6. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

LINUX OPERATING SYSTEM

Subject Code: BMCAS1—403 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives:

1. To teach principles of operating system including basic Linux commands.
2. To facilitate students in understanding Inter process communication.
3. To understand and make effective use of linux utilities and shell scripting language to solve problems
4. To Develop the skills the necessary for systems programming including file system programming,process and signal management .

Course Outcomes:

After completion of course students will be able to:

1. Understand the basic commands of linux operating system and can write shell scripts.
2. Create file systems and directories and operate them.
3. Create processes background and fore ground etc..by fork() system calls.
4. Create shared memory segements,pipes ,message queues and can exercise interprocess communication

UNIT- I **(14 Lectures)**

Introduction to Operating Systems: its needs and services, Simple batch Systems, Multi- programmed batched systems, Time sharing systems, Parallel systems, Distributed systems and Real-time systems. Introduction to process, Process States.
Structure of LINUX: Kernel, Shell. LINUX Directory system.

UNIT- II **(15 Lectures)**

LINUX Commands: User Access and User ID Commands, Directory commands, Editors Commands, File Manipulation Commands, Security and Protection Commands, Inter-User and Inter-Machine Communication, Process Management Commands, I/O Redirection and Piping Commands, Vi editor, File Handling commands, and Introduction to Regular Expressions and Grep.

UNIT- III **(17 Lectures)**

Administering LINUX System: Introduction to System Administration, Functional activities of System Administration - Starting up the system, Maintaining the Super User Login, shutting down the system, recovering from system crash, taking backups, managing disk space, Mounting and Un-mounting file system, Adding and removing users, Changing groups and password.

UNIT- IV **(14 Lectures)**

Shell Programming: Executing a shell program, Study of shell programming as a Language; Wild card characters, Type of statements and Reserved Words, Special Shell parameters. The AWK pattern scanning and processing language: Operators, Control Statements and arrays.

Recommended Books:

1. J. Goerzen," Linux Programming Bible", IDG Books, New Delhi**.**
2. N. Mathew&R. Stones,"Beginning Linux Programming", Wiley Publishing India.

MATHEMATICS-II

Subject Code: BMATH5-201 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objective:

1.To provide the basic Knowledge of Probability spaces, Basic Statistics, Sequence and Series, Partial differentiation.

UNIT-I **(14Lectures)**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables;

UNIT-II **(15Lectures)**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT-III **(15Lectures)**

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Cauchy's Integral test, series of positive and negative terms); Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

UNIT-IV **(16Lectures)**

Partial differentiation –Function of two variables, Partial derivatives of higher order, Homogeneous functions, Euler's theorem and its extension (with proof), Composite functions, Total derivative, Differentiation of implicit functions and composite functions, Jacobians and its properties.

Course Outcome: After the completion of the course, the students will able to :

1. Apply the concept and consequences of Probability and Measures of Central tendency:
2. Understand moments, skewness and Kurtosis Binomial, Poisson and Normal Probability

distributions also concepts of correlation

3. To demonstrate the idea convergence of sequence and series, tests for convergence,power series and to represent function as series.
4. Extend the knowledge of Partial derivatives ofhigher order for further exploration of the subject for going into higher education.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
4. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.
5. S.C. Gupta and V.K. Kapoor ,Fundamentals of Applied Statistics,4th Edition, Sultan Chand & Sons, 2014.

BASIC MATHEMATICS-II

Subject Code: BMATH5-202 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objective:

To define and interpret the concepts of Matrices and Determinants, Sequence and Series, Partial differentiation, Partial derivatives.

UNIT-I **(14Lectures)**

Matrices and Determinants: Algebra of matrices, Inverse and rank of a matrix, System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II **(15Lectures)**

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Cauchy's Integral test, series of positive and negative terms); Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

UNIT-III **(16Lectures)**

Partial differentiation –Function of two variables, Partial derivatives of higher order, Homogeneous functions, Euler's theorem and its extension (with proof), Composite functions, Total derivative,

Differentiation of implicit functions and composite functions, Jacobians and its properties.

UNIT-IV **(15Lectures)**

Partial derivatives, directional derivatives, total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers.

Course Outcome: After the completion of the course, the students will be able

1. Understand the basic concepts of matrices and determinants in order to explore the advance study of theoretical problems of linear algebra.
2. To demonstrate the idea convergence of sequence and series, tests for convergence,power series and to represent function as series.
3. Extend the knowledge of Partial derivatives of higher order for further exploration of the subject for going into higher education.
4. Apply derivatives for the computation of directional derivative and Optimization.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
4. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
5. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.

THERMAL PHYSICS LAB

Subject Code: BPHYS1-204 **L T P C** **(30 Lectures)**

0 0 2 1

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective:

To learn practically the various concepts of thermodynamics.

The course will provide hand on training to the students for handling various related instruments.

Course Outcome:

- Practical knowledge of concepts of Thermodynamics.
- To inculcate and develop scientific aptitude by performing the various experiments.

- Learn to draw conclusions from data and develop skills in experimental design.
- To inculcate the spirit of teamwork

List of Experiments:-

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using Null Method
8. To calibrate a thermocouple to measure temperature in a specified Range using Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

Reference Books

1 Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2 A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3 Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4 A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

SOFTWARE LAB VIII (BASED ON BMCAS1-403 LINUX OPERATING SYSTEM)

Subject Code: BMCAS1--406 **L T P C** **Duration: 30 Lectures**
0 0 21

Course Objectives

1. To describe the basic file system in Linux and its file attributes.
2. To Appraise different filters, process handling, regular expressions and network handling features using suitable commands.
3. To Summarize different Linux commands to write Shell Programs
4. To demonstrate use of system calls

Course Outcomes: After completion of course students will be able to:

1. Demonstrate installation of Linux operating system and understand the importance of Linux
2. Manage shell and processes using various commands.
3. Demonstrate Linux administration and its environment.
4. Write Shell scripts and C programs using vi editor

ORGANIC CHEMISTRY-II

SUBJECT CODE -BCHMS1-301 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objectives

1. To understand the concepts behind basics of organic chemistry

2. To familiarize with concepts behind reaction intermediates
3. To understand the mechanism of various organic reactions
4. To describe concepts of preparation and properties of functional group derivatives

Course Outcomes:

After the completion of course, students will be able to:

1. Describe chemistry of functional groups

2.Use of reaction intermediates in organic reactions

3. Sketch mechanism of various organic reactions

4. Explain the concepts of preparation and properties of functional group derivatives

Unit I **(16 Hrs.)**

Chemistry of Halogenated Hydrocarbons:

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and controlling factors, Comparison of nucleophilic substitution and elimination reactions.

Aryl halides: Preparation (including preparation from diazonium salts). Nucleophilic aromatic substitution; SNAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

Unit II **(16 Hrs.)**

Alcohols, Phenols, Ethers and Epoxides:

Alcohols: Preparation, properties and relative reactivity of 1°, 2°, 3°alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Unit III **(14 Hrs.)**

Carbonyl Compounds:

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV and PDC); Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Unit IV **(14 Hrs.)**

Carboxylic Acids and their Derivatives:

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic, phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic

sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation,

Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.

Sulphur containing compounds:
Preparation and reactions of thiols, thioethers and sulphonic acids.

Reference Books:
1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education)2010.
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education)2002.
3. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.,2016.

PHYSICAL CHEMISTRY-III

SUBJECT CODE –BCHMS1-302 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objectives

1. To familiarize the student with the basic concepts of chemical kinetics.
2. To elaborate the concept of phases and phase equilibria.
3. To understand the concept of various surface phenomena and adsorption isotherms.
4. To understand various adsorption isotherms.

Course Outcomes: On completion of this course students will be able to:

1. Apply the knowledge of catalysis and its mechanism in reactions.
2. Predict and control the rate of formation of products/reactants based on concept of chemical kinetics.
3. Explain the reason for reaction rates on the basis of theories and mechanisms.
4. Identify and analyse uni/multicomponent systems.

Unit I **(12 Hrs.)**

Phase Equilibria-I:

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systemswith applications.

Unit II **(14 Hrs.)**

Phase Equilibria-II:

Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent andincongruent melting points, solid solutions.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation, azeotropes, partial miscibility of liquids, CST, miscible pairs, steam distillation.

Nernst distribution law: its derivation and applications.

Unit III **(20 Hrs.)**

Chemical Kinetics :

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism.

Unit IV **(14 Hrs.)**

Catalysis:

Types of catalyst, specificity and selectivity, effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Surface chemistry:

Physical adsorption, chemisorption, adsorption isotherms.

Reference Books

1. Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.,* Oxford University Press (2011).
2. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
3. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
4. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd. (2004).
5. Puri, B. R.; Sharma, L. R.&Pathania, M. S.; *Principles of Physical Chemistry.*Vishal Publishing (2011).
6. Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
7. Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006)
8. Zundhal, S.S. *Chemistry concepts and applications* Cengage India (2011).
9. Ball, D. W. *Physical Chemistry* Cengage India (2012).
10. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier(2009).

ORGANIC CHEMISTRY LAB II

SUBJECT CODE-BCHMS1-303 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To understand synthesis of various organic compounds
2. To determine the melting points of organic compounds
3. To understand the use of thin layer chromatography
4. To understand chemistry involved in functional group determination

Course Outcomes:

After completion of course students will be able to:

1. Prepare prepare small organic compounds
2. Make use of melting point apparatus
3. Comparison of various organic compounds on thin layer chromatography
4. Analyze and detect organic functional groups

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included

Experiments

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidinesand *o*-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylicacid) by any one method:

a. Using conventional method.

b. Using green approach

ii Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-,*m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, p-cresol)by Schotten-Baumann reaction.

iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).

iv. Bromination of any one of the following:

a. Acetanilide by conventional methods

b. Acetanilide using green approach (Bromate-bromide method)

v. Nitration of any one of the following:

a. Acetanilide/nitrobenzene by conventional method

b. Salicylic acid by green approach (using ceric ammonium nitrate).

vi. Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.

vii. Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
viii. Hydrolysis of amides and esters.
ix. Semicarbazone of any one of the following compounds: acetone, ethyl methylketone, cyclohexanone, benzaldehyde.
x. *S*-Benzylisothiouronium salt of one each of water soluble and water insoluble acids(benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).

xi. Aldol condensation using either conventional or green method.

xii. Benzil-Benzilic acid rearrangement.
The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education(2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and* QuantitativeAnalysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: QualitativeAnalysis,* University Press (2000).

PHYSICAL CHEMISTRY LAB III

SUBJECT CODE-BCHMS1-304 **L T P C** **(60 Hrs.)**
0 0 4 2

1. **Course Objectives**
2. 1. To understand phase rule and phase diagram.
3. 2. To familiarize with various adsorption isotherms.
4. 3. To introduce the concept of critical solution temperature.
5. 4. To understand the kinetics of a reaction practically.

Course Outcomes: The students will be able to:
1. Construct the phase diagram and calculate various parameters associated with the phase concept.
2. Study kinetics of a reaction practically.
3. Apply adsorption isotherm to study adsorption phenomena.
4. Compare the strengths of acids.

Note:
1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2 Any other subject related experiment can also be included

Experiments

I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
a. simple eutectic and
b. congruently melting systems.
III. Distribution of acetic/ benzoic acid between water and cyclohexane.
IV. Study the equilibrium of at least one of the following reactions by the distribution method:
(i) $I_2(aq) + I^- \rightarrow I^{3-}(aq)$
(ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$
V. Study the kinetics of the following reactions.
1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
a. Acid hydrolysis of methyl acetate with hydrochloric acid.
b. Saponification of ethyl acetate.
3. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methylacetate.
VI. Adsorption
1. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid onactivated charcoal.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003)

CHEMISTRY OF COSMETICS AND PERFUMES

Subject Code: BCHMD1-311 **L T P C** **(30 Hrs.)**
2 0 0 2

Course Objectives

1. To provide the significance of everyday usage of cosmetics and fundamental principles related to it..
2. 3. To give an overview of cosmetic ingredients and different types of stability tests of finished products.
To familiarise the students with the chemical aspect of the cosmetics and safety measures required while applying the cosmetic product..

Course Outcomes: After completion of this course, the students will :

1. Know the significance and fundamentals of cosmetics of everyday use.
2. Have an overview of cosmetic ingredients, quality & stability testing of the finished product..
3. Understand the cosmetics from the chemical perspective and its safety measures.Students will be able to prepare some cosmetics on their own.

Unit-I **(7 Hrs.)**

Cosmetics through the Ages, Formulations of cosmetics for everyday use, A general studyincluding preparation and uses of hair care products: Hair dye, hair spray, shampoo, Skin preparations: creams (cold, vanishing and shaving creams).

Unit-II **(8 Hrs.)**

Colouring materials used in decorative cosmetics and colour matching, preparation and uses ofdecorative products: face powder, lipsticks, talcum powder, nail enamel.Sun damage and Sunscreen preparations.

Unit-III **(7 Hrs.)**

Quality, stability and safety assurance of cosmetics: analytical methods, efficacy testing of cosmetics, emulsion theory, microbiological control of cosmetics, hazard determination of ingredients, stability testing.

Unit-IV **(8 Hrs.)**

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

Practicals (any two)

1. Preparation of shampoo.
2. Preparation of nail polish and nail polish remover.
3. Preparation of cold creams.
4. Preparation of glycerine soap.

Reference Books:

1. *Handbook of Cosmetic Science and Technology* Edited by: Edited by André O. Barel, Marc Paye, Howard I. Maibach, 3rd edition
2. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
3. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
4. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).

GREEN METHODS IN CHEMISTRY

Subject Code: BCHMD1-312 **L T P C** **(30 Hrs.)**
2 0 0 2

Course Objectives :

1. To learn principles of green chemistry.
2. To familiarize with real world case studies related to green chemistry

Course Outcomes:

After completion of the course, students will be able to:

1. Explain principles of green chemistry
2. Define applications of green chemistry in industry

Tools of Green chemistry, Twelve principles of Green Chemistry, with examples.

The following Real world Cases in Green Chemistry should be discussed:
1 A green synthesis of ibuprofen which creates less waste and fewer by-products (Atomeconomy).
2 Surfactants for Carbon Dioxide – replacing smog producing and ozone depletingsolvents with CO_2 for precision cleaning and dry cleaning of garments.
3 Environmentally safe antifoulant.
4 CO_2 as an environmentally friendly blowing agent for the polystyrene foam sheetpackaging market.
5 Using a catalyst to improve the delignifying (bleaching) activity of hydrogenperoxide.
6 A new generation of environmentally advanced preservative: getting the chromiumand arsenic out of pressure treated wood.
7 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganicpigments.
8 Development of a fully recyclable carpet: cradle to cradle carpeting.

Reference Books:

1. Manahan S.E. (2005) Environmental Chemistry, CRC Press
2. Miller, G.T. (2006) Environmental Science 11th edition. Brooks/Cole
3. Mishra, A. (2005) Environmental Studies. Selective and Scientific Books, New Delhi

ELEMENTS OF MODERN PHYSICS

Subject Code: BPHYS1-302 **L T P C** **(60 Hrs.)**

4 0 0 4

Course Objective:

1. To learn and understand basic concepts of Quantum Mechanics
2. To understand the concepts of Nuclear Physics, Laser and its Applications.

Course Outcomes:

- Understanding the basic concepts in the development of modern physics.
- To establish the basic foundation of students to study the advance level course like quantum physics, particle physics and high energy physics.
- Skill enhancement to solve numerical problems related with basic quantum, nuclear and particle physics.
- To provide the knowledge of the state-of-the-art of modern days lasers and their applications in daily life.

UNIT-I(15 Hours)

Introduction to Quantum Mechanics

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

UNIT-II (15 Hours)

Quantum Mechanical Uncertainty

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence.

UNIT-III (15 Hours)

Nuclear Physics

Constituents of nucleus and their intrinsic properties, Qualitative facts about size, mass, density, energy, charge. Binding energy, angular momentum, magnetic moment and electric quadruple moments of the nucleus, Wave mechanical properties of nucleus, average binding energy and its variation with mass numbers, Properties of nuclear forces, Non existence of electrons in the nucleus and neutron-proton model, Liquid drop model and semi empirical mass formula, Conditions of nuclear stability.Radioactivity. Modes of decay and successive radioactivity. Alpha emission. Electron emission, Positron emission. Electron capture, Gamma-ray emission, Internal conversion.

UNIT-IV(15 Hours)

Laser and its Applications

Introduction**,** Coherence**,** Spatial and temporal coherence,Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Einstein's A and B coefficients. Three-Level and Four-Level Lasers. Components of Laser, Types of Laser: Ruby Laser and He-Ne Laser, Semiconductor Laser and CO_2 Laser. Q-switching, Mode locking, Applications of lasers–a general outline. Basics of holography.

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

PROGRAMMING IN C LANGUAGE

Subject Code: BMCAS1-104 **L T P C** **(60 Hrs.)**
3 1 04

Course Objectives:

1. To help the students in finding solutions to various real life problems.
2. To convert the solutions into computer program using C language (structured programming).
3. To understand a functional hierarchical code organization.
4. To design and develop modular programming.

Course Objectives Outcomes:

1. Students will learn to write algorithm for solutions to various real- life problems.
2. Students will learn to convert the algorithms into computer programs using C language.
3. Students will implement different Operations on arrays, functions, pointers, structures, unions and files

UNIT- I **(14 Hrs.)**

Algorithm and Programming Development: Steps in development of a program, Flow charts, Algorithm Development, Program Debugging, Compilation and Execution.

Fundamentals of 'C': I/O statements, Assignment Statements, Constants, Variables, Operators and Expressions, Standards and Formatted statements, Keywords, Data Types and Identifiers.

UNIT- II **(15 Hrs.)**

Control Structures: Introduction, Decision making with if – statement, if-else and Nested if, while and do-while, for loop. Jump statements: break, continue, goto, switch Statement

Functions: Introduction to Functions, Function Declaration, Function Categories, Standard Functions, Parameters and Parameter Passing, Call – by value/reference, Recursion, Global and Local Variables, Storage classes.

UNIT- III **(17 Hrs.)**

Arrays: Introduction to Arrays, Array Declaration, Single and Multidimensional Array, Memory Representation, Matrices, Strings, String handling functions.

Structure and Union: Declaration of structure, Accessing structure members, Structure Initialization, Arrays of structure, nested structures, Unions.

UNIT- IV **(14 Hrs.)**

Pointers: Introduction to Pointers, Address operator and pointers, Declaring and Initializing pointers, Assignment through pointers, Pointers and Arrays

Files: Introduction, creating a data file, opening and closing a data file, processing a data file.

Preprocessor Directives: Introduction and Use, Macros, Conditional Preprocessors, Header Files.

Recommended Books:

1. Yashvant P. Kanetkar, 'Let us C', 7th Edn., BPB Publications, NewDelhi,**2010**.
2. E. Balagurusami, 'Programming in ANSI C', 4th Edn., Tata McGrawHill, **2007**.
3. Byron S. Gottfried, 'Programming in C', 2nd Edn.,McGrawHills, **1998**.
4. Kernighan & Richie, 'The C Programming Language', 2nd Edn.,PHIPublication, **1988**.
5. R. Lafore, 'Object Oriented Programming', 3rd Edn.,GalgotiaPublications, **1999**.
6. R.S. Salaria, 'Problem Solving and Programming in C', 2nd Edn, **2015**.

MATHEMATICS-III

Subject Code: BMATH5-301 **L T P C** **(60 Hrs.)**
3 1 0 4

Course Objective:

1. To introduce concept of ordinary and partial differential equations.

Course Outcome:

Students will be able to:

1. Apply various methods to Solve first and second order linear ordinary differential equations.
2. Solve the linear partial differential equations using various methods and apply these methods in solving some physical problems.
3. Understand the formation and solution of some significant PDEs like wave equation, heat equation and Laplace equation.
4. Apply differential equations to significant applied and theoretical problems.

UNIT-I(14 Lectures)

First Order Ordinary Differential Equations: Linear and Bernoulli's equations, exact equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II(16 Lectures)

Ordinary Differential Equations of higher Orders: Second order linear differential equations with variable coefficients, (complementary function, particular integral) method of variation of parameters, Cauchy-Euler equation.

UNIT-III(15 Lectures)

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method, Second-order linear equations and their classification.

UNIT-IV(15 Lectures)

Separation of variables in a PDE; wave and heat equations in one dimensional form, Elementary solutions of Laplace equations.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
4. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
5. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.

ELEMENTS OF MODERN PHYSICS LAB

Subject Code: BPHYS1-306 **L T P C** **(30 Hrs.)**
0 0 2 1

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective:

To understand practically the laws of Modern Physics.

The course will provide hand on training to the students for handling various related instruments.

Course Outcomes:

- Able to verify the concepts/laws of basic quantum, nuclear and particle physics.
- To inculcate and develop scientific aptitude by performing the various experiments.
- Skill enhancement by solving experimental problems.
- To inculcate the spirit of teamwork.

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

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, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SOFTWARE LAB II (BASED ON BMCAS1-104 PROGRAMMING IN C LANGUAGE)

Subject Code: BMCAS1-106 **L T P C** **Duration (30 Hrs.)**
0 0 21

Course Objectives:

1. The objective of this course is to help the students in finding solutions to various real life problems
2. To convert the solutions into computer program using C language (structured programming).

Course Outcomes:

Students will learn to write programs for solving various real- life problems.

1. **Input-Output Statements:** formatted and non-formattedstatements.
2. **Decision Making:** switch, if-else, nested if, else-if ladder, break, continue, goto.
3. **Loops:** while, do-while, for.
4. **Functions:** definition, declaration, variable scope, parameterized functions, return statement, call by value, call by reference, recursivefunctions.
5. **Arrays:** Array declarations, Single and multi-dimensional, memory limits, strings and string functions.
6. **Files:** Creation and editing of various types of files, closing a file (using functions and without functions).

INORGANIC CHEMISTRY-II

SUBJECTCODE -BCHMS1-401 **L T PC** **(60 Hrs.)**
4 0 0 4

Course Objectives

1. To understand the principles of metallurgy
2. To familiarize with the concepts of acids and bases
3. To understand the concepts behind chemistry of s & p block elements
4. To learn the chemistry behind noble gases and inorganic polymers

Course Outcomes:

After the completion of course students will have:

1. Comprehend the metallurgy principles with various refining processes
2. understand chemistry of s and p block elements
3. have an overview of noble gases and inorganic polymers

UnitI **(14 Hrs.)**

General Principles of Metallurgy:

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagramsforreduction of metal oxides using carbon and carbon monoxide as reducing agent. ElectrolyticReduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Partingprocess, van Arkel-de Boer process and Mond's process, Zone refining.

Acids and Bases:

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids,types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification ofLewis acids, Hard and Soft Acids and Bases (HSAB), Application of HSAB principle.

UnitII **(13 Hrs.)**

Chemistry of *s* and *p* Block Elements-I:

Inert pair effect, Relative stability of different oxidation states, diagonal relationship andanomalous behavior of first member of each group. Allotropy and catenation. Complexformation tendency of *s* and *p* block elements.Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate andnitrate.

UnitIII(17 Hrs.)

Chemistry of *s* and *p* Block Elements-II (Continued Unit II):

Study of the following compounds with emphasis on structure, bonding, preparation,properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acidsof sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

UnitIV **(16 Hrs.)**

Noble Gases:

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation andproperties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valencebond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds(VSEPR theory).

Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, andpolysulphates.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models ofInorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning IndiaEdition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
7. Atkin, P. *Shriver & Atkins' Inorganic Chemistry 5th Ed*. Oxford University Press,2010.

ORGANIC CHEMISTRY-III

SUBJECTCODE -BCHMS1-402 **L T P C** **(60** Hrs.**)**
4 0 0 4

Course Objectives:

1.To provide the knowledge of Organic Chemistry and fundamental principles related to it..
2.To give an overview of reactivity and properties of various Organic compounds. .
3.To familiarise the students with the applications of the Organic compounds.

Course Outcomes: After completion of this course, the students will :

1.Know the significance and fundamentals of Organic compounds.
2.Have an overview of reactivity and properties of Organic copounds..
3.Understand the applications of Organic compounds in medicinal field.

UnitI (18 Hrs.)

Nitrogen Containing Functional Groups:

Preparation and important reactions of nitro and compounds, nitriles and isonitriles.Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive emethylation, Hofmann-elimination reaction; Distinction between 1°, 2°and 3°amines withHinsberg reagent and nitrous acid.Diazonium Salts: Preparation and their synthetic applications.

UnitII (15 Hrs.)

Polynuclear Hydrocarbons:

Reactions of naphthalene, phenanthrene and anthracene. Structure, Preparation and structureelucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

Heterocyclic Compounds-I:

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered ringscontaining one heteroatom; Synthesis, reactions and mechanism of substitution reactions of:Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis),Thiophene,

Unit III(15 Hrs.)

Heterocyclic Compounds-II (Continued Unit II):

Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole,Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline andisoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-FritschreactionDerivatives of furan: Furfural and furoic acid.

UnitIV (12 Hrs.)

Alkaloids:

Natural occurrence, General structural features, Isolation and their physiological actionHoffmann's exhaustive methylation, Emde's modification, Structure elucidation andsynthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine,Morphine, Cocaine, and Reserpine.

Terpenes:

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral,Neral and α-terpineol.

Reference Books:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds*, John Welly & Sons, 1976.
5. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.

6. McMurry, J.E. *Fundamentals of Organic Chemistry*, *7th Ed*. Cengage Learning India Edition, 2013.
7. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
8. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press
9. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan,2010.

INORGANIC CHEMISTRY-II LAB

SUBJECTCODE-BCHMS1-403 **L T PC** **(60 Hrs.)**
0 0 4 2

Course Objectives:

1. To learn the principles applicable to various experiments.

2. To understand the concepts behind Iodo/Iodimetric titrations
3. To synthesize various inorganic compounds

Course Outcomes:

After completion of course students will gain the knowledge of:

1. Obtaining precise results of Iodo/Iodimetric titrations
2. Preparation of transition metal based inorganic compounds

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included

(A) Iodo/Iodimetric Titrations:

(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution(Iodimetrically).
(ii)Estimation of antimony in tartar-emetic iodimetrically
(iii) Estimation of available chlorine in bleaching powder iodometrically.
(iv) Calculation of percentage dehydration in copper sulphate crystals.
(v) Determination of percentage composition of mixture (copper sulphate and potassium sulphate).

(B) Inorganic preparations:

(i) Preparation of Cuprous Chloride, Cu_2Cl_2
(ii) Preparation of tristhioureacopper(I)chloride
(iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum)
(iv) Preparation of Chrome alum $KCrS_2O_8$
(v) Cis-Trans diaquodioxalatochromate(II)

Reference Books:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009

ORGANIC CHEMISTRY-III LAB

SUBJECTCODE-BCHMS1-404 **L T PC** **(60 Hrs.)**
0 0 4 2

Course Objectives:

1. To understand the concepts behind detection of extra elements
2. To acquire knowledge of chemistry behind functional group tests
3. To study the quantitative analysis of organic compounds

Course Outcomes:

After completion of course students will acquire the knowledge of:

1. Detection techniques of extra elements
2. Concepts of functional groups detection
3. Quantitative analysis of organic molecules

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included

Experiments

1. Detection of extra elements
2. Functional group tests for (a) nitro groups
   (b) amine groups
   (c) amide groups
3. Qualitative analysis of unknown organic compounds containing simple functionalGroups:
   (a) Alcohols
   (b) Carboxylic acids
   (c) Phenols
   (d) Other carbonyl compounds

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education, 2009.
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry*, 5^{th} *Ed.*,Pearson,2012.
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis*, University Press, 2000.
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry:Qualitative Analysis*, University Press, 2000.

FUEL CHEMISTRY

SUBJECTCODE- BCHMD1-411 **L T PC** **(30 Hrs.)**
2 0 0 2

Course Objectives

1. To study the classification of fuels, uses and their calorific value
2. To understand the industrial uses of petroleum
3. To study the classification and properties of lubricants

Course Outcomes:

After completion of course students will attain the knowledge of:

1. Industrial applications of coal
2. Industrial uses and applications of petroleum
3. Properties and uses of lubricants

UnitI **(8 Hrs.)**

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

Coal:

Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization ofcoal. 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.

UnitII **(7 Hrs.)**

Petroleum and Petrochemical Industry*:*

Composition of crude petroleum, Refining anddifferent types of petroleum products and their applications.Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking).

UnitIII **(8** Hrs.**)**

Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derivedfrom biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and itsderivatives Xylene.

UnitIV **(7 Hrs.)**

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.

Reference Books:

1. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK, 1990.
2. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut, 1996.

PHARMACEUTICAL CHEMISTRY

SUBJECTCODE-BCHMD1-412 **L T PC** **(30 Hrs.)**
2 0 0 2

Course Objectives

1. To understand the concepts of drug design and development
2. To acquire the knowledge of synthesis of drug molecules.
3. To study the concepts of aerobic and anaerobic fermentation for industrial applications

Course Outcomes:

After completion of course students will gain the knowledge of:

1. Synthetic methods used for the drug design and development
2. Aerobic and anaerobic fermentation and its importance in pharmaceutical industries.

UNIT I (8 Hrs.)

Drugs & Pharmaceuticals-I:

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of therepresentative drugs of the following classes: analgesic agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol).

UNIT II (8 Hrs.)

Drugs & Pharmaceuticals-II:

Synthesis of the representative drugs:Antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide,Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital,Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS relateddrugs (AZT-Zidovudine).

UnitIII (8 Hrs.)

Fermentation-I:

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii)Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin.

UnitIV (6 Hrs.)

Fermentation-II (Continued Unit III):

(iii) Lysine,Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Reference Books:

1. Patrick, G. L. *Introduction to Medicinal Chemistry, Oxford University* Press, UK, 2013.
2. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry,* Vallabh Prakashan, Pitampura, New Delhi, 2012.
3. Foye, W.O., Lemke, T.L. & William, D.A.: *Principles of Medicinal Chemistry*, 4th*Ed*., B.I. Waverly Pvt. Ltd. New Delhi

WAVES AND OPTICS

Subject Code: BPHYS1-202 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objective:

To understand the fundamentals of harmonic oscillations, wave motion,
To provide the knowledge of wave optics: diffraction, interferometer and holography.

Course Outcomes:

- Understanding the concepts of harmonic oscillations, wave motion, wave optics, interference and diffraction.
- Skill enhancement to solve numerical problems related with Waves and Optics.
- Apply knowledge of Waves and Optics to go for higher studies in diverse fields.
- To inculcate and develop the ability to think abstractly.

UNIT-I (15 Hours)

Harmonic oscillations and Superpositions

Introduction to Harmonic oscillations, Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.

UNIT-II (15 Hours)

Wave Motion

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

UNIT-III (15 Hours)

Wave Optics and Interference

Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Interference: Division of amplitude and 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. Interferometer: Michelson Interferometer-(1) Idea of form of fringes (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

UNIT-IV (15 Hours)

Diffraction

Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone

Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Reference Books

1 Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2 Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3 Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
4 The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
5 The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
6 Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

OBJECT ORIENTED PROGRAMMING LANGUAGE IN C++

Subject Code: BMCAS1-204 **L T P C** **(60 Hrs.)**

3 1 0 4

Course Objectives:

1. To develop a greater understanding of the issues involved in programming language design and object oriented paradigms and its implementation.
2. To impart adequate knowledge on the need of object oriented programming languages.
3. To enhance problem solving and programming skills in C++ by implementing the object oriented concepts.
4. To understand the difference between the top-down and bottom-up approach.

Course Objectives:After completion of this course students will be able to:

1. Apply the concepts of object-oriented programming.
2. Illustrate the process of data file manipulations using C++.
3. Apply virtual and pure virtual function and complex programming situations.
4. Describe the object-oriented programming approach in connection with C++.

UNIT-I (14 Hrs.)

Characteristics of Object Oriented Programming: Abstraction, Encapsulation, Data hiding, Inheritance, Polymorphism, Code Extensibility and Reusability, User defined Data Types.Introduction to C++: Identifier, Keywords, Constants, And Operators: Arithmetic, relational, logical, And conditional and assignment. Size of operator, Operator precedence and associativity.

UNIT-II (15 Hrs.)

Classes and Objects: Class Declaration and Class Definition, defining member functions, making functions inline, nesting of member functions, Members access control. this pointer.Objects: Object as function arguments, array of objects, functions returning objects, Const member functions.
Destructors: Properties, Virtual destructors. Destroying objects. Rules for constructors and destructors. Array of objects. Dynamic memory allocation using new and delete operators, Nested and container classes.

UNIT-III (17 Hrs.)

Static data members and Static member functions. Friend functions and Friend classes.
Constructors: properties, types of constructors (Default, parameterized and copy), Dynamic constructors, multiple constructors in classes.
Inheritance: Defining derived classes,inheriting private members,single inheritance,types of derivation, function redefining, constructors in derived class.
Types of Inheritance: Single, Multiple, Multilevel and Hybrid. Types of base classes: Direct, Indirect, Virtual, Abstract. Code Reusability.

UNIT-IV (14 Hrs.)

Polymorphism: Methods of achieving polymorphic behavior.
Operator overloading: overloading binary operator, overloading unary operators, rules for operator overloading, operator overloading using friend function.
Function overloading: Early binding, Polymorphism with pointers, virtual functions,late binding, pure virtual functions and abstract base class. Introduction to File Handling.

Recommended Books:

1. E. Balagurusamy, 'Object Oriented Programming with C++', Tata McGrawHill, **2008**.
2. Deitel and Deitel, 'C++ How to Program', PearsonEducation, **2012**.
3. Herbert Schildt, 'The Complete Reference C++', Tata McGrawHill, **2003**.
4. Robert Lafore, 'Object Oriented Programming in C++', GalgotiaPublications, **2002**.
5. BjarneStrautrup, 'The C++ Programming Language', Addition-Wesley PublicationCo, **1986**.
6. Stanley B. Lippman, JoseeLajoie, 'C++ Primer', Pearson Education, **2002.**

MATHEMATICS-IV

Subject Code: BMATH5-401 **L T P C** **(60 Hrs.)**
3 1 0 4

Course Objective:

To learn about basics and properties of fourier series

To learn about Laplace transformation, inverse Laplace transformation and their uses to solve differential equations

UNIT-I **(14 Hrs.)**

Fourier series: Definition of Periodic functions, Euler's formula, Even and odd functions, half range expansions, Fourier series of different wave forms.

UNIT-II **(16 Hrs.)**

Fourier transform: Dirichlet's conditions, Fourier integral formula, properties of Fourier transform, inversion formula, convolution, Parseval's equality; Fourier transform of generalized functions, application of transforms to heat wave and Laplace equation.

UNIT-III **(15 Hrs.)**

Laplace Transforms: Laplace transforms of functions and its properties, inverse Laplace transforms, transform of derivatives and integrals.

UNIT-IV **(15 Hrs.)**

Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients and simultaneous differential equations.

Course Outcome: After the completion of the course ,Students will understand :

1. Basics of periodic functions and Fourier series representation.
2. The use of Fourier transforms and its applications in different fields.
3. Laplace and Inverse Laplace transform and their properties.
4. Methods for Laplace transformation and its applications for the solutions of Differential Equations.

References Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.

3. Ian N. Sneedon, Elements of Partial Differential Equations, McGraw- Hill, Singapore, 1957.
4. Advanced Engineering Mathematics, O'Neil, Cengage Learning.
5. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
6. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.

WAVES AND OPTICS-LAB

Subject Code: BPHYS1-205 **L T P C** **Duration: 30 Hrs.**

0 0 21

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective:

1. To learn practically the various concepts of waves and optics.
2. The course will provide hand on training to the students for handling various related instruments.

Course Outcome:

- Able to verify the concepts/laws of Waves and Optics
- To inculcate and develop scientific aptitude by performing the various experiments.
- Skill enhancement by solving experimental problems.
- To inculcate the spirit of teamwork.

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster`s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes roduced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.
13. To Simulation of interference fringes with different shapes using Fortran Programming
14. To Simulate the effect of coherence on interference fringes
15. To Simulate propagation of EM waves in free space and in an optical fiber

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

SOFTWARE LAB-IV (BASED ON BMCAS1-204)

Subject Code: BMCAS1--207 **L T PC**

0 0 2 1 **(30 Hrs.)**

This laboratory course will comprise as exercises to supplement what is learnt under paper BMCAS1-: 204 Object oriented Programming Usng C++.Students will be provided with Operational Knowledge and Implementation of numerical methods & statistical Techniques using C++ Language

INORGANIC CHEMISTRY-III

SUBJECT CODE -BCHMS1-501 **L T P C** **(60 Hrs.)**

4 0 0 4

Course Objectives

1. To understand the concepts behind the basics of coordination chemistry.
2. To understand the concept of chemistry of various transition elements.
3. To familiarize with the chemistry of lanthanoids and actinoids.
4. To introduce the fundamentals of bioinorganic chemistry.

Course Outcomes: After completion of this course, students will be able to:

1. Understand the fundamental concepts of Inorganic and Bioinorganic Chemistry.
2. know the application of Inorganic and Bioinorganic chemistry.
3. Interpret and analyze the facts on the basis of fundamentals of Inorganic and Bioinorganic Chemistry.
4. Differentiate the related concepts of Inorganic chemistry.

Unit I **(15 Hrs.)**

Coordination Chemistry-I:

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination,

Unit II **(15 Hrs.)**

Coordination Chemistry-II:

Tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar geometry.Qualitative aspect of Ligand field and MO Theory. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

Unit III **(15 Hrs.)**

Transition Elements:

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer &Bsworth diagrams). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

Unit IV **(15 Hrs.)**

Lanthanoids and Actinoids: Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Bioinorganic Chemistry: Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

Reference Books:

1. Purcell, K.F &Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977. • Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
2. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
3. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999
4. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
5. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, ButterworthHeinemann,1997.

ORGANIC CHEMISTRY-IV

SUBJECT CODE –BCHMS1-502 **L T P C** **(60 Hrs.)**

4 0 0 4

Course Objectives

1. To familiarize the students with the basic concepts of nucleic acids.
2. To elaborate the concept of amino acids, peptides and proteins.
3. To understand the enzymes chemistry and their mechanism of action.
4. To understand the concept of energy in bio systems.

Course Outcomes: The completion of this course will make students to :

1. Understand the basic concepts of nucleic acids, amino acids, peptides and proteins
2. Classify and sketch the synthesis routes of nucleic acids, amino acids, peptides and proteins
3. Analyze enzymes chemistry and their mechanism of action

Outline the energy conversion pathways of bio systems

Unit I **(15 Hrs.)**

Nucleic Acids:

Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and representative reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine. Structure of polynucleotides.

Lipids: Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Unit II **(15 Hrs.)**

Amino Acids, Peptides and Proteins:

Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting and C-protecting groups -Solid-phase synthesis.

Unit III **(15 Hrs.)**

Enzymes:

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), 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, uncompetitive and non-competitive inhibition including allosteric inhibition).

Unit IV **(15 Hrs.)**

Concept of Energy in Biosystems:

How cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism).

ATP: ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD+ , FAD.

Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein.Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types

Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis),Analgesics: Ibuprofen (with synthesis), Antimalarials : Chloroquine (with synthesis). Medicinal values of curcumin (haldi),

azadirachtin (neem), vitamin C and antacid (ranitidine).

Reference Books:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.

3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill. 32 CHEMISTRY PRACTICAL-C XI

PHYSICAL CHEMISTRY-IV

SUBJECT CODE-BCHMS1-503 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objectives

1. To familiarize with the concept of conductance and related theories.
2. To introduce basic concepts of electrochemistry.
3. To explain the applications of EMF measurements.
4. To introduce electrical & magnetic properties of atoms and molecules.

Course Outcomes: On completion of this course, students will be able to:

1. Apply the theories of conductance in various solutions.
2. Understand the role of EMF in determination of physical parameters like pH, entropy etc.
3. Calculate the various physical parameters based on conductance.
4. Predict the electrical & magnetic properties of atoms and molecules.

Unit I (15 Hrs.)

Conductance:

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity atinfinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods.

Unit II (15 Hrs.)

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts and (iv) hydrolysis constants of salts.

Electrochemistry-I:

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation.

Unit III (15 Hrs.)

Electrochemistry-II:

Standard electrode (reduction) potential and its application to different kinds of half-cells.

Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone and glass electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Unit IV (15 Hrs.)

Electrical & Magnetic Properties of Atoms and Molecules:

Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement.

Reference Books:

1. Atkins, P.W & Paula, J.D. Physical Chemistry, 9th Ed., Oxford University Press (2011).
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
3. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
4. Barrow, G. M., Physical Chemistry 5th Ed., Tata McGraw Hill: New Delhi (2006).
5. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).

6. Rogers, D. W. Concise Physical Chemistry Wiley (2010).
7. Silbey, R. J.; Alberty, R. A. &Bawendi, M. G. Physical Chemistry 4th Ed., John Wiley & Sons, Inc. (2005).

INORGANIC CHEMISTRY –III LAB

Subject Code: BCHMS1-504 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To develop basic understanding of gravimetric analysis and estimation of different metals using the concept.
2. To familiarize the students with inorganic preparation.
3. To make the students understand principles involved in chromatographic separations.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the fundamental concepts related to Gravimetric analysis, Inorganic complexes and chromatography.
2. Extend and associate the fundamental concepts to Gravimetric analysis, Inorganic complexes and chromatographic separation .
3. Perform the gravimetric & chromatographic analysis and prepare the Inorganic complexes in the laboratory.

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

Gravimetric Analysis:

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
ii. Estimation of copper as CuSCN
iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
iv. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).

Inorganic Preparations:

i. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
ii. Iron acetylacetonate
iii. Tetraamminecarbonatocobalt (III) ion
iv. Potassium tris(oxalate)ferrate(III)

Chromatography of metal ions:

i. Principles involved in chromatographic separations.
ii. Paper chromatographic separation of following metal ions:
  i. Ni (II) and Co (II)
  ii. Fe (III) and Al (III)

Reference Book:

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

ORGANIC CHEMISTRY –IV LAB

Subject Code: BCHMS1-505 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To develop basic understanding of estimation of amino acids and proteins
2. To study the action of salivary amylase and the effect of various parameters on its action.
3. To determine various physical parameters of oil and fat.
4. To make them familiar with the procedures for synthesis of drugs and peptides

Course Outcomes: The completion of this course will make students able to:

1. Estimate amino acids, proteins and other natural products by chemical methods
2. Study the action of salivary amylase and the effect of various parameters on its action.
3. Calculate the physical parameters of oil and fat.
4. Learn the procedures for synthesis of drugs and peptides and apply the methods to synthesize basic drug molecules

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Estimation of proteins by Lowry's method.
4. Study of the action of salivary amylase on starch at optimum conditions.
5. Effect of temperature on the action of salivary amylase.
6. Saponification value of oil or a fat.
7. Determination of Iodine number of an oil/ fat.
8. Isolation and characterization of DNA from onion/ cauliflower/peas.
9. Synthesis of drugs: Paracetamol, Ibuprofen, Chloroquine, acetaminophen and Aspirin
10. Determination of pK_a and isoelectric points of amino acids:Alanine, Cystine, Glutamic acid and Histidine
11. Synthesis of peptides using N-protecting, C-protecting groups and DCC.

Reference Books:

1. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
2. Arthur, I. V. Quantitative Organic Analysis, Pearson.

PHYSICAL CHEMISTRY –IV LAB

Subject Code: BCHMS1-506 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To familiarise with the working of the conductivity meter.
2. To familiarise with determination of cell constant.
3. To introduce the principle of conductometric titrations.
4. To introduce the principle of potentiometric titrations.

Course Outcomes: On completion of this course, students will be able to:

1. Standardise the conductivity meter.
2. Handle various electrodes.
3. Apply conductometric titrations for various determinations.
4. Perform potentiometric titrations for various applications.

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

Conductometry:

i. Determination of cell constant
ii. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
iii. Perform the following conductometric titrations:
   i. Strong acid vs. strong base
   ii. Weak acid vs. strong base
   iii. Mixture of strong acid and weak acid vs. strong base
   iv. Strong acid vs. weak base

Potentiometry:

i. Perform the following potentiometric titrations:
   i. Strong acid vs. strong base
   ii. Weak acid vs. strong base
   iii. Dibasic acid vs. strong base
   iv. Potassium dichromate vs. Mohr's salt

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

APPLICATIONS OF COMPUTERS IN CHEMISTRY

Subject Code: BCHMD1-511 **L T P C** **(45 Hrs.)**
3 0 0 3

Course Objectives

1. To familiarize with the basics of computers.
2. To understand the roots of equations and differential calculus.
3. To understand basic concepts of simultaneous equations and molecular modelling

Course Outcomes: The completion of this course students will be able to:

1. Understand the basic concepts of computers
2. Solve the numerical problems based on concepts of roots of equations, differential calculus and simultaneous equations
3. Learn basic concepts of molecular modelling

Unit I **(11 Hrs.)**

Basics:

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics.

Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis

Unit II **(11 Hrs.)**

Numerical methods:

Roots of equations:

Numerical methods for roots of equations:Quadratic formula, iterative method, Newton-Raphson method, Binary bisection and Regula-Falsi.

Differential calculus: Numerical differentiation.

Unit III **(11 Hrs.)**

Integral calculus:

Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values. Simultaneous equations:

Matrix manipulation: addition, multiplication. Gauss-Siedal method.

Unit IV **(12 Hrs.)**

Interpolation, extrapolation and curve fitting:

Handling of experimental data.

Conceptual background of molecular modelling:

Potential energy surfaces. Elementary ideas of molecular mechanics and practical MO methods.

Reference Books:

1. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
2. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages.
3. Noggle, J. H. Physical chemistry on a Microcomputer. Little Brown & Co. (1985).
4. Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996

INSTRUMENTAL METHODS OF ANALYSIS

Subject Code: BCHMD1-512 **L T P C** **(45 Hrs.)**
30 0 3

Course Objectives

1. To familiarize with qualitative and quantitative aspects of analysis.
2. To introduce optical methods of analysis.
3. To explain the concepts of thermal methods and electroanalytical methods.
4. To introduce the concept of separation techniques.

Course Outcomes: On completion of this course, students will be able to:

1. Apply qualitative and quantitative analysis for appropriate purposes.
2. Carry out analytical estimations scientifically using appropriate methods.
3. Understand the principle and instrumentation of various instruments used for analytical purpose.
4. Select and apply suitable separation techniques for separation in mixtures.

Unit I (11 Hrs.)

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.

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;

Unit II (12 Hrs.)

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.

Unit III (12 Hrs.)

Thermal methods of analysis:
Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

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 pKa values.

Unit IV **(10 Hrs.)**

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.

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).

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

NOVEL INORGANIC SOLIDS

Subject Code: BCHMD1-513 **L T P C** **(45 Hrs.)**
30 0 3

Course Objectives

1. To familiarize with synthesis and modification of inorganic solids.
2. To understand the concept of nanomaterials.
3. To understand engineering materials for mechanical construction.
4. To understand composite materials and polymers

Course Outcomes: The completion of this course will make students to acquire the knowledge of:

1. Basic concepts of synthesis and modification of inorganic solids
2. Concepts of nanomaterials
3. Basic concepts engineering materials for mechanical construction
4. Fundamentals of composite materials and polymers

Unit I **(12 Hrs.)**

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.

Unit II **(11 Hrs.)**

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.

Unit III **(10 Hrs.)**

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, aluminum and their alloys like duralumin, brasses and bronzes

Unit IV **(12 Hrs.)**

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.

Speciality polymers:
Conducting polymers - Introduction, conduction mechanism, polyacetylene and polypyrole, applications of conducting polymers

Reference Books:

1. Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)
2. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry.
3. Frank J. Ovens, Introduction to Nanotechnology

APPLICATIONS OF COMPUTERS IN CHEMISTRY LAB

Subject Code:BCHMD1-514 **L T P C** **(30 Hrs.)**
0 0 2 1

Course Objectives

1. To make the students develop programs to solve chemistry problems using computer programs based on numerical methods.
2. To understand the basic tools of computer science in relation with chemistry.
3. To differentiate between systematic errors and random errors and how to delete or reduce their effects.
4. To design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

Course Outcomes: The completion of this course will make student able to:

1. Understand the basic tools of computer science in relation with chemistry.
2. Develop programs to solve chemistry problems using computer programs based on numerical methods.
3. Differentiate between systematic errors and random errors and how to delete or reduce their effects.
4. Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

EXPERIMENTS

Computer programs based on numerical methods for:

1. Roots of equations: (e.g. volume of Van der Waals gas and comparison with ideal gas, pH of a weak acid).
2. Numerical differentiation (e.g., change in pressure for small change in volume of a Van der Waals gas, potentiometric titrations).
3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values.
4. Matrix operations. Application of Gauss-Siedel method in colourimetry.
5. Simple exercises using molecular visualization software.

Reference Books:

1. McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008).
2. Mortimer, R. Mathematics for Physical Chemistry. 3rd Ed. Elsevier (2005).
3. Steiner, E. The Chemical Maths Book Oxford University Press (1996).
4. Yates, P. Chemical Calculations. 2nd Ed. CRC Press (2007).
5. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
6. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages.
7. Noggle, J. H. Physical Chemistry on a Microcomputer. Little Brown & Co. (1985).
8. Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996).

INSTRUMENTAL METHODS OF ANALYSIS LAB

Subject Code:BCHMD1-515 **L T P C** **(30 Hrs.)**
0 0 21

Course Objectives

1. To familiarize with preparation of TLC.
2. To familiarize with chromatographic separation of mixtures.
3. To introduce the basic concept of extractions techniques.
4. To familiarise with working of UV/VIS spectrophotometer.

Course Outcomes: On completion of this course, students will be able to:

1. Prepare and use TLC
2. Perform chromatographic separations.
3. Apply the concept of solvent extraction.
4. Apply spectrophotometric determination of various quantities.

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

Separation Techniques

Chromatography: 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 Rf values.
iii. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.
iv. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

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 zirconium with amberliti LA-1, separation from a mixture of irons and gallium.
iii. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
iv. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.
v. Analysis of soil: (i) Determination of pH of soil. (ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate
vi. 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.

Spectrophotometry:

i. Determination of pKa values of indicator using spectrophotometry.
ii. Structural characterization of compounds by infrared spectroscopy.
iii. Determination of dissolved oxygen in water.
iv. Determination of chemical oxygen demand (COD).
v. Determination of Biological oxygen demand (BOD).
vi. Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London. 45
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

NOVEL INORGANIC SOLIDS LAB

Subject Code: BCHMD1-516 **L T P C** **(30 Hrs.)**
0 0 2 1

Course Objectives

1. To familiarize with determination of cation exchange method and total difference of solids
2. To understand the basic concept of synthesis of hydrogels and nanoparticals

Course Outcomes: The completion of this course will make students will be:

1. Able to understand basic concepts of determination of cation exchange method and total difference of solids
2. Familiarize with basic concept of synthesis of hydrogels and nanoparticals

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

1. Determination of cation exchange capacity.
2. Determination of total difference of solids.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of Iron, Zinc and copper metal nanoparticles by any two methods.
5. Estimation of Aluminium in various alloys.
6. Estimation of copper in various alloys.
7. Synthesis of any two nanocomposites.

Reference Book:

1. Fahan, Materials Chemistry, Springer (2004).

PHYSICAL CHEMISTRY V

Subject Code: BCHMS1-601 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives

1. To understand the concept of quantum mechanics, Schrödinger wave equation and its applications
2. To introduce the concept of spherical harmonics and quantum chemical description of chemical bonding
3. To familiarize with the basics of electronic, vibrational and nuclear magnetic resonance spectroscopy
4. To understand fundamentals of photochemistry including photochemical reactions in biochemical processes

Course Outcomes:

The students will be able to:

1. Understand the concept of quantum mechanics, molecular spectroscopy and photochemistry
2. Solve numerical problems based on the concept of quantum mechanics.
3. Analyze the spectroscopic transition.
4. Quantitative analysis of photochemical reactions

UNIT I (15 Hrs.)

Quantum Chemistry:

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

UNIT II (15 Hrs.)

Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorm and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations.

UNIT III (16 Hrs.)

Molecular Spectroscopy:

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-

rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

UNIT IV **(14 Hrs.)**

Photochemistry:

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Reference Books:

1 Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).

2 Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).

3 House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).

4 Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).

5 Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

INORGANIC CHEMISTRY-IV

Subject Code: BCHMS1-602 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives

1. To understand the basic principles involved in analysis of cations and anions
2. To familiarize with organometallic compounds, 18 electron rule, metal carbonyls and metal alkyls
3. To introduce inorganic reaction mechanisms, trans effect
4. To understand the concept of catalysis by organometallic compounds

Course Outcomes:

The students will be able to

1 Understand solubility products, common ion effect. group reagents and interfering anions

2 Familiarize with organometallic compounds, p acceptor ligands and metal alkyls 3 Understand the mechanism of substitution in square planar and octahedral complexes

4 Write mechanism ofvarious catalytic processes including hydrogenation, Hydroformylation

5 Get knowledge of preparation methods and reactions of ferrocene

UNIT I (13 Hrs.)

Theoretical Principles in Qualitative Analysis (H_2S Scheme):

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

UNIT II (18 Hrs.)

Organometallic Compounds:

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. □-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

UNIT III (12 Hrs.)

Reaction Kinetics and Mechanism:

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

UNIT IV (17 Hrs.)

Catalysis by Organometallic Compounds:

Study of the following industrial processes and their mechanism: Alkene hydrogenation (Wilkinsons Catalyst), Hydroformylation (Co salts), Wacker Process, Synthetic gasoline (Fischer Tropsch reaction), Synthesis gas by metal carbonyl complexes

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

Reference Books:

1 Vogel, A.I. *Qualitative Inorganic Analysis*, Longman, 1972 36

2 Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall,1996-03- 07.

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

4 Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.,* Harper Collins 1993, Pearson,2006.

5 Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005

6 Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry3rd Ed.,* John Wiley and Sons, NY, 1994.

7 Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements*, *Elsevier 2nd Ed*, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).

8 Lee, J.D. *Concise Inorganic Chemistry 5th Ed.,* John Wiley and sons 2008.

9 Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.

10 Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.,* Oxford University Press, 1994.

11 Basolo, F. & Person, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.,* John Wiley & Sons Inc; NY.

12 Purcell, K.F. & Kotz, J.C., *Inorganic Chemistry*, W.B. Saunders Co. 1977

13 Miessler, G. L. & Donald, A. Tarr, *Inorganic Chemistry 4th Ed.,* Pearson, 2010.

14 Collman, James P. et al. *Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987.

15 Crabtree, Robert H. *The Organometallic Chemistry of the Transition Metals*. *J* New York, NY: John Wiley, 2000.

16 Spessard, Gary O., &Gary L. Miessler. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.

ORGANIC CHEMISTRY-V

Subject Code: BCHMS1-603 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives

1. To understand the basic principles of organic spectroscopy including UV, IR and NMR spectroscopy
2 To familiarize with mechanistic pathways of complex organic molecules
3. To familiarize with classification/biological significance/color/constitution of carbohydrates/dyes
4. To understand concepts of classification/chemistry of polymers and fabrics

Course Outcomes:

After completion of the course, students will be able to:

1. Achieve the fundamentals of UV/IR/NMR spectroscopy for organic molecules
2. Write mechanisms of various organic molecules (simple/complex molecules)
3. Explain concepts behind classification/biological significance/color/constitution of carbohydrates/dyes
4. Describe concepts of classification/chemistry of polymers and fabrics

UNIT I (18 Hrs.)

Organic Spectroscopy: General principles Introduction to absorption and emission spectroscopy.
UV Spectroscopy: Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.
NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpetation of NMR spectra of simple compounds.

UNIT II (16 Hrs.)

Carbohydrates: Occurrence, classification and their biological importance.
Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Inter conversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose.
Polysaccharides: Elementary treatment of starch, cellulose and glycogen.

UNIT III (13 Hrs.)

Dyes: Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

UNIT IV **(13 Hrs.)**

Polymers: Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index. **Polymerisation reactions**:Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); **Fabrics:** Natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

Reference Books:

1 Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
2 Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3 Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
4 Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
5 Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6 Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
7 Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, OxfordUniversity Press.
8 Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Prakashan(2010).
9 Kemp, W. *Organic Spectroscopy*, Palgrave

PHYSICAL CHEMISTRY LAB-V

Subject Code: BCHMS1-604 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Course Objective:

1. To acquaint the students with the basics absorption spectroscopy
2. To make the students learn to run the UV VIS Spectrophotometer and its various applications in chemical analysis
3. To learn colourimetry techniques for various analytical applications .

Course Outcomes:

The students will be able to:

1. Understand the basics absorption spectroscopy
2. Run the UV VIS Spectrophotometer and do various chemical analysis using the technique
3. Do chemical analysis using colourimetry techniques

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

UV/Visible spectroscopy

I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).

II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.

III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

I. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration.

II. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.

III. Study the kinetics of iodination of propanone in acidic medium.

IV. Determine the amount of iron present in a sample using 1,10-phenathroline.

V. Determine the dissociation constant of an indicator (phenolphthalein).

VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

VII. Analysis of the given vibration-rotation spectrum of HCl(g)

Reference Books

1 Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New
2 'Findlay's Practical Physical Chemistry'.
3. J.B. Yadav, 'Advanced Practical Physical Chemistry'.

INORGANIC CHEMISTRY LAB-IV

Subject Code: BCHMS1-605 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Course Objective:

1 To understand qualitative semi micro analysis of mixtures containing 3 anions and 3 cations.
2 To provide knowledge of various methodologies for synthesis of target molecules

Course Outcomes:

The students will acquire knowledge of
1 Analysis of mixture for cations and anions 2 Syntheses of inorganic complexes

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments

1 Qualitative semi micro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:
CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+,Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+},Sr^{2+}, Ca^{2+},Mg^{2+}
Mixtures should preferably contain one interfering anion, **or** insoluble component ($BaSO_4$,$SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3)**or** combination of anions e.g. $CO_3^{2-}$and SO_3^{2-}, NO_2^- and NO_3^-,Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-. Spot tests should be done whenever possible.
2. Measurement of 10 Dq by spectrophotometric method
3. Verification of spectrochemical series.
4. Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs thermodynamic factors.
5. Preparation of acetylacetanato complexes of Cu^{2+}/Fe^{3+}. Find the λmax of the complex.
6. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Reference Books:

1 Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla.
2 Marr & Rockett *Inorganic Preparations.*

ORGANIC CHEMISTRY LAB-V

Subject Code: BCHMS1-606 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Course Objective:

1 To provide knowledge of extraction of organic compounds from natural sources. 2 To familiarize with syntheses of compounds
3 Analysis of unknown organic molecules
4. To identify organic compounds by applying IR//NMR spectroscopic concepts

Course Outcomes:

After completion of the course, students will be able to:

1. Extract caffeine from tea leaves
2. Carry out selected polymeric reactions/methyl orange
3. Detect various organic functional group
4. Identify organic compounds by applying IR//NMR spectroscopic concepts

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments

1. Extraction of caffeine from tea leaves.
2. Preparation of sodium polyacrylate.
3. Preparation of urea formaldehyde.
4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
5. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.
6. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).
7. Preparation of methyl orange.

Reference Books:

1 Vogel, A.I. *Quantitative Organic Analysis*, Part 3, Pearson (2012).
2 Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
3 Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
4 Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, University Press (2000).
5 Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press (2000).

POLYMER CHEMISTRY

Subject Code: BCHMD1-611 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives

1. To recall concepts involved in polymerization..
2. To introduce various mechanism and kinetics of polymer.
3. To introduce properties and factor affecting the properties of polymers
4. To familiarise with applications of polymer.

Course Outcomes:

The students will be able to

1. concept of polymers and polymer related termnology.
2. To familiarize with concept of kinetics of Polymerization, Morphology of crystalline polymers.
3. Apply the advanced polymer in various field of industries.
4. Analyze the crystal structure of polymer with advanced characterization techniques

UNIT I **(11 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. Bifunctional systems, Poly-functional systems.

UNIT II **(11 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.

Nature and structure of polymers: Structure Property relationships.

UNIT III **(11 Hrs.)**

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).

UNIT IV **(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 critical solution 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 formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Reference Books:

1 *Seymour's Polymer Chemistry*, Marcel Dekker, Inc.
2 G. Odian: Principles of Polymerization, John Wiley.
3 F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
4 P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
5 R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

MOLECULAR MODELLING AND DRUG DESIGN

Subject Code: BCHMD1-612 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives

1. To impart knowledge about concept of molecular modelling
2. To understand computer simulation methods
3. To familiarize molecular dynamics and monte carlo simulation methods
4. To understand structure prediction and drug design

Course Outcomes:

The students will be able to:

1. Understand the concept of molecular modelling
2. Learn computer simulation methods
3. Apply molecular dynamics and monte carlo simulation methods on different molecules
4. Predict structure and design new drug molecules

UNIT I **(11 Hrs.)**

Introduction to Molecular Modelling: Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature.

Force Fields: Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. van der Waals Interactions. Hydrogen bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.

UNIT II **(11 Hrs.)**

Energy Minimization and Computer Simulation: Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.

UNIT III **(11 Hrs.)**

Molecular Dynamics & Monte Carlo Simulation: Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of molecules. Models used in Monte Carlo simulations of polymers.

UNIT IV **(12 Hrs.)**

Structure Prediction and Drug Design: Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR.

4 Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics

Reference Books:

1 A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.
2 J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
3 Satya Prakash Gupta, QSAR and Molecular Modeling, Springer – Anamaya Publishers, 2008.

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

Subject Code: BCHMD1-613 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives

1. To impart knowledge about manufacturing and properties of glasses, ceramics and cements
2. To understand manufacturing of different fertilizers and surface coating
3. To develop an understanding about primary and secondary batteries
4. To understand the mechanism of homogeneous catalysis

Course Outcomes:

The students will acquire knowledge of

1. Types, classification and manufacturing process of glass, ceramics and cement
2. Classification of surface coatings paints and pigment formulation
3. Different types of fertilizers and their manufacturing processes
4. Classification of alloys, properties of different types of steel
5. Homogeneous and hetrerogeneous catalyst and their industrial applications

UNIT I (11 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.

UNIT II (11 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 Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

UNIT 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.

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.

UNIT IV **(11 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, New Delhi.
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

POLYMER CHEMISTRY LAB

Subject Code: BCHMD1-614 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Course Objective:

1. To familiarize with syntheses of different polymers
2. To understand characterization techniques for polymers
3 Analysis of polymers using different instrumental techniques and IR methods

Course Outcomes:

The students will acquire knowledge of
1 Synthesis of different polymers
2 Apply techniques for the determination of Molecular weight.
3. Analyze structure of polymer by instrumental methods such as IR spectrometer.

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

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-bis-isobutylonitrile (AIBN)
2. Preparation of nylon 66/6
3. Redox polymerization of acrylamide
4. Preparation of urea-formaldehyde resin
5. Preparations of novalac resin/resold resin.

Polymer characterization

1. Determination of molecular weight by viscometry:
(a) Polyacrylamide-aq.$NaNO_2$ solution
(b) Poly vinyl proplylidine (PVP) in water
(c) Polymethyl methacrylate (PMMA)
2. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).

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

Reference Books:

1 Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
2 Harry R. Allcock, Frederick W. Lampe and James E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003)
3 Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)
4 Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)
5 Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)
6 L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
7 Malcolm P.zq4 Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
8 Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

MOLECULAR MODELLING AND DRUG DESIGN LAB

Subject Code: BCHMD1-615 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Course Objective:

1. To draw the chemical structure structure of the molecules using various drawing packages
2. To perform different modelling simulations methods for optimization of bond lengths and bond angles to obtain minimum strain energy structure of the molecule.
3. To run programs to calculate physico chemical properties and spectroscopic of molecules

Course Outcomes:

The students will be able to:

1. Draw the chemical structure structure of the molecules using various drawing packages
2. Perform different molecular modelling simulations for optimization of bond lengths and bond angles to obtain minimum strain energy structure of the molecule.
3. Run programs to calculate physico chemical properties and spectroscopic of molecules

Note:

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments

1 Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene.
Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzene and pyridine π bonds.
2 (a) Perform a conformational analysis of butane. (b) Determine the enthalpy of isomerization of *cis* and *trans* 2-butene.
3 Visualize the electron density and electrostatic potential maps for LiH, HF, N_2, NO and CO and comment. Relate to the dipole moments. Animate the vibrations of these molecules.
4 (a) Relate the charge on the hydrogen atom in hydrogen halides with their acid character. (b) Compare the basicities of the nitrogen atoms in ammonia, methylamine, dimethylamine and trimethylamine.
5 (a) Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol. Note the dipole moment of each molecule. (b) Show how the shapes affect the trend in boiling points: (118 ºC, 100 ºC, 108 ºC, 82 ºC,respectively).
6 Build and minimize organic compounds of your choice containing the following functional groups. Note the dipole moment of each compound: (a) alkyl halide (b) aldehyde (c) ketone (d) amine (e) ether (f) nitrile (g) thiol (h) carboxylic acid (i) ester (j) amide.
7. (a) Determine the heat of hydration of ethylene. (b) Compute the resonance energy of benzene by comparison of its enthalpy of hydrogenation with that of cyclohexene.
8. Arrange 1-hexene, 2-methyl-2-pentene, (*E*)-3-methyl-2-pentene, (*Z*)-3-methyl-2- pentene, and 2,3-dimethyl-2-butene in order of increasing stability.
9 (a) Compare the optimized bond angles H_2O, H_2S, H_2Se. (b) Compare the HAH bond angles for the second row dihydrides and compare with the results from qualitative
MO theory.
Note: Software: ChemSketch, ArgusLab (www.planaria-software.com), TINKER 6.2 (dasher.wustl.edu/ffe), WebLab Viewer, Hyperchem, or any similar software.

Reference Books:

1 A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.
2 J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and

Sons, 1997.
3 Satya Prakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE LAB

Subject Code: BCHMD1-616 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Course Objective:
1. To impart knowledge and hand-on experiences of different analytical techniques for chemical analysis
2. To impart skills for preparation of buffer

Course Outcomes:
The students will acquire knowledge

1. Different analytical techniques for analysis different materials

2. Preparation of buffer solution

Note:
1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments
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).
9 To study the saponification reaction for preparation of soap.
10 Preparation of buffers and measurement of their pH

11 Determination standard electrode potential of Fe^{2+}/Fe^{3+} system by potentiometer using potassium permanganate solution.

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, New Delhi.
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