DEPARTMENT OF CHEMISTRY
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

Proposed Scheme of the programme for Dual degree B.Sc. (Hons) Chemistry-M.Sc. Chemistry under Choice Based Credit System (w.e.f 2016-17)

SEMESTER-I

Paper code	Course opted	Nomenclature	Credits	Hrs/ week	Marks		
					Ext.	Int.	Total
BXL-101	Ability Enhancement Compulsory Course-I	English	2	2	70	30	100
BXL-102	Ability Enhancement Compulsory Course-II	Environmental Science	2	2	70	30	100
BPL-101	Generic Elective-I	Physics-I Mechanics	4	4	70	30	100
BCL-101	Core Course-I	Chemistry-I	4	4	70	30	100
BML-101/ BBL-101	Generic Elective-II	Elementary Mathematics-I / Elementary Biology-I	4	4	70	30	100
BML-102 /BBL-102	Generic Elective-III	Mathematics-I Basic Algebra /Biology-I	4	4	70	30	100
BPP-101	Generic Elective Practical-I	Physics Lab-I	2	4	70	30	100
BCP-101	Core Course Practical-I	Chemistry Lab-I	2	4	70	30	100
BBP-101	Generic Elective Practical-II	Biology Lab	2	4	70	30	100
			26	**32**			

Notes:

i) Students who have studied mathematics at 10+1 and 10+2 level shall opt Elementary Biology-I (Paper code: BBL-101) & Mathematics-I (BML-102) and those who have studied Biology shall opt Elementary Mathematics -I (BML-101) & Biology -I (BBL-102) in 1st semester.

ii) Semester-I & II will be common for all the four programmes

SEMESTER-II

BXL-201	Ability Enhancement Compulsory Course-III	Hindi	2	2	70	30	100
BPL-201	Generic Elective-IV	Physics-II (Heat and Thermodynamics)	4	4	70	30	100
BCL-201	Core Course-II	Chemistry-II	4	4	70	30	100
BML-201/ BBL-201	Generic Elective-V	Elementary Mathematics-II / Elementary Biology-II	4	4	70	30	100
BML-202 /BBL-202	Generic Elective-VI	Mathematics-II Calculus /Biology-II	4	4	70	30	100
BXL-202	Generic Elective-VII	Computer Science	2	2	70	30	100
BPP-201	Generic Elective Practical-III	Physics Lab-II	2	4	70	30	100
BCP-201	Core Course Practical-II	Chemistry Lab -II	2	4	70	30	100
BXP-201	Generic Elective Practical –IV	Computer Science Lab	2	4	70	30	100
			26	**32**			

Notes:

i) Students who have studied mathematics at 10+1 and 10+2 level shall opt Elementary Biology-I (Paper code: BBL-201) & Mathematics-I (BML-202) and those who have studied Biology shall opt Elementary Mathematics -I (BML-201) & Biology -I (BBL-202) in 1st semester.

ii) Semester-I & II will be common for all the four programmes.

SEMESTER-III

BCL-301	Core Course-III	Inorganic Chemistry-I	4	4	70	30	100
BCL-302	Core Course-IV	Organic Chemistry-I	4	4	70	30	100
BCL-303	Core Course-V	Physical Chemistry-I	4	4	70	30	100
BCL-304	Discipline Specific Elective -I	Analytical Methods in Chemistry	4	4	70	30	100
BCL-305	Skill Enhancement Course-I	Chemical Technology and Society	2	2	70	30	100
BCP-301	Core Course Practical-III	Inorganic Chemistry Lab-I	2	4	70	30	100
BCP-302	Core Course Practical-IV	Organic Chemistry Lab-I	2	4	70	30	100
BCP-303	Core Course Practical-V	Physical Chemistry Lab-I	2	4	70	30	100
			24	**30**			

SEMESTER-IV

BCL-401	Core Course-VI	Inorganic Chemistry-II	4	4	70	30	100
BCL-402	Core Course-VII	Organic Chemistry-II	4	4	70	30	100
BCL-403	Core Course-VIII	Physical Chemistry-II	4	4	70	30	100
BCL-404	Discipline Specific Elective -II	Industrial Chemicals & Environment	4	4	70	30	100
BCL-405	Skill Enhancement Course-II	Green Methods in Chemistry	2	2	70	30	100
BCP-401	Core Course Practical-VI	Inorganic Chemistry Lab-II	2	4	70	30	100
BCP-402	Core Course Practical-VII	Organic Chemistry Lab-II	2	4	70	30	100
BCP-403	Core Course Practical-VIII	Physical Chemistry Lab-II	2	4	70	30	100
			24	**30**			

SEMESTER-V

BCL-501	Core Course-IX	Inorganic Chemistry-III	4	4	70	30	100
BCL-502	Core Course-X	Organic Chemistry-III	4	4	70	30	100
BCL-503	Core Course-XI	Physical Chemistry-III	4	4	70	30	100
BCL-504	Discipline Specific Elective -III	Pharmaceutical Chemistry	4	4	70	30	100
BCP-501	Core Course Practical-IX	Inorganic Chemistry Lab-III	2	4	70	30	100
BCP-502	Core Course Practical-X	Organic Chemistry Lab-III	2	4	70	30	100
BCP-503	Core Course Practical-XI	Physical Chemistry Lab-III	2	4	70	30	100
			22	**26**			

SEMESTER-VI

BCL-601	Core Course-XII	Inorganic Chemistry-IV	4	4	70	30	100
BCL-602	Core Course-XIII	Organic Chemistry-IV	4	4	70	30	100
BCL-603	Core Course-XIV	Physical Chemistry-IV	4	4	70	30	100
BCL-604	Discipline Specific Elective -IV	Polymer Chemistry	4	4	70	30	100
BCP-601	Core Course Practical-XII	Inorganic Chemistry Lab-IV	2	4	70	30	100
BCP-602	Core Course Practical-XIII	Organic Chemistry Lab-IV	2	4	70	30	100
BCP-603	Core Course Practical-XIV	Physical Chemistry Lab-IV	2	4	70	30	100
			22	**26**			

Proposed Syllabus of the programme for Dual degree B.Sc. (Hons) Chemistry-M.Sc. Chemistry under Choice Based Credit System (w.e.f 2016-17)

Ist Semester

ENGLISH

Paper code: BXL 101

30 Hrs (2Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Syntax **7Hrs**

Sentence structures, Verb patterns and their usage.

UNIT-II

Phonetics **8Hrs**

Basic Concepts – Vowels, Consonants, Phonemes, Syllables; Articulation of Speech Sounds – Place and Manner of Articulation; Transcription of words and simple sentences, using International Phonetic Alphabet.

UNIT-III

Comprehension **7Hrs**

Listening and Reading comprehension – Note taking, Reviewing, Summarising, Interpreting, Paraphrasing and Précis Writing.

UNIT-IV

Composition **8Hrs**

Descriptive, Explanatory, Analytical and Argumentative Writing - description of simple objects like instruments, appliances, places, persons, principles; description and explanation of processes and operations; analysis and arguments in the form of debate and group discussion.

BOOKS SUGGESTED:

1. Roy A. & Sharma P.L. English for Students of Science, Orient Longman.
2. Spoken English for India by R.K. Bansal and J.B. Harrison, Orient Longman.
3.Tickoo M.L. & Subramanian A.E. Intermediate Grammar, Usage and Composition, Orient Longman.
4. Pink M.A. & Thomas S.E. English Grammar, Composition and Correspondence, S. Chand and Sons Pvt.Ltd.,Delhi.
5. Thomson & Martinet A Practical English Grammar, OUP, Delhi.
6. Hornby A.S Guide to Patterns and Usage in English, OUP, Delhi.
7. Balasubramanian T. A Textbook of English Phonetics for Indian Students, MacMillan, Chennai.
8. O¨Connor J.D. Better English Pronunciation, Cambridge Univ. Press, London.
9. McCarthy English Vocabulary in Use, Foundation Books (Cambridge University Press), Delhi.
10. Buck,Assessing Listening, Foundation Books (Cambridge University Press), Delhi.

ENVIRONMENTAL SCIENCE

Paper code: BXL 102

30 Hrs (2Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

The Multidisciplinary nature of environmental studies **8Hrs**

Definition, scope and importance, Need for public awareness.

Natural resources: Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestration

b) Water resources: Use and over-utilization of surface and ground water, floods and drought.

c) Mineral resources: Use and exploitation, environmental effects of extrading.

d) Food resources: World food problems, changes caused by agriculture, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

e) Energy Resources: Growing energy needs, renewable and non renewable energy sources use of alternative energy sources.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

UNIT-II

Ecosystems **7Hrs**

Concept of an ecosystem, Structure and function of an ecosystem, Procedures, consumers and decomposers, Energy flow in the ecosystem, Ecological succession & Food chains, food webs and ecological pyramids.

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a megadiversity nation.

UNIT-III

Environmental Pollution **7Hrs**

Definition, Causes, effects and control measures of: - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution & Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

UNIT-IV

Social Issues and the Environment **8Hrs**

From Unsustainable to sustainable development, urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation, Consumerism and waste products, environment Protection Act, Air (Prevention and Control of Pollution) Act, Water(Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environment legislation & Public awareness.

BOOKS SUGGESTED:

1. De A. K. Environmental Chemistry, Wiley Eastern Ltd, 1999.
2. Bharucha E. Text book of Environmental studies, University press, Hydrabad 2005.
3. Cunningham W P., Cooper T H. Gorhani E. Hepworth M T, Environmental Enclopedia, Jaico publication House, Mumbai, 2001.
4. Miller T G. Environmental Science Wadsworth publishing corp, 2000.

BPL-101: PHYSICS - I: MECHANICS

Marks (Theory) : 70 **Credits : 4 (60 lectures)**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**

Note: Paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of seven short answer type questions, each of two marks. Rest of Eight questions is to be set uniformly selecting two questions from each Unit. A student is required to attempt five questions in all selecting one from each Unit and a compulsory question 1. The question paper shall contain 20% numerical problems in the relevant papers.

Course Objective: The objective of this course is to teach the students fundamentals of Newtonian Mechanics, rigid body dynamic, concept of inverse square force and the special theory of relativity.

Unit – I

Fundamentals of Dynamics: Reference frames, Inertial and non-inertial frames of references, Conservative and non-conservative forces, Fictitious forces, Concept of potential energy, Energy diagram. Stable and unstable equilibrium, Elastic potential energy, Force as gradient of potential energy, Work & Potential energy, Impulse, Centre of Mass for a system of particles, Motion of centre of mass (discrete and continuous), Expression for kinetic energy, Linear momentum and angular momentum for a system of particles in terms of centre of mass values.

Collisions: Elastic and inelastic collisions between particles, Centre of Mass and Laboratory frames.

Unit - II

Rotational Dynamics: Equation of motion of a rigid body, Rotational motion of a rigid body in general and that of plane lamina, Rotation of angular momentum vector about a fixed axis, Angular momentum and kinetic energy of a rigid body about principal axis, Torque, Principle of conservation of angular momentum, Moment of Inertia (discrete and continuous), Calculation of moment of inertia for rectangular, cylindrical and spherical bodies, Kinetic energy of rotation, Motion involving both translation and rotation, elementary Gyroscope.

Unit – III

Inverse Square Law Force: Forces in nature (qualitative), Central forces, Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Potential energy and force between a point mass and spherical shell, a point mass and solid sphere, gravitational and electrostatic self-energy, two body problem and concept of reduced mass, Motion of a body under central force, Equation of orbit in inverse-square force field, satellite in Circular orbit & Geosynchronous orbits, Basic idea of GPS (Global Positioning System).

Unit – IV

Special Theory of Relativity: Michelson-Morley Experiment and its outcome, Galilean transformation (velocity, acceleration)and its inadequacy, Postulates of Special Theory of Relativity, Lorentz Transformations, simultaneity, Lorentz contraction, Time dilation, Relativistic transformation of velocity, frequency and wave number, Relativistic addition of velocities, Variation of mass with velocity, Massless Particles, Mass-energy Equivalence, Relativistic Doppler effect, Relativistic Kinematics (decay, inelastic collision, Compton effect), Transformation of Energy, Momentum and force, Four Vectors.

Reference Books:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 2007, McGraw-Hill.
2. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2012.
3. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
4. University Physics, F.W. Seers, M. W. Zemansky, H. D. Young, Addison-Wesley Pub. Co.
5. Fundamentals of Physics, Halliday, & Walker, Resnick John Wiley & Sons, Inc.

CHEMISTRY-I

Paper code: BCL 101

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Chemical Thermodynamics **15 Hrs**

Objectives and limitations of Chemical Thermodynamics, state functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy. First Law of Thermodynamics: First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas.Irreversible isothermal and adiabatic expansion.Enthalpy change and its measurement, standard heats of formation and absolute enthalpies.Kirchoff's equation.

Second and Third Law: Various statements of the second law of thermodynamics. Efficiency of a cyclic process (Carnot's cycle). Entropy: Entropy changes of an ideal gas with changes in P,V, and T. Free energy and work functions. Gibbs-Helmholtz Equation, Criteria of spontaneity in terms of changes in free energy.Introduction to Third law of thermodynamics.

UNIT-II

Conductance and Electrochemistry **15 Hrs**

Arrhenius theory of electrolytic dissociation.Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes.Molar conductivity at infinite dilution.Kohlrausch law of independent migration of ions.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods.Applications of conductance to measure degree of dissociation of weak electrolytes.

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half cell potentials, application of electrolysis in metallurgy and industry.Chemical cells with examples; Standard electrode (reduction) potential.

UNIT-III

Fundamentals of Organic Chemistry **15 Hrs**

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonanceand Hyperconjugation.

Cleavage of Bonds: Homolysis and Heterolysis.
Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles.
Reactive Intermediates: Carbocations, Carbanions and free radicals.
Strength of organic acids and bases: Comparative study with emphasis on factors affectingpK values.

UNIT-IV

Stereochemistry **8Hrs**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis–trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (forupto two C=C systems).

Chemistry of Biomolecules **7Hrs**

Occurrence, classification of Carbohydrates. Amino acids, peptides and their classification. α-Amino Acids. Zwitterions, pK_avalues, isoelectric point, components of nucleic acids, nucleosides and nucleotides.

BOOKS SUGGESTED:

1. Atkins, P.W. & Paula, J. *Physical Chemistry,* 10th Ed., Oxford University Press, 2014.
2. Castellan, G.W.,Physical Chemistry, Narosa Publishers
3. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Finar, I. L. *Organic Chemistry (Volume 1),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Eliel, E. L. &Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London,1994.
7. Kalsi, P. S. *Stereochemistry Conformation and Mechanism,* New Age International, 2005.
8. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

ELEMENTARY MATHEMATICS-I

Paper code: BML 101

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT – I

15 Hrs

Sets, Relations and Functions: Sets and their Representations, The Empty Set, Finite and Infinite Sets, Equal Sets, Subsets, Universal Set, Venn Diagrams, Operations on Sets, Complement of a Set, Practical Problems on Union and Intersection of Two Sets, Cartesian Product of Sets, Relations, Functions.

Sequences and Series: Sequences, Series, Arithmetic Progression (A.P.), Geometric Progression (G.P.), Relationship Between A.M. and G.M.

UNIT – II

15 Hrs

Straight Lines: Introduction, Slope of a Line, Various Forms of the Equation of a Line, General Equation of a Line, Distance of a Point From a Line.

Trigonometric Functions: Angles, Trigonometric Functions, Trigonometric Functions of Sum and Difference of Two Angles, Trigonometric Equations.

UNIT – III

15 Hrs

Permutations and Combinations: Fundamental Principle of Counting, Permutations, Combinations.

Binomial Theorem: Introduction, Binomial Theorem for Positive Integral Indices, General and Middle Terms.

UNIT – IV

15 Hrs

Linear Inequalities: Inequalities, Algebraic Solutions of Linear Inequalities in One Variable and their Graphical Representation, Graphical Solution of Linear Inequalities in Two Variables, Solution of System of Linear Inequalities in Two Variables.

Probability: Introduction, Random Experiments, Event, Axiomatic Approach to Probability, Addition Theorems on Probability, Conditional Probability, Multiplicative Law of Probability.

BOOKS SUGGESTED:

1. Mathematics Text Book for Class XI, National Council of Educational Research and Training.
2. R.S. Verma and K.S. Sukla, Text Book on Trigonometry, Pothishala Pvt. Ltd, Allahabad.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons.
4. Ivo Duntsch and Gunther Gediga, Set, Relations, Functions, Methodos Publishers.

ELEMENTARY BIOLOGY-I: FUNDAMENTALS OF BIOLOGY

Paper code: BBL-101

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT – I

15 Hrs

Introduction to concepts of biology

Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life.

Evolutionary history of biological diversity

Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life.

UNIT – II

15 Hrs

Classifying the diversity of life

Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea

Darwinian view of life and origin of species

Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation

Genetic approach to Biology

Patterns of inheritance and question of biology; Variation on Mendel's Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental noise; Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

UNIT – III

15 Hrs

Chemistry of life

The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

Water and life

The water molecule is polar; Properties of water; Ionization of water

Carbon and life

Organic chemistry-the study of carbon compounds; what makes carbon special? Properties of organic compounds

UNIT - IV

15 Hrs

Structure and function of biomolecules

Most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information

BOOKS SUGGESTED

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

MATHEMATICS-I : BASIC ALGEBRA

Paper code: BML 102

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT – I

15 Hrs

Symmetric, Skew-symmetric, Hermitian and skew Hermitian matrices. Elementary operations on matrices. Rank of a matrices. Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Row rank and column rank of a matrix. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

UNIT – II

15 Hrs

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. UNITary and Orthogonal Matrices, Bilinear and Quadratic forms.

UNIT – III

15 Hrs

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations.

UNIT – IV

15 Hrs

Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.

Suggested Books:

1. H.S. Hall and S.R. Knight, Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan, A Text Books of Matrices.
3. Chandrika Prasad, Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

BIOLOGY-I: CELL & CELLULAR PROCESSES

Paper code: BBL-102

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT – I

Techniques in Biology **15 Hrs**

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis

UNIT II

Cell as a UNIT of Life **15 Hrs**

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

UNIT III

Cell Organelles **15 Hrs**

• Mitochondria: Structure, marker enzymes, composition; mitochondrial biogenesis; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA

• Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA

• ER, Golgi body & Lysosomes Structures and roles. Signal peptide hypothesis, N-linked glycosylation, Role of golgi in O-linked glycosylation. Cell secretion, Lysosome formation.

• Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis

• Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

UNIT IV

Cell Wall & Membrane **10 Hrs**

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall

Cell Division **5 Hrs**

Role of Cell division; Overview of Cell cycle; Molecular controls; Meiosis

SUGGESTED BOOKS:

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Sheeler, P and Bianchi, D.E. (2006) Cell and Molecular Biology, 3rd edition, John Wiley & sons NY

PHYSICS LAB – I

Paper code: BPP-101 **Marks for Major Test (External): 70**
Credits: 2 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

1. Each student should perform at-least eight experiments.
2. The students are required to calculate the error involved in a particular experiment.
3. List of experiments may vary.

List of Experiments:

1. Measurements of length (or diameter) using Vernier calliper, screw gauge and travelling microscope.
2. To determine the height of an object using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine **g** and velocity for a freely falling body using Digital Timing Technique
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of g using Bar Pendulum.
11. To determine the value of g using Kater's Pendulum.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S. Panigrahi & B. Mallick,2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

CHEMISTRY LAB-I

Paper code: BCP 101

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 4 Hrs **Total Marks: 100**

1. Preparation of reference solutions.
2. Redox titrations: Determination of Fe^{2+}, $C_2O_4^{2-}$(using $KMnO_4$, $K_2Cr_2O_7$)
3. Iodometic titrations: Determination of Cu^{2+} (using standard hypo solution).
4. To determine the surface tension of at least two liquids using stalagmometer by drop no. and drop weight methods (Use of organic solvents excluded).
5. To study the effect of surfactant on surface tension of water.
6. To determine the viscosity of at least two liquids by using Ostwald's viscometer (use of organic solvents excluded).
7. To study the process of (i) sublimation (ii) Crystallization of camphor and phthalic acid
8. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point
   (i) Iodoform from ethanol (or acetone)
   (ii) p-Bromoacetanilide from acetanilide

BOOKS SUGGESTED:

1. Vogel A. I., Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G.,Vogel's Text Book of Practical Organic Chemistry,5th Edn.,Pubs: ELBS, 1989.
2. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., Introduction to Organic Laboratory Techniques, 3rd Edn., Pubs: Thomson Brooks/Cole,2005.
3. Mann F.G., Saunders. P.C.,Practical Organic Chemistry,Pubs:Green& Co. Ltd., London, 1978.
4. Svehla, G., Vogel's Qualitative Inorganic Analysis (revised); 7th edition, Pubs: Orient Longman, 1996.
5. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis (revised); 4th edition, Pubs: Orient Longman, 1978.
6. Yadav J. B., Advanced Practical physical Chemistry

BIOLOGY LAB

Paper code: BBP-101

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 4 Hrs **Total Marks: 100**

1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes
4. Measurement of cell size by cytometry
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides with in
cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
8. To study of plasmolysis & deplamolysis of *Rhoeo* leaf.
9. To study prokaryotic cells, Bacteria/fungi and eukaryotic cells.
10. To prepare squash from root tip of Alium cepa & study various stages of mitosis.

IInd Semester

BPL 201: Physics-II (Heat and Thermodynamics)

Marks (Theory): 70 **Credits: 4 (60 lectures)**
Marks (Internal Assessment): 30 **Time: 3 hrs**

Note: Paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of seven short answer type questions, each of two marks. Rest of Eight questions is to be set uniformly selecting two questions from each Unit. A student is required to attempt five questions in all selecting one from each Unit and a compulsory question 1. The question paper shall contain 20% numerical problems in the relevant papers

Course Objective: The course on thermal physics is framed with the objective that students are able to understand basic concepts of thermos-dynamical systems. Students will be able to understand heart, work, temperature, entropy and the laws of thermodynamics. Behavior of real gases as thermos-dynamical systems has also been included.

UNIT - I

Zeroth and First Law of Thermodynamics: Extensive and intensive thermodynamic variables, Thermodynamic equilibrium, zeroth law and Concept of Temperature, Work and heat, State functions, First law of thermodynamics, Internal energy, Applications of first law, General relation between C_p and C_v, Work done during isothermal and adiabatic processes.

Second Law of Thermodynamics: Reversible and Irreversible process with examples, Conversion of Work into Heat and Heat into Work, Heat Engines, Carnot's Cycle, Carnot engine &its efficiency, Refrigerator & coefficient of performance, 2^{nd}Law of Thermodynamics: Kelvin-Planck andClausius Statements and their equivalence, Carnot's Theorem.

UNIT-II

Entropy and Third law of Thermodynamics: Concept of entropy, Clausius theorem, ClausiusInequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a Perfect Gas and Universe, Entropy Changes in Reversible and Irreversible Processes, Principle of Increase of Entropy, Third Law of Thermodynamics, Unattainability of absolute zero, T-S Diagrams, Phase Change, Classification of Phase Changes.

UNIT-III

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables; Internal Energy; Definition, importance, properties and applications of Chemical Potential, Enthalpy, Gibbsfunction and Helmholtz function.

Maxwell's Thermodynamic Relations: Derivations of Maxwell's Relations and their applications: (1) Clausius-Clapeyron equation (2) C_p- C_v value, (3) Energy equations (4) Change of temperature during adiabatic process.

UNIT-IV

Real gases: Behavior of Real Gases, Deviations from the Ideal Gas Equation. The Virial Equation, Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas, Boyle Temperature, Van-der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves, P-V Diagrams, Joule's Experiment, Free Adiabatic Expansion of a Perfect Gas.

Thermo-electricity: Seeback effect, Paltier effect, Thomson effect and their

explanations.

Reference Books:

1. A Treatise on Heat: Meghnad Saha and B.N. Srivastava, Indian Press
2. Thermal Physics: S. Garg, R. Bansal and Ghosh, Tata McGraw-Hill
3. Concepts in Thermal Physics: S.J. Blundell and K.M. Blundell, Oxford University Press
4. Heat and Thermodynamics: An Intermediate Textbook by M. W. Zemansky and R. Dittman, McGraw-Hill.

CHEMISTRY-II

Paper code: BCL 201

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Chemical Bonding and Molecular Structure 15 Hrs

Introduction to Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, polarizing power and polarizability

Introduction to Covalent bonding: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Ionic Solids: Factors affecting the formation of ionic solids, concept of close packing, radius ratio rule and coordination number. Calculation of limiting radius ratio for tetrahedral and octahedral sites. Structures of some common ionic solids NaCl, ZnS (zinc blende and wurtzite).

UNIT-II

Acids and Bases 8 Hrs

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

Basic Coordination Chemistry 7Hrs

Coordinate Bond. Werner's coordination theory, ligands, chelates. Nomenclature of coordination compounds. Stereochemistry of different coordination numbers, isomerism. Valence-bond and crystalfield theories of bonding in complexes. Explanation of properties such as geometry colour and magnetism.

UNIT-III

Chemical Kinetics and Catalysis 15 Hrs

Rates of reactions, rate constant, order and molecularity of reactions. Differential rate law and integrated rate expressions for zero, first, second and third order reactions. Half-life time of a reaction. Methods for determining order of reaction. Effect of temperature on reaction rate and the concept of activation energy.

Catalysis: Homogeneous catalysis, Acid-base catalysis and enzyme catalysis. Heterogeneous catalysis.

UNIT-IV

Basics of spectroscopy **15 Hrs**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.Electromagnetic radiations, Introduction to ultraviolet, visible and infrared spectroscopy, electronic transitions, λ_{max}&ε_{max}, chromophore, auxochrome, bathochromic, hypsochromic shifts.Infrared radiation and types of molecular vibrations, functional group and fingerprint region.

BOOKS SUGGESTED:

1.Cotton F.A. and Wilkinson G., Murillo C.A., Bochmann M., Advanced Inorg. Chemistry, 6th Edition, Pubs: John Wiley & Sons. Inc., 1999.

2. Lee J.D., Concise Inorganic Chemistry, 4th edition, Pubs: ELBS,1991.

3. Huheey J.E., Keiter E.A., Keiter R.L., Inorganic Chemistry : Principles of Structures and Reactivity; 4th Edition, Pubs: Harper Collins, 1993.

4. Greenwood N.N. and Earnshaw A., Chemistry of the Elements, 2nd edition., Pubs: Butterworth/Heinemann, 1997.

5. Douglas B., Daniel D. Mc and Alexander J., Concepts of Models of Inorganic Chemistry, Pubs: John Wiley,1987.

6. Puri B.R., Sharma L. R. and Pathania M. S., Principles of Physical Chemistry, Pubs: Vishal Publishing Company, 2003.

7. Laidler K. J Chemical Kinetics, McGraw Hill.

8. Castellan G.W. Physical Chemistry, Narosa Publishers

9. Kemp W. Organic Spectroscopy

ELEMENTARY MATHEMATICS-II

Paper code: BML 201

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I **15 Hrs**

Matrix Algebra : Introduction, types of matrices, addition and multiplication of matrix, transpose of matrix, concept of elementary row and column operations. Determinant and its properties, minors, cofactors. Application of determinants in finding area of triangle. Adjoint and inverse of square matrix. Solution of homogeneous and non-homogeneous linear equations and condition for solution.

UNIT-II **15 Hrs**

Differential Calculus : Differentiation of standard functions including function of a function (Chain rule). Differentiation of implicit functions, logarithmic differentiation, parametric differentiation, elements of successive differentiation.

Integral Calculus : Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, partial fractions and substitution. Formal evaluation of definite integrals.

UNIT-III **15 Hrs**

Ordinary Differential Equations : Definition and formation of ordinary differential equations, equations of first order and first degree, variable separable, homogeneous equations, linear equations (Leibnitz form) and differential equations reducible to these types, Linear differential equation of order greater than one with constant coefficients, complementary function and particular integrals.

UNIT-IV **15 Hrs**

Partial Differential Equations: Introduction and formation of P.D.E., solution of P.D.E., linear equation of first order (Lagrange's Equation), Non-Linear Equation of first order.

Vector Calculus: Differentiation of vectors, scalar and vector point functions, gradient of scalar field and directional derivative, divergence and curl of vector field and their physical interpretation.

BOOKS SUGGESTED:

1. Shanti Narayan : Differential and Integral Calculus, S. Chand.
2. S.L. Ross, : Differential Equations, John Wiley and sons inc., Ny, 1984.
3. Shanti Narayan : A Textbook of Matrices, S. Chand.
4. Ian N. Snnedon : Elements of Partial Differential Equations, McGraw Hill.
5. Murray R. Spiegal : Vector Analysis Schaum Publishing Company, New York

ELEMENTARY BIOLOGY-II: CELL BIOLOGY

Paper code: BBL-201

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I **15 Hrs**

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.

Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT-II **15 Hrs**

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments.

Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT-III **15 Hrs**

Lysosomes: Vacuoles and micro bodies: Structure and functions

Ribosomes: Structures and function including role in protein synthesis.

Mitochondria: Structure and function, Genomes, biogenesis.

Chloroplasts: Structure and function, genomes, biogenesis

Nucleus: Structure and function, chromosomes and their structure.

UNIT-IV **15 Hrs**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

SUGGESTED READING/BOOKS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

MATHEMATICS-II: CALCULUS

Paper code: BML 202

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I **15 Hrs**

Definition of the limit of a function. Basic properties of limits, Continuous functions and classification of discontinuities. Differentiability. Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions.

UNIT-II **15 Hrs**

Asymptotes in Cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates. Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves. Newton's method. Radius of curvature for pedal curves. Tangential polar equations. Centre of curvature. Circle of curvature. Chord of curvature, evolutes. Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points. Type of cusps.

UNIT-III **15 Hrs**

Tracing of curves in Cartesian, parametric and polar co-ordinates. Reduction formulae. Rectification, intrinsic equations of curve.

UNIT-IV **15 Hrs**

Quadrature (area) Sectorial area. Area bounded by closed curves. Volumes and surfaces of solids of revolution. Theorems of Pappu's and Guilden.

BOOKS SUGGESTED:

1. Differential and Integral Calculus, Shanti Narayan.
2. Murray R. Spiegel, Theory and Problems of Advanced Calculus. Schaun's Outline series. Schaum Publishing Co., New York.
3. N. Piskunov, Differential and Integral Calculus. Peace Publishers, Moscow.
4. Gorakh Prasad, Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
5. Gorakh Prasad, Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

BIOLOGY-II: GENERAL BIOCHEMISTRY

Paper code: BBL 202

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I **15 Hrs**

Introduction to Biochemistry

A historical prospective. Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

UNIT-I **15 Hrs**

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

UNIT-I **15 Hrs**

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD+ , NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

UNIT-I **15 Hrs**

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

SUGGESTED BOOKS:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

COMPUTER SCIENCE

Paper code: BXL 202

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

An Overview of Computer System **8Hrs**

Anatomy of a digital Computer, Memory UNITs, Main and Auxiliary Storage Devices, Input Devices, Output Devices, Classification of Computers. Radix number system: Decimal, Binary, Octal, Hexadecimal numbers and their inter-conversions; Representation of information inside the computers.

UNIT-II

Operating System Basics **7Hrs**

The user Interface, Running Programmes, Managing files, Introduction to PC operating Systems: Unix/Linux, DOS, Windows 2000.

UNIT-III

Internet basics **7Hrs**

Introduction to the basic concepts of Networks and Data Communications, How Internet works, Major features of internet, Emails, FTP, Using the internet.

UNIT-IV

Programming Languages **8Hrs**

Machine-, Assembly-, High Level- Language, Assembler, Compiler, Interpreter, debuggers, Programming fundamentals: problem definition, algorithms, flow charts and their symbols, introduction to compiler, interpreter, assembler, linker and loader and their inter relationship.

BOOKS SUGGESTED:

1. Goel A., Computer Fundamentals, Pearson Education, 2010.
2. Aksoy P. & DeNardis L., Introduction to Information Technology, Cengage Learning, 2006
3. Sinha P. K. & Sinha P. Fundamentals of Computers, BPB Publishers, 2007

PHYSICS LAB - II

Paper code: BPP-201 **Marks for Major Test (External): 70**
Credits: 2 **Marks for Internal Exam: 30**
Time: 3Hrs **Total Marks: 100**

Note:

1. Each student should perform at-least eight experiments.
2. The students are required to calculate the error involved in a particular experiment.
3. List of experiments may vary.

List of Experiments:

1. To determine Mechanical Equivalent of Heat,J. by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
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 Leeand 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 (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.
8. Study of Electrochemical Equivalent of Hydrogen using Voltmeter
9. Study of Newton's Law of cooling.
10. Determination of specific heat of Solids

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, KitabMahal
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.

CHEMISTRY LAB-II

Paper code: BCP 201

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 4Hrs **Total Marks: 100**

1. Complexometrictitrations: Determination of Mg^{2+}, Zn^{2+} by EDTA.
2. Paper Chromatography: Qualitative Analysis of any one of the following Inorganic cations and anions by paper chromatography (Pb^{2+}, Cu^{2+}, Ca^{2+}, Ni^{2+}, Cl^-, Br^-, I^- and PO_4^{3-} and NO_3^-).
3. To determine the specific refractivity of at least two liquids.
4. Determine rate constant of acid catalyzed hydrolysis of methyl acetate.
5. Determination of conductance of electrolytes
6. The preliminary examination of physical and chemical characteristics (physical state, colour, odour and ignition test), extra element detection (N,S,Cl, Br and I).

BOOKS SUGGESTED:

1. Vogel A. I., Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G.,Vogel's Text Book of Practical Organic Chemistry,5th Edn.,Pubs: ELBS, 1989.
2. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., Introduction to Organic Laboratory Techniques, 3rd Edn., Pubs: Thomson Brooks/Cole,2005.
3. Mann F.G., Saunders. P.C.,Practical Organic Chemistry,Pubs:Green& Co. Ltd., London, 1978.
4. Svehla, G., Vogel's Qualitative Inorganic Analysis (revised); 7th edition, Pubs: Orient Longman, 1996.
5. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis (revised); 4th edition, Pubs: Orient Longman,1978.
6. Das R.C. &Behra B. Experimental Physical Chemistry, , McGraw Hill.
7. Shoemaker &GailandExperiments in Physical Chemistry, McGraw Hill.
8. YadavJ. B. Advanced Practical physical Chemistry

COMPUTER SCIENCE LAB

Paper code: BXP 201

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 4Hrs **Total Marks: 100**

C Programming language: C fundamentals, formatted input/ output, expressions, selection statements, loops and their applications; Basic types, arrays, functions, including recursive functions, program organization: local and external variables and scope; pointers & arrays

Representative programming in C

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average mail height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program to multiply two matrices

BOOKS SUGGESTED:

1. Kanetkar Y. Let Us C, BPB publication

IIIrd Semester

INORGANIC CHEMISTRY-I
(Atomic Structure & Chemical Bonding)

Paper code: BCL 301

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Atomic Structure **15 Hrs**

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrodinger'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

Periodicity of Elements **15 Hrs**

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* and 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-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT-III

Chemical Bonding-I **15 Hrs**

Ionic bond: types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Lande equation with derivation and

importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its applications, Solvation energy.

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 (o and n bond approach) and bond lengths.

UNIT-IV

Chemical Bonding-II **15 Hrs**

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 ionic character from dipole moment and electronegativity difference.

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

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, solubility energetics of dissolution process.

BOOKS SUGGESTED:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970.
3. Atkins, P.W. & Paula, J. *Physical Chemistry,* 10th Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry,* ACS Publications, 1962.
5. Rodger, G.E. *Inorganic and Solid State Chemistry,* Cengage Learning India Edition, 2002.

ORGANIC CHEMISTRY- I
(Hydrocarbons)

Paper code: BCL 302

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Basics of Organic Chemistry **10Hrs**

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

Dipole moment; Organic acids and bases; their relative strength, Curly arrow rules, formal charges; Nucleophlicity and basicity.

Aromaticity: Benzenoids and Hückel's rule.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Chemistry of Aliphatic Hydrocarbons-I **5Hrs**

Carbon-Carbon sigma bonds

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

UNIT-II

Chemistry of Aliphatic Hydrocarbons-II **15 Hrs**

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, hydroboration-oxidation, 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-III

Chemistry of Aliphatic Hydrocarbons-III **15 Hrs**

Cycloalkanes and Conformational Analysis

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

Aromatic Hydrocarbons

Aromaticity: Huckel'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 their mechanism. Directing effects of the groups.

UNIT-IV

Chemistry of Halogenated Hydrocarbons **15 Hrs**

Alkyl halides: Methods of preparation, nucleophilic substitution reactions - S_N1, S_N2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

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.

BOOKS SUGGESTED:

1. Morrison, R. N., Boyd, R. N. & Bhattacharjee S. K. *Organic Chemistry, 7th ed.* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

2. Finar, I. L. *Organic Chemistry (Volume 1),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

PHYSICAL CHEMISTRY-I
(States of Matter & Ionic Equilibrium)

Paper code: BCL 303

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Gaseous state **15 Hrs**

Kinetic molecular model of a gas: derivation of the kinetic gas equation; collision frequency and diameter; mean free path and viscosity of gases, temperature and pressure dependence, relation between mean free path and coefficient of viscosity.

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.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, and its variation with pressure. 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.

UNIT-II

Solid state **15 Hrs**

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, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

UNIT-III

Liquid state **8Hrs**

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.

Ionic equilibria-I **7Hrs**

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).

UNIT-IV

Ionic equilibria-II **15 Hrs**

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.

BOOKS SUGGESTED:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Engel, T. & Reid, P. *Physical Chemistry* 3rd Ed. Pearson (2013).

DISCIPLINE SPECIFIC ELECTIVE-I
(Analytical Methods in Chemistry)

Paper code: BCL 304

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Qualitative and quantitative aspects of analysis **8 Hrs**

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.

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.

UNIT-II

15 Hrs

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.Structural illustration through interpretation of data, Effect and importance of isotope substitution.

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

UNIT-III

Thermal methods of analysis **7 Hrs**

Basic principles and instrumentation of TG, DTA and DSC.Quantitative estimation of Ca and Mg from their mixture.

Electroanalytical methods **8 Hrs**

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

UNIT-IV

Chromatographic techniques **15 Hrs**

Introduction, Classification, Mechanism of Chromatography separation: adsorption, partition & ion exchange.

Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis Paper and thin layer chromatography, liquid chromatography and ion-exchange chromatography.

Books Suggested:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
2. Willard, H.H. *et al.: Instrumental Methods of Analysis,* 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, G.D. *Analytical Chemistry,* 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, D.C. *Exploring Chemical Analysis,* 9th Ed. New York, W.H. Freeman, 2016.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry.* New Age International Publisher, 2009.
6. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis,* Cengage Learning India Ed.
7. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods,* Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
8. Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.

SKILL ENHANCEMENT COURSE-I
(Chemical Technology & Society)

Paper code: BCL 305

30 Hrs (2Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

7 Hrs

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption.

UNIT-II

8 Hrs

An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry.Introduction to clean technology.

UNIT-III

7 Hrs

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms).

UNIT-IV

8 Hrs

Energy from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.

BOOKS SUGGESTED:

1. John W. Hill, Terry W. McCreary & Doris K. Kolb, *Chemistry for changing times* 13thEd,Prentice-Hall (2012).

INORGANIC CHEMISTRY LAB- I

Paper code: BCP 301

60 Hrs (4Hrs /week) | **Marks for Major Test (External): 70**

Credits: 2 | **Marks for Internal Exam: 30**

Time: 4 Hrs | **Total Marks: 100**

(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.

BOOKS SUGGESTED:

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

ORGANIC CHEMISTRY LAB- I

Paper code: BCP 302

60 Hrs (4Hrs /week) | **Marks for Major Test (External): 70**

Credits: 2 | **Marks for Internal Exam: 30**

Time: 4 Hrs | **Total Marks: 100**

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

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

    a. Using conventional method.
    b. Using green approach

ii. Nitration of any one of the following:

a. Acetanilide/nitrobenzene by conventional method

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

iii. Aldol condensation using either conventional or green method.

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.

BOOKS SUGGESTED:

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, 5th 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: QualitativeAnalysis,* University Press (2000).

PHYSICAL CHEMISTRY LAB-I

Paper code: BCP 303

60 Hrs (4Hrs /week)	**Marks for Major Test (External): 70**
Credits: 2	**Marks for Internal Exam: 30**
Time: 4 Hrs	**Total Marks: 100**

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. **pHmetry**
    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.

BOOKS SUGGESTED:

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).
4. Yadav J. B. Advanced Practical physical Chemistry

IVth Semester

INORGANIC CHEMISTRY-II
(Periodic properties of elements)

Paper code: BCL 401

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Chemistry of *s* and *p* Block Elements **15 Hrs**

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

UNIT-II

Chemistry of *p*Block Elements **15 Hrs**

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 acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

UNIT-III

Transition Elements **15Hrs**

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and 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

Lanthanides and Actinides **7 Hrs**

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

Noble Gases **8Hrs**

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

BOOKS SUGGESTED:

1. Lee, J.D. *Concise Inorganic Chemistry,* ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rdEd.,* 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 India, Edition, 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-II
(Functional Group Chemistry)

Paper code: BCL 402

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Alcohols, Phenols, Ethers and Epoxides **15 Hrs**

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-II

Carbonyl Compounds **15 Hrs**

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC); 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-III

Carboxylic Acids and their Derivatives **15 Hrs**

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 substitution at acyl group- Mechanism of acidic and alkaline

hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

Sulphur containing compounds:

Preparation and reactions of thiols, thioethers and sulphonic acids.

UNIT-IV

Nitrogen Containing Functional Groups **15 Hrs**

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 methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

Diazonium Salts: Preparation and their synthetic applications.

BOOKS SUGGESTED:

1. Morrison, R. T., Boyd, R. N. &Bhattacharjee S. K. *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. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
4. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
5. Carey, F. A.&Sundberg R. J. Advanced Prganic Chemistry, Part A: Structure and Mechanism, Springer.
6. Carey, F. A.&Sundberg R. J. Advanced Prganic Chemistry, Part B: Reactions and Synthesis, Springer.

PHYSICAL CHEMISTRY- II
(Molecular Spectroscopy & Chemical Thermodynamics)

Paper code: BCL 403

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Molecular Spectroscopy-I **15 Hrs**

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.

UNIT-II

Molecular Spectroscopy-II **7 Hrs**

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.

Chemical Thermodynamics-I **8 Hrs**

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.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

UNIT-III

Chemical Thermodynamics-II **8 Hrs**

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.

Systems of Variable Composition **7 Hrs**

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.

UNIT-IV

Chemical Equilibrium **8 Hrs**

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.

Solutions and Colligative Properties **7 Hrs**

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.

BOOKS SUGGESTED:

1. Peter, A. & Paula, J. de. *Physical Chemistry* 10th Ed., Oxford University Press (2014).
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.New Delhi (2004).
5. Levine, I .N. *Physical Chemistry* 6th Ed., Tata McGraw Hill (2010).
6. Banwell C. N. Fundamental of molecular spectroscopy, McGraw-Hill Education (India)

DISCIPLINE SPECIFIC ELECTIV-II
(Industrial Chemicals and Environment)

Paper code: BCL 404

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Industrial Gases and Inorganic Chemicals **10 Hrs**

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Industrial Metallurgy **5 Hrs**

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

UNIT-II

Environmental Chemistry **15 Hrs**

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere.Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution.

Pollution by SO_2, CO_2, CO, NO_x, H_2S and other foul smelling gases. Methods of estimation of CO, NO_x, SO_x and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

UNIT-III

15 Hrs

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

UNIT-IV

Energy & Environment **10 Hrs**

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis **5 Hrs**

Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

BOOKS SUGGESTED:

1. Stocchi E.: *Industrial Chemistry,* Vol-I, Ellis Horwood Ltd. UK.
2. Felder R.M., Rousseau R.W.: *Elementary Principles of Chemical Processes,* Wiley Publishers, New Delhi.
3. Kent J. A.: Riegel's*Handbook of Industrial Chemistry,* CBS Publishers, New Delhi.
4. DaraS. S.: *A Textbook of Engineering Chemistry,* S. Chand & Company Ltd. NewDelhi.
5. De A K., *Environmental Chemistry:* New Age International Pvt., Ltd, New Delhi.
6. KhopkarS. M., *Environmental Pollution Analysis:* Wiley Eastern Ltd, New Delhi.
7. Manahan S.E., *Environmental Chemistry,* CRC Press (2005).
8. Miller,G.T. *Environmental Science* 11th edition. Brooks/ Cole (2006).
9. Mishra A., *Environmental Studies.* Selective and Scientific Books, New Delhi (2005).

SKILL ENHANCEMENT COURSE-II
(Green Methods in Chemistry)

Paper code: BCL 405

30 Hrs (2Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

8 Hrs

Introduction: Definitions of Green Chemistry. Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

UNIT-II

7 Hrs

Introduction of twelve principles of Green Chemistry with examples. Special emphasis on atom economy.

UNIT-III

7 Hrs

Prevention/ minimization of hazardous/ toxic products reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability

UNIT-IV

8 Hrs

Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)

Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic

acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction

Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)

BOOKS SUGGESTED:

1. Anastas, P.T. & Warner, J.K. *Green Chemistry- Theory and Practical,* Oxford University Press (1998).
2. Matlack, A.S. *Introduction to Green Chemistry,* Marcel Dekker (2001).
3. Cann, M.C. &Connely, M.E. *Real-World cases in Green Chemistry,* American Chemical Society, Washington (2000).
4. Ryan, M.A. &Tinnesand, M. *Introduction to Green Chemistry,* American Chemical Society, Washington (2002).
5. Sharma, R.K.; Sidhwani, I.T. &Chaudhari, M.K. *Green Chemistry Experiments: A monograph* I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.
6. Lancaster, M. *Green Chemistry: An introductory text* RSC publishing, 2nd Edition.

INORGANIC CHEMISTRY LAB-II

Paper code: BCP 401

60 Hrs (4Hrs /week)	**Marks for Major Test (External): 70**
Credits: 2	**Marks for Internal Exam: 30**
Time: 4 Hrs	**Total Marks: 100**

Iodo / Iodimetric Titrations

1. Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution(Iodimetrically).
2. Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically
3. Estimation of available chlorine in bleaching powder iodometrically.

Inorganic preparations

4. Cuprous Chloride, Cu_2Cl_2
5. Preparation of Manganese(III) phosphate, $MnPO_4.H_2O$
6. Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

BOOKS SUGGESTED:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
2. Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education,2002.
3. Marr & Rockett *Practical Inorganic Chemistry*.John Wiley & Sons 1972.
4. Synthesis and characterization of inorganic compounds by W. L. Jolly, Prentice Hall.

ORGANIC CHEMISTRY LAB-II

Paper code: BCP 402

60 Hrs (4Hrs /week) | **Marks for Major Test (External): 70**

Credits: 2 | **Marks for Internal Exam: 30**

Time: 4 Hrs | **Total Marks: 100**

1. Detection of extra elements (N, S, Halogens).
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing following functional groups: alcohol, carboxylic acid, phenol and carbonyl groups.

BOOKS SUGGESTED:

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 Quantitative Analysis,* University Press (2000).
4. Ahluwalia, V.K. &Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

PHYSICAL CHEMISTRY LAB-II

Paper code: BCP 403

60 Hrs (4Hrs /week)	**Marks for Major Test (External): 70**
Credits: 2	**Marks for Internal Exam: 30**
Time: 4 Hrs	**Total Marks: 100**

1. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
2. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
    a. simple eutectic and
    b. congruently melting systems.
3. Distribution of acetic/ benzoic acid between water and cyclohexane.
4. 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) $Cu^{2+}(aq) + n\text{NH+} \rightarrow Cu(NH_3)_n$

5. Initial rate method: Iodide-persulphate reaction
6. Integrated rate method: Saponification of ethyl acetate.
7. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methylacetate.
8. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

BOOKS SUGGESTED:

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 Chemistry8th 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).
4. Yadav J. B., Advanced Practical physical Chemistry.

Vth Semester

INORGANIC CHEMISTRY-III
(Coordination Chemistry)

Paper code: BCL 501

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Coordination Chemistry-I **15 Hrs**

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, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

UNIT-II

Coordination Chemistry-II **15Hrs**

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- Thermodynamic & Kinetic stability.

UNIT-III

Reaction Kinetics and Mechanism **15 Hrs**

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

Bioinorganic Chemistry **15 Hrs**

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.

BOOKS SUGGESTED:

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

2. Huheey, J.E., *Inorganic Chemistry,* Prentice Hall, 1993.

3. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.

4. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999.

5. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry,* John Wiley & Sons, NY, 1967.

6. Greenwood, N.N. &Earnshaw A. *Chemistry of the Elements,* Butterworth-Heinemann, 1997.

ORGANIC CHEMISTRY-III
(Heterocyclic Chemistry and Organic Spectroscopy)

Paper code: BCL 502

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Polynuclear Hydrocarbons **15 Hrs**

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

Heterocyclic Compounds-I

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

UNIT-II

Heterocyclic Compounds-II **15 Hrs**

Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole (Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction

Derivatives of furan: Furfural and furoic acid.

UNIT-III

Organic Spectroscopy-I **15 Hrs**

General principles Introduction to absorption and emission spectroscopy.

UV Spectroscopy: Types of electronic transitions, X_{max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of Xmax for the following systems: a,|3 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.

UNIT-IV

Organic Spectroscopy-II **15 Hrs**

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, Interpretation of NMR spectra of simple compounds.

Applications of IR, UV and NMR for identification of simple organic molecules.

BOOKS SUGGESTED:

1. Morrison, R. T., Boyd, R. N. &Bhattarcharjee S. K. *Organic Chemistry 7th Ed.,* 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. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry,* Oxford University Press.
6. Kemp W. Organic Spectroscopy, Mac
7.LampmanG. M. & Pavia D L. Introduction to spectroscopy.

PHYSICAL CHEMISTRY-III
(Phase Equilibrium and Chemical Kinetics)

Paper code: BCL 503

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Phase Equilibria-I **15 Hrs**

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 systems, with applications.

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

UNIT-II

Phase Equilibria-II **15 Hrs**

Three component systems, water-chloroform-acetic acid system, triangular plots.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation.

Nernst distribution law: its derivation and applications.

UNIT-III

Chemical Kinetics **15 Hrs**

Rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, 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, qualitative treatment of the theory of absolute reaction rates.

UNIT-IV

Catalysis **15 Hrs**

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts.Enzyme catalysis, Michaelis-Menten mechanism.

Surface chemistry

Physical adsorption, chemisorption, adsorption isotherms, nature of adsorbed state.

BOOKS SUGGESTED:

1. Atkins P.&Paula J. D., *Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
3. McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics,* Viva Books Pvt. Ltd.:New Delhi (2004).
4. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
6. Zundhal, S.S. *Chemistry concepts and applications* Cengage India (2011).
7. Ball, D. W. *Physical Chemistry* Cengage India (2012).
8. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
9. Levine, I. N. *Physical Chemistry 6th Ed.,* Tata McGraw-Hill (2011).
10. Metz, C. R. *Physical Chemistry 2ndEd.,*Tata McGraw-Hill (2009).

DISCIPLINE SPECIFIC ELECTIV-III
(Pharmaceutical Chemistry)

Paper code: BCL 504

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

15 Hrs

Physiochemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bioisoterism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding. Drug receptor, Drug receptor interactions, receptor- effector theories, types of receptor and their action including transduction mechanism and G proteins. Principles of drug design (Theoretical aspects).

UNIT-II

15 Hrs

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis),

Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, and antacid (ranitidine). Antibacterial and antifungal agents (Sulphonamides, Sulphanethoxazol, Sulphacetamide, Trimethoprim).

Medicinal values of curcumin (haldi), azadirachtin (neem).

UNIT-III

15 Hrs

Synthesis of the representative drugs of the following classes: Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryltrinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine), antiviral agents (Acyclovir).

UNIT-IV

15 Hrs

Fermentation: Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

BOOKS SUGGESTED:

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.

INORGANIC CHEMISTRY LAB-III

Paper code: BCP 501

60 Hrs (4Hrs /week) | **Marks for Major Test (External): 70**

Credits: 2 | **Marks for Internal Exam: 30**

Time: 4 Hrs | **Total Marks: 100**

Gravimetric Analysis:

1. Estimation of nickel (II) using Dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN
3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
4. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).

Inorganic Preparations:

5. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
6. *Cis* and *trans* $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate (III)
7. Tetraamminecarbonatocobalt (III) ion
8. Potassium tris(oxalate)ferrate(III)

BOOKS SUGGESTED:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
1. Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education,2002.
2. Marr & Rockett *Practical Inorganic Chemistry.*John Wiley & Sons 1972.
3.Synthesis and characterization of inorganic compounds by W. L. Jolly, Prentice Hall.

ORGANIC CHEMISTRY LAB-III

Paper code: BCP 502

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 4 Hrs **Total Marks: 100**

1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Isolation of caffeine from tea leaves.
4. Isolation of casein from milk.
5. Isolation of lactose from milk.
6. Isolation of piperine from black pepper.
7. Saponification value of oil or a fat.
8. Determination of Iodine number of an oil/ fat.

BOOKS SUGGESTED:

1. Manual of Biochemistry Workshop, 2012, Department of Chemistry, Universityof Delhi.
2. Arthur, I. V. *Quantitative Organic Analysis*, Pearson
3. Experiments in Organic Chemistry, L.F. Fieser, O.C. Heath, Company.
4. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
8. Analytical Organic Chemistry, Jag Mohan, Narosa Publishers.

PHYSICAL CHEMISTRY LAB-III

Paper code: BCP 503

60 Hrs (4Hrs /week)	**Marks for Major Test (External): 70**
Credits: 2	**Marks for Internal Exam: 30**
Time: 4 Hrs	**Total Marks: 100**

Conductometry

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. 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

4. 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

BOOKS SUGGESTED:

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).
4. Yadav J. B., Advanced Practical physical Chemistry

VIth Semester

INORGANIC CHEMISTRY-IV
(Organometallic Chemistry)

Paper code: BCL 601

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Organometallic Compounds-I **15Hrs**

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

UNIT-II

Organometallic Compounds-II **15 Hrs**

Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-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 trialkylaluminium (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

Organometallic Compounds-III **8 Hrs**

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

Catalysis by Organometallic Compounds **7 Hrs**

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinsons Catalyst)

2. Hydroformylation (Co salts)
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)
5. Synthesis gas by metal carbonyl complexes
6.

UNIT-IV

General Principles of Metallurgy **15Hrs**

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

BOOKS SUGGESTED:

1. Cotton, F.A.G.; Wilkinson &Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.;* Wiley India,
2. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.,* Harper Collins 1993, Pearson,2006.
3. Sharpe, A.G. *Inorganic Chemistry,* 4th Indian Reprint (Pearson Education) 2005
4. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry3rdEd.*,John Wiley and Sons, NY, 1994.
5. Greenwood, N.N. &Earnshaw, A. *Chemistry of the Elements, Elsevier 2nd Ed,* 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
6. Lee, J.D. *Concise Inorganic Chemistry 5th Ed.,* John Wiley and sons 2008.
7. Powell, P. *Principles of Organometallic Chemistry,* Chapman and Hall, 1988.
8. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.,* Oxford University Press,1994.
9. Basolo, F. & Pearson, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.
10. Purcell, K.F. &Kotz, J.C., *Inorganic Chemistry,* W.B. Saunders Co. 1977
11. Miessler, G. L. &Tarr, D.A. *Inorganic Chemistry 4th Ed.,* Pearson, 2010.
12. Collman, J. P. *et al. Principles and Applications of Organotransition Metal Chemistry.* Mill Valley, CA: University Science Books, 1987.
13. Crabtree, R. H. *The Organometallic Chemistry of the Transition Metals.*NewYork, NY: John Wiley, 2000.
14. Spessard, G. O. &Miessler, G.L. *Organometallic Chemistry.* Upper Saddle River,NJ: Prentice-Hall, 1996.

ORGANIC CHEMISTRY-IV
(Biomolecules)

Paper code: BCL 602

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Carbohydrates **15 Hrs**

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; Interconversions 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-II

Amino Acids, Peptides and Proteins **15 Hrs**

α-Amino Acids - Synthesis, ionic properties and reactions.

Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups- Solid-phase synthesis. Structure of peptides and proteins, forces responsible for holding of protein structures.

Nucleic Acids

Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure, synthesis and reactions of: Adenine, Guanine. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA.

UNIT-III

Enzymes **8 Hrs**

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).

Lipids **7 Hrs**

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins, saponification value, acid value, iodine number.

UNIT-IV

Alkaloids **15 Hrs**

Natural occurrence, General structural features, Isolation and their physiological action. Hoffmann's exhaustive methylation, Emde's modification, Synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Terpenes

Occurrence, classification, isoprene rule; Synthesis of Citral, Neral and α-terpineol.

BOOKS SUGGESTED:

1. Berg, J.M., Tymoczko, J.L. &Stryer, L. (2006) *Biochemistry*. 6th Ed. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. &Lehninger, A.L. (2009) *Principles of Biochemistry. IV Edition.*W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A. &Rodwell, V.W. (2009) *Harper's Illustrated Biochemistry.* XXVIII edition.Lange Medical Books/ McGraw-Hill.
4. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry,* Oxford University Press.
5. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry,* PrajatiPrakashan(2010).

PHYSICAL CHEMISTRY-IV
(Quantum Chemistry& Electrochemistry)

Paper code: BCL 603

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Quantum Chemistry-I **15 Hrs**

Postulates of quantum mechanics, quantum mechanical operators, Schrodinger 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 Schrodinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.

UNIT-II

Quantum Chemistry-II **15 Hrs**

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

Rigid rotator model of rotation of diatomic molecule.Schrodinger equation, transformation to spherical polar coordinates.Separation of variables.Sphericalharmonics.Discussion of solution.

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrodinger 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 Schrodinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

UNIT-III

Conductance and elctrochemistry **15 Hrs**

Conductance of electrolytes, Debye-Huckel-Onsager theory, Wien effect, Debye-Falkenhagen effect, Walden rules.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, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

Reversible and irreversible cells with examples.Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells.

UNIT-IV

Electrochemistry **15 Hrs**

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, glass and SbO/Sb_2O_3electrodes. 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).

BOOKS SUGGESTED:

1. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press(2014).
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).
8. Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
9. House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).
10.Lowe, J. P. & Peterson, K. *Quantum Chemistry,* Academic Press (2005).
11. Levine I N Quantum Chemistry, Prentice Hall
12. McQuarrie D A Quantum Chemistry, university Science Books.

DISCIPLINE SPECIFIC ELECTIV-IV
(Polymer Chemistry)

Paper code: BCL 604

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 4 **Marks for Internal Exam: 30**

Time: 3Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

UNIT-I

Functionality and its importance **15 Hrs**

Criteria for synthetic polymer formation, Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

UNIT-III

Kinetics of Polymerization **15 Hrs**

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

15 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).

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.

UNIT-IV

Properties of Polymers **15 Hrs**

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-phenylenesulphidepolypyrrole, polythiophene)].

BOOKS SUGGESTED:

1. Seymour R.B. &CarraherC.E.: *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. OdianG.:*Principles of Polymerization,* 4th Ed. Wiley, 2004.
3. BillmeyerF.W: *Textbook of Polymer Science,* 2nd Ed. Wiley Interscience, 1971.
4. GhoshP.: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. Lenz R.W.: *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, New York, 1967.

INORGANIC CHEMISTRY LAB-IV

Paper code: BCP 601

60 Hrs (4Hrs /week)	**Marks for Major Test (External): 70**
Credits: 2	**Marks for Internal Exam: 30**
Time: 4 Hrs	**Total Marks: 100**

1. Qualitative semi-micro analysis of mixtures containing 2 anions and 2 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** 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.

Chromatography of metal ions

2. Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:
i. Ni (II) and Co (II)
ii. Fe (III) and Al (III)
(e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

BOOKS SUGGESTED:

1. Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education,2002.
2. Marr & Rockett *Practical Inorganic Chemistry.*John Wiley & Sons 1972.
3.Synthesis and characterization of inorganic compounds by W. L. Jolly, Prentice Hall.

ORGANIC CHEMISTRY LAB-IV

Paper code: BCP 602

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**

Credits: 2 **Marks for Internal Exam: 30**

Time: 4 Hrs **Total Marks: 100**

1. Preparation of sodium polyacrylate.
2. Preparation of urea formaldehyde resin.
3. Preparation of methyl orange.
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.

BOOKS SUGGESTED:

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).

PHYSICAL CHEMISTRY LAB-IV

Paper code: BCP 603

60 Hrs (4Hrs /week)	**Marks for Major Test (External): 70**
Credits: 2	**Marks for Internal Exam: 30**
Time: 4 Hrs	**Total Marks: 100**

UV/Visible spectroscopy

1. 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 λ_{max} values. Calculate the energies of the two transitions in different UNITs (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
3. 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

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

5. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
6. Determine the amount of iron present in a sample using 1,10-phenathroline.
7. Determine the dissociation constant of an indicator (phenolphthalein).
8. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

BOOKS SUGGESTED:

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).
4. Yadav J. B., Advanced Practical physical Chemistry

DEPARTMENT OF CHEMISTRY
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR

SYLLABUS (W.E.F 2023)

Scheme for Dual Degree B.Sc. (Hons) Chemisty-M.Sc. Chemistry under Choice Base Credit System

M.Sc. Chemistry

SEMESTER-VII

Paper Code	Course opted	Nomenclature	Credits	Hrs/ week	Marks		
					Ext	Int	Total
MCL-701	Core Course-XV	Inorganic Chemistry-V	4	4	70	30	100
MCL-702	Core Course-XVI	Organic Chemistry-V	4	4	70	30	100
MCL-703	Core Course-XVII	Physical Chemistry-V	4	4	70	30	100
MCL-704	Core Course-XVIII	Bioinorganic Chemistry	2	2	70	30	100
MCP-701	Core Course Practical-XV	Inorganic Chemistry Lab-V	4	8	70	30	100
MCP-702	Core Course Practical-XVI	Organic Chemistry Lab-V	4	8	70	30	100
MCP-703	Core Course Practical-XVII	Physical Chemistry Lab-V	4	8	70	30	100
			26	**38**			**700**

SEMESTER-VIII

Paper Code	Course opted	Nomenclature	Credits	Hrs/ week	Marks		
					Ext	Int	Total
MCL-801	Core Course-XIX	Inorganic Chemistry-VI	4	4	70	30	100
MCL-802	Core Course-XX	Organic Chemistry-VI	4	4	70	30	100
MCL-803	Core Course-XXI	Physical Chemistry-VI	4	4	70	30	100
MCL-804	Core Course-XXII	Spectroscopy-I	4	4	70	30	100
MCP-801	Core Course Practical-XVIII	Inorganic Chemistry Lab-VI	4	8	70	30	100
MCP-802	Core Course Practical-XIX	Organic Chemistry Lab-VI	4	8	70	30	100
MCP-803	Core Course Practical-XX	Physical Chemistry Lab-VI	4	8	70	30	100
			28	**40**			**700**

DEPARTMENT OF CHEMISTRY
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR

SYLLABUS (w.e.f. the session 2023)

Scheme for Dual Degree B.Sc. (Hons) Chemistry-M.Sc. Chemistry under Choice Base Credit System

M.Sc. Chemistry

SEMESTER-IX

Paper Code	Course opted	Nomenclature	Credits	Hrs/ week	Marks		
					Ext	Int	Total
MCL-901	Core Course-XXII	Group Theory and its Applications	4	4	70	30	100
MCL-902	Core Course-XXIII	Bioorganic and Retrosynthetic analysis	2	2	70	30	100
MCL-903(IC)/ MCL-903(OC)/ MCL-903(PC)	Discipline Specific Elective –I	Inorganic Chemistry Elective-I/ Organic Chemistry Elective-I/ Physical Chemistry Elective-I	4	4	70	30	100
	Open Elective-I	To be opted from other department[#]	4	4	70	30	100
MCP-901(IC)/ MCP-901(OC)/ MCP-901(PC)	Discipline Specific Practical-I	Inorganic Chemistry Lab Elective-I/ Organic Chemistry Lab Elective-I/ Physical Chemistry Lab Elective-I	4	8	70	30	100
MRP-901	Discipline Specific Project –I	Project part-I	4	8	70*	30**	100
			22	**30**			**600**

The nomenclature and content of Paper code MCL-903(IC) and MCL-532(IC) of M.Sc. Chemistry 3rd semester are same.
The nomenclature and content of Paper code MCL-903(OC) and MCL-532(OC) M.Sc. Chemistry 3rd semester are same.
The nomenclature and content of Paper code MCL-903(PC) and MCL-532(PC) M.Sc. Chemistry 3rd semester are same.
The open elective offered by the Departments of Physics, Environmental Science and Engg., Mathematics, Food Technology, Pharmaceutical Sciences, Bio and NanoTechnology may be opted.
*Project report-35 marks; Presentation/Seminar/Viva-voce-35 marks. ** Assessment by Supervisor.

SEMESTER-X

Paper Code	Course opted	Nomenclature	Credits	Hrs/ week	Marks		
					Ext	Int	Total
MCL-1001	Core Course-XXIV	Spectroscopy-II	4	4	70	30	100
MCL-1002	Core Course-XXV	Biophysical Chemistry	2	2	70	30	100
MCL-1003 (IC)/ MCL-1003 (OC)/ MCL-1003 (PC)	Discipline Specific Elective –II	Inorganic Chemistry Elective-II/ Organic Chemistry Elective-II/ Physical Chemistry Elective-II	4	4	70	30	100
MCP-1001(IC)/ MCP-1001 (OC)/ MCP-1001 (PC)	*Discipline Specific Practical-II*	*Inorganic Chemistry Lab Elective-II/ Organic Chemistry Lab Elective-II/ Physical Chemistry Lab Elective-II*	*4*	*8*	*70*	*30*	*100*
MCP-1002(IC)/ MCP-1002 (OC)/ MCP-1002 (PC)	*Discipline Specific Practical-III*	*Inorganic Chemistry Lab Elective-III/ Organic Chemistry Lab Elective-III/ Physical Chemistry Lab Elective-III*	*4*	*8*	*70*	*30*	*100*
OR							
MRP-1001	*Discipline Specific Project –II*	*Project part-II*	*8*	*16*	*140[#]*	*60[##]*	*200*
			18	**26**			**500**

The nomenclature and content of Paper code MCL-1003(IC) and MCL-545(IC) are same.
The nomenclature and content of Paper code MCL-1003(OC) and MCL- 545(OC) are same.
The nomenclature and content of Paper code MCL-1003(PC) and MCL- 545(PC) are same.
#Project report-70 marks; Presentation/Seminar/Viva-voce-70 marks. ## Assessment by Supervisor.

Note 1:

Allotment of specialization to the students of Dual Degree B.Sc. (Hons.)-M.Sc. Chemistry will be made in 9th semester on the basis of merit-cum-choice. For this purpose, the merit will be drawn based on absolute marks obtained in the 5th, 6th and 7th semesters and the choices of the students for allotment of specialization which will be invited in the 8th semester. The student will carry out the Project part-I as per the allotted specialization in the 9th semester. The teacher for the Project part-I shall be decided by the staff council.

Note 2:

The Project part-I in 9th semester will consists of submitting a project report by the end of 9th semester under the supervision of allotted teacher on the latest development in chemistry by reviewing at least 15 research publications (SCI) in the relevant area followed by presentation in the form of Seminar in front of the committee constituted by the staff council.

Note 3:

The allotment of Project part-II or MCP-1001 & MCP-1002 (Practicals) in the 10th semester will be decided by the staff council as per the prevailing situation at that time in terms of number of students who opt MRP-1001 (Project part-II) or MCP-1001 & MCP-1002 (Practicals) for10th semester and number of teachers in the Department, etc.

Note 4:

The student will submit the Project part-II report by the end of 10th semester under the supervision of allotted teacher. The viva-voce examination on the Project part-II will be conducted by a committee consisting of Chairperson, external examinor, one internal teacher in the relevant specialization preferably supervisor. If external examinor not available, internal arrangment can be made by Chairperson.

Dual Degree B.Sc.(Hons)Chemistry-M.Sc. chemistry

M.Sc. Chemistry
7th Semester

INORGANIC CHEMISTRY-V
(Bonding and Properties of Inorganic Compounds)

Paper Code: MCL-701 **Marks for Major Test (External): 70**
60 Hrs (4Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 3Hrs

Note*: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Co-ordination Compounds **15 Hrs**

Rules for nomenclature for coordination compounds, Valence bond theory and its limitations, crystal field theory, CF splitting of d-orbitals in cubic, octahedral, tetragonal, tetrahedral and square planar complexes .factors affecting the magnitude of crystal field splitting, application of CFT, Jahn Teller theorem. Structure of spinels, ligand field theory-molecular orbital theory, MOT with σ and π bonding.

UNIT-II

Chemistry of Lanthanides and Actinides **15 Hrs**

Lanthanides-Occurrence, extraction, separation and applications, properties-oxidation state, radii, colour, spectra, magnetic properties, binary and ternary compounds, cyclopentadienyl compounds, Low oxidation state compounds, Lanthanide contraction, Use of lanthanide compounds as shift reagents.
Actinides- General properties, oxidation states, dioxoions, chemistry of actinium, thorium, protactinium, uranium, uranyl and cyclopentadienyl compounds, transuranic elements
.

UNIT-III

Chemistry of Non Transition Elements **15 Hrs**

Properties of the non transition elements, special features of individual groups, synthesis, properties and structure of halides and oxides of non-transition elements, allotropes of carbon, phosphorus and sulphur, Synthesis, properties and structure of boranes, carboranes, borazines, silicates, phosphazenes, sulphur-nitrogen compounds, oxy acids of nitrogen, phosphorus, sulphur and halogens, interhalogens, pseudohalides and compounds of xenon; Metal clusters.

UNIT-IV

Non- aqueous solvents **15 Hrs**

Classification and characteristics of non-aqueous solvents, reactions in non-aqueous media-ammonia, sulphuric acid, bromine trifluoride, dinitrogen tetraoxide, hydrogen fluoride, thionyl chloride and phosphoryl chloride. Mechanism of coordination reactions in non-aqueous media.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, K.E. Keiter and R.L. Kieter Harper Collins.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Elsevier
4. Magnetochemistry, R.L. Carlin, Springer-Verlog.
5. Inorganic Chemistry, G. Wulfsburg, University Science Books.
6. Introduction to Ligand Fields, B.N. Figgis, Wiley Eastern.

ORGANIC CHEMISTRY-V
(Stereochemistry & Reaction Mechanism)

Paper Code: MCL-702 **Marks for Major Test (External): 70**
60 Hrs (4Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 3Hrs

***Note**: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Stereochemistry **15 Hrs**

Optical activity and chirality, asymmetric synthesis (basic principle, auxiliary, substrate, reagent and catalyst controlled). Methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Conformational analysis of substituted cycloalkanes, decalins, effect of conformation on reactivity, conformation of mono- and di-saccharides, Optical activity in the absence of chiral carbon: Biphenyl, atropisomerism, allenes, spiranes; Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

UNIT-II

Reaction Mechanism: Structure and Reactivity **15 Hrs**

Thermodynamic and kinetic requirements for a reaction, kinetic vs thermodynamic control, Curtin-Hammett principle. Methods of determining mechanisms: Identification of products, determination of presence of intermediate, study of catalysis, isotopic labeling, stereochemical evidence, kinetic evidence and isotopic effect. Generation, structure, stability and reactivity of arynes, carbenes and nitrenes. Quantitative treatments of the effect of structure on reactivity - Hammett equation and linear free energy relationship.

Bimolecular mechanisms – S_E2 and S_Ei. The S_E1 mechanism, electrophilic substitution accompanied by double bound shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT-III

Pericyclic Reactions-I **15 Hrs**

Classification of pericyclic reactions, Molecular orbitals of Alkenes, conjugated ions or radical. Symmetry properties of π or σ-Molecular orbitals. Analysis of Pericyclic reactions. Electrocyclic reactions: Conrotatory and Disrotatory modes, stereochemistry, selection rules and analysis. Cycloaddition reactions: Stereochemical modes, feasibility of reactions, [2+2] and [4+2] cycloaddition.

UNIT-IV

Pericyclic Reactions- II **15 Hrs**

Sigmatropic rearrangements: antarafacial and suprafacial processes, Analysis of sigmatropic rearrangements of hydrogen and alkyl group, [3,3] and [5,5] rearrangements. Group transfer reactions and Ene reaction.

Books Suggested:

1. March's Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Michael B. Smith and Jerry March, Wiley-Interscience.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Springer.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, CBC Publisher & Distributors.
5. Organic Chemistry, R.T. Morrison, R.N. Boyd and S. K. Bhattacharjee, Pearson.
6. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh revised by S.P. Singh and Om Prakash, Trinity.
7. Organic Chemistry, P.Y. Bruice, Pearson.
8. Organic Chemistry, J. Clayden, N. Geeves and S. Warren, Oxford University Press.
9. Organic Chemistry, T.W.G. Solomon, W.B. Fryhl and S.A. Snyder, Wiley.
10. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.
12. Stereochemistry of Organic Compounds, E.L. Eliel and S.H. Wilen, Wiley Interscience.
13. Pericyclic Reactions, S. Kumar, V. Kumar and S.P. Singh, Academic Press.

PHYSICAL CHEMISTRY-V
(Surface Chemistry & Electrochemistry)

Paper Code: MCL-703 **Marks for Major Test (External): 70**
60 Hrs (4Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 3Hrs

Note*: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Surface Chemistry-I **15 Hrs**

Adsorption: The extent of adsorption: Physisorption and Chemisorption, adsorption isotherms (Langmuir, BET, Freundlich isotherms), rates of surface processes (adsorption and desorption), mobility on surfaces, biosensor analysis. Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), surface films on liquids (Electro-kinetic phenomenon).

UNIT-II

Surface Chemistry-II **15 Hrs**

General features, structure of surfactants in solution, influence of chain length and salt concentration, surfactant parameters, surface active agents, classification of surface active agents, micellisation, hydrophobic interactions, critical micellar concentration, factors affecting CMC of surfactants, CMC temperature dependence, counter ions binding to micelles, thermodynamics of micellization-phase, separation & mass action models, solublization, microemulsion, reverse micelles.

UNIT-III

Electrochemistry-I **15 Hrs**

Electrochemistry of solutions: Debye-Hückel–Onsager treatment and its extension, ion-ion interactions, electrode/electrolyte interface, potential difference across electrified interfaces, nonpolarizable interface and equilibrium, concept of surface excess; thermodynamics of electrified interfaces- interfacial tension, electro-capillarity curves, thermodynamic treatment of polarizable interfaces, Lippmann equation, determination of charge density on electrode, capacitance of interface and surface excess.

Structure of electrified interfaces: Helmholtz-Perin,Guoy-Chapman, Stern, Graham-Devanathan-Mottwatts.

UNIT-IV

Electrochemistry-II

Semiconductor-electrolyte interface– theory of double layer at semiconductor, Effect of light on semiconductor solution interface.
Electron transfer under interfacial electric field: exchange current density, over potentials, derivation of Butler-Volmer equation, Tafel plot.
Polarography theory, Ilkovic equation, half wave potential and its significance.

Fuel Cells and Batteries: Energy conversion, theoretical consideration of fuel cells, maximum intrinsic efficiency, Hydrogen–Oxygen cell, Hydrocarbon –Air cells, Natural gas and Carbon mono-oxide-Air cells.

Battery characteristics specification, components, battery systems, Lead storage battery, Dry cell, Silver-Zinc cell, Sodium –Sulphur cell, Ni-Cd and Li battery.

Books Suggested:

1. Physical Chemistry of Surfaces, A.W. Adamson, John Wiley and Sons.
2. Physical Chemistry, P.W. Atkins, Oxford University Press.
4. Electrochemistry, S. Glasstone, Affiliated East-West Press.
5. Modern Electrochemistry, Vol.1 and II, J.O.M. Bockris and A.K.N. Reddy, Plenum.

BOINORGANIC CHEMISTRY

Paper Code: MCL-704 **Marks for Major Test (External): 70**
30 Hrs (2Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 2 **Total Marks: 100**
Time: 3Hrs

***Note**: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Metal Ions in Biological Systems **7.5 Hrs**
Classofication and role of metals ions in biological processes, Bioenergetics and ATP Cycle
DNA polymerisation, glucose storage, metal complexes in transmission of energy.

UNIT-II

Nitrogenase **7.5 Hrs**
Biological nitrogen fixation, molybdenum nitrogenase, other nitrogenases model systems.
Transport and Storage of Dioxygen
Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, synthetic models.

UNIT-III

Electron Transfer in Biology **7.5 Hrs**
Structure and function of metalloproteins in electron transport processes – cytochromes and ion- sulphur proteins, synthetic models.
Metal Storage Transport and Biomineralization
Ferritin, transferrine and siderophores.

UNIT-IV

Mettaloenzymes **7.5 Hrs**
Zinc enzymes- carboxypeptidase. Iron enzymes- catalase, peroxidase and cytochrome P-450. Copper enzymes- superoxide dismutase. Molybednum oxatransferase enzymes- xanthine oxidase. Coenzyme vitamin B_{12}.

Books Suggested:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentne, University Science Books.
3. Bio-inorganic Chemistry, R.W. Hay; Ellis Harwood limited.
4. Metal ions in Biochemistry, P.K. Bhattacharya, Narosa Publishing House.

INORGANIC CHEMISTRY LAB-V

Paper Code: MCP-701 **Marks for Major Test (External): 70**
120 Hrs (8Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 6 Hrs

Water Analysis

1. Determination of total suspended solids dried at 103- 105°C.

5 C.

2. Determination of the amount of bleaching powder required to disinfect a water sample by Horrock's test.
3. Determination of free carbon dioxide in a water sample.
4. Determination of free and combined chlorine residuals.
5. To determine the minimum dose of a coagulant required to coagulate a given sample by Jar test and to compare the effectiveness of aluminium sulphate and ferric sulphate as coagulants for a given sample at room temperature.
6. Determination of dissolved oxygen in water sample.
7. Determination of total dissolved solids dried at 180 °C.
8. Determination of alkalinity of water sample.

Preparations

Preparation of the following compounds:

1. $K_3[Cr(C_2O_4)_3]$
2. $NH_4[Cr(NH_3)_2(CNS)_4]$
3. $Mn(acac)_3$
4. $Na_3[Co(NO_2)_6]$
5. $[Cu_2(NH_2CSNH_2)_5](NO_3)_2$
6. $Cu_2[HgI_4]$
7. $ZnCl_2(NH_2OH)_2$ (crismer's salt)

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, J. Bassett, R. C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, G. Svehla, Longman.
3. Practical Inorganic Chemistry, G. Marr and B.W. Rockett.
4. Applied Chemistry by O.P. Virmani and A.K. Narula, New Age International

ORGANIC CHEMISTRY LAB-V

Paper Code: MCP-702 **Marks for Major Test (External): 70**
120 Hrs (8Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 6 Hrs

I Separation and Purification Techniques

Distillation: simple, fractional, steam and vacuum distillation, extraction.

II Qualitative Analysis

Separation of an organic binary mixture using water, $NaHCO_3$, ether and identification of its constituents through chemical methods

III Organic preparations

Preparations of organic compounds by one or two steps synthesis involving oxidation, reduction, rearrangement, etc.

Books Suggested:

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, K.M. Masters, Cengage learning.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

PHYSICAL CHEMISTRY LAB-V

Paper Code: MCP-703 **Marks for Major Test (External): 70**
120 Hrs (8Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 6 Hrs

I Adsorption

1. To investigate the adsorption of oxalic acid from aqueous solutions by activated charcoal and examine the validity of Langmuir's adsorption isotherm.

II Partition Coefficient

2. To determine partition coefficient for iodine between water and carbon tetrachloride.
3. To study the distribution of benzoic acid between benzene and water at room temperature and show that benzoic acid dimerizes in benzene.

III Conductometry

4. Determination of the equivalent conductance of strong electrolytes such as HCl, KCl, KNO_3, $AgNO_3$, and NaCl and the validity of Onsager equation.
5. Titrate a mixture of (H_2SO_4 + CH_3COOH) against NaOH.
6. Determine of strength of (HCl + NH_4Cl) titrating against NaOH.

IV Colorimetry/Spectrophotometry

7. Verification of the Lambert-Beer's law using solutions such as $K_2Cr_2O_7$, $KMnO_4$, $CuSO_4$ in water, I_2 in CCl_4.
8. Determine the concentration of $K_2Cr_2O_7$ and $KMnO_4$ in mixture of ($K_2Cr_2O_7$ + $KMnO_4$) solution.

V Chemical Kinetics

9. Determine the rate constant of hydrolysis of an ester such methyl acetate catalyzed by an acid. Determine its energy of activation.

VI Polarimeter

10. To determine specific and molecular rotation of an optically active substance.
11. To determine the concentration of an optically active substance.

VII Potentiometry

12. Titrate potentiometrically (i) HCl / NaOH (ii) HCl / NH_4OH.
13. Titrate oxalic acid and sodium hydroxide potentiometrically.

VIII pH–metry

14. To determine the hydrolysis constant of aniline hydro chloride.

IX Spectroscopy

15. Record the UV Spectrum of a given compound (acetone) in cyclohexane:
    a) Plot transmittance vs. wavelength, b) Plot absorbance vs. wavelength.
    c) Assign the transitions by recording spectra in solvents of different polarities (H_2O, CH_3OH, $CHCl_3$, CH_3CN and 1,4-dioxane). Calculate hydrogen bond energy.
    c) Calculate the oscillator strength/ transition probability.

X Refractometer

16. To determine the refractive index of some liquids.

Books Suggested:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand, McGraw Hill.
6. Thermal Methods of Analysis: Principles, Application and Problems, P.J. Hains, Blackie Academic and Professional.

Dual Degree B.Sc.(Hons)Chemistry-M.Sc. chemistry

M.Sc. Chemistry
8th Semester

INORGANIC CHEMISTRY-VI
(Chemistry of Transition Metals)

Paper Code: MCL-801 **Marks for Major Test (External): 70**
60 Hrs (4Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 3Hrs

Note*: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Electronic Spectra **15 Hrs**

Microstates, ground states term symbols , Coupling Schemes, Term symbols for excited states, Energies terms and energy state, Racah Parameters, Selection rules, splitting of S, P, D and F terms under octahedral and tetrahedral complexes for strong and weak field ligand, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq, B, β and x parameters

UNIT-II

Charge Transfer Spectra and Magnetic Properties **15 Hrs**

Types of Charge transfer transitions of complexes - metal to ligand ,ligand to metal and metal to metal, Magnetic properties of coordination compounds, types of magnetism- Diamagnetism, Paramagnetism, Ferro, ferri and Anti ferromagnetism, effect of temperature and magnetic field on various types of magnetism

Stability of complexes in Solution

Stability stepwise and overall formation constants, their interaction, trends in stepwise constants, factors affecting the stability of metal complexes- the nature of metal ion and ligand, chelate effect and its thermodynamic origin, Irving-William order.

UNIT-III

Reaction Mechanism and kinetics **15 Hrs**

Energy profile of a reaction, reactivity of metal complexes, concept of inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage.

UNIT-IV

Reaction Mechanism **15 Hrs**

Substitution reaction in square planar complexes, the trans effect, theories of trans effect, electron transfer

reactions, complementary and noncomplementary reactions, mechanism of one electron transfer reactions, outer sphere type reactions and its mechanism, factors affecting rate of outer sphere reactions, inner sphere type reactions, mechanism ,consequences, evidences in favour of bridge mechanism.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, K.E. Keiter and R.L. Kieter Harper Collins.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Elsevier
4. Magnetochemistry, R.L. Carlin, Springer-Verlog.
5. Inorganic Chemistry, G. Wulfsburg, University Science Books.
6. Introduction to Ligand Fields, B.N. Figgis, Wiley Eastern.

ORGANIC CHEMISTRY-VI
(Methods of Organic Synthesis)

Paper Code: MCL-802 **Marks for Major Test (External): 70**
60 Hrs (4Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 3Hrs

***Note**: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Oxidation **15 Hrs**

Oxidation of hydrocarbons: Alkanes, Aromatic hydrocarbons and Alkene
Oxidation of alcohols: Chromium reagents, oxidation via alkoxysulfonium salts, Maganese reagents, metal-based oxidants, non-metal-based oxidants and oxidation to carboxylic acids or esters.
Oxidation of ketones: α,β-Unsaturated ketones, α-Hydroxy ketones and Baeyer-Villiger oxidation of ketones.

UNIT-II

Reduction **15 Hrs**

Catalytic hydrogenation, reduction by dissolving metals, Reduction by hydride-transfer reagents ($LiAlH_4$, $NaBH_4$, mixed $LiAlH_4$ and $LiAlCl_4$, DIBAL-H, $NaBH_3CN$, $NaBH(OAc)_3$, Borane and derivative, enzyme catalysed, wolf-kishner reduction, reduction with diimide and trialkylsilanes.

UNIT-III

Reactions and Rearrangements **15 Hrs**

A detailed study of the following reaction- Favorskii, Arndt-Eistert synthesis, Shapiro reaction, Chichibabin reaction. Mitsunobu reaction, Suzuki reaction, Buchwald-Hartwing reaction (cross-coupling), Sonogarshira reaction, Heck reaction.

UNIT-IV

Reagents **15 Hrs**

Gilman's reagent – Lithium dimethylcuprate, Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DCC), 1,3-Dithiane (Umpolung reagent), DDQ, Palladium catalysed reactions, Woodward and Prevost hydroxylation, Ionic liquids, Phase transfer Catalysts (Quaternary ammonium salts) Wilkinson's catalyst

Books Suggested:

1. Modern methods of organic synthesis, William Carruthers and Iain Coldham, Cambridge.
2. March's Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Michael B. Smith and Jerry March, Wiley-Interscience.
3. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Springer.
4. Organic Chemistry, R.T. Morrison, R.N. Boyd and S. K. Bhattacharjee, Pearson.
5. Organic Chemistry, P.Y. Bruice, Pearson.
6. Organic Chemistry, J. Clayden, N. Geeves and S. Warren, Oxford University Press.
7. Organic Chemistry, T.W.G. Solomon, W.B. Fryhl and S.A. Snyder, Wiley.

PHYSICAL CHEMISTRY-VI
(Statistical Thermodynamics & Quantum Chemistry)

Paper Code: MCL-803 **Marks for Major Test (External): 70**
60 Hrs (4Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 3Hrs

Note*: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Statistical Thermodynamics **15 Hrs**

Concept of distribution, thermodynamic probability and most probable distribution. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions– translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions. Heat capacity, behavior of solids – chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, Bose–Einstein statistics.

UNIT-II

Quantum Chemistry-I **15 Hrs**

Approximate Methods: Perturbation theory (first order and non-degenerate), applications of perturbation theory. The linear variation principle, applications of variation method and comparison of perturbation and variation methods. The concept of tunneling, Shape of the barriers for tunneling. Tunneling in hydrogen-transfer reactions.

UNIT-III

Quantum Chemistry-II **15 Hrs**

Orbital angular momentum of many electron atoms, Electron spin, Wave functions of many electron atoms. Pauli Exclusion Principle, Slater determinants, Perturbation treatment of Lithium ground state and variation treatment of Lithium ground state, Born-Oppenheimer approximation, valence bond & molecular orbital theory, extension of MO theory to other systems-homonuclear & heteronuclear diatomic molecules.

UNIT-IV

Chemical Kinetics **15 Hrs**

Theories of unimolecular reactions: Lindemann–Hinshelwood and Rice - Ramsperger–Kassel – Marcus (RRKM). General features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and nuclear magnetic resonance method.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, Oxford University Press.
2. Quantum Chemistry, I.M. Levine, Prentice Hall.
3. Quantum Mechanics, M.L. Strause, Prentice – Hall.
4. Quantum Chemistry, D.A. McQuarrie, Viva Books.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Statistical mechanics, D.A. McQuarrie, Viva Book
7. Introductory Quantum Chemistry, A K Chandra, McGraw Hill.

SPECTROSCOPY-I
(Spectroscopic Methods for Structure Determination)

Paper Code: MCL-804 **Marks for Major Test (External): 70**
60 Hrs (4Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 3Hrs

***Note**: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consists of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory question No. 1.*

UNIT-I

Infrared Spectroscopy
Application of IR in structure elucidation of organic compounds-carbonyls and effect of substituents on it, C-H, NH, O-H vibrations and H-bonding- unsaturated, mono- and disubstituted aromatic compounds, metal-ligand vibrations, group frequencies of complex ligands-CN stretching and effect of coordination on it, nitro and nitrite and C=O ligands and effect of their coordination with metal ions. Applications of far and near IR.

UNIT-II

NMR-Spectroscopy
Introduction to NMR including instrumentation. Chemical shift and its measurements. Factors influencing chemical shift. Magnetic anisotropy. The relaxation processes. Mechanism of nuclear spin-spin interactions. Different spin systems. The coupling constant and factors effecting coupling constant. Long range spin-spin coupling. Simplification of complex proton spectra with examples. Interpretation of first order and complex PMR Spectra of specific organic compounds. Distinction between geometrical isomers.
Study of some dynamic effects by ^{1}H NMR, Hindered rotation, kete-enol tautomerism, aromaticity. Nuclear overhauser effect. Introduction to ^{19}F and ^{31}P-NMR.

UNIT-III

^{13}C-NMR Spectroscopy
Pulsed Fourier Transform NMR spectroscopy. Decoupled and off- resonance proton decoupled Spectra, ^{13}C-NMR structural applications.
DEPT ^{13}C NMR spectra. General introduction to two dimensional NMR spectroscopy - COSY. HSQC, HMBC, INADEQUATE and NOESY.

UNIT-IV

Mass Spectrometry
Introduction, ion production – EI, CI, FD and FAB, factors affecting fragmentation, McLafferty rearrangement, Nitrogen rule. Mass spectral fragmentation of organic compounds hving common functional groups, High resolution mass spectrometry (HRMS).
Combined problems relating to structure elucidation by UV, IR, NMR Spectroscopy and Mass Spectrometry.

Books Suggested:

1. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
2. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
3. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
4. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw-Hill.
5. Organic Chemistry, W. Kemp, John Wiley.
6. Organic Spectroscopy, J. Mohan, Narosa Publishers, New Delhi
7. Spectroscopy, G.M. Lampman, D.L. Pavia, G.S. Kriz and J.M. Vyvyan, Cengage Learning

INORGANIC CHEMISTRY LAB-VI

Paper Code: MCP-801 **Marks for Major Test (External): 70**
120 Hrs (8Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 6 Hrs

I Qualitative Analysis

Five unknown mixtures will be given containing three radicals out of which one must be an insoluble and one may be an acid radical and one metal ions.

(a) Less common metal ions –Mo, W, Ti, Zr, Th, V, (two metal ions in cationic/anionicforms)
(b) Insolubles– oxides (Al_2O_3, Cr_2O_3, SnO_2,), sulphates ($PbSO_4$, $BaSO_4$) halides (AgCl, AgBr, AgI).
(c) Acid radicals CO_3^{2-}, SO_3^{2-}, SO_4^{2-}, CH_3COO^-, S^{2-}, PO_4^{3-}, NO_3^-, NO_2^-, Cl^-, Br^-, I^- etc.

II Quantitative Analysis

1. Separation of Copper and Nickel and estimation of Copper volumetrically and Nickel gravimetrically.
2. Separation of Copper and Zinc and estimation of Copper gravimetrically and Zinc volumetrically.
3. Separation of Iron and Magnesium and estimation of Iron volumetrically and Magnesium gravimetrically.
4. Separation of Iron and Nickel and estimation of Iron gravimetrically Nickel gravimetrically.
5. Separation of Silver and Nickel and estimation of Silver volumetrically and Nickel gravimetrically.
6. Separation of Copper and Barium and estimation of Copper gravimetrically and Barium gravimetrically.
7. Separation of Silver and Magnesium and estimation of Silver gravimetrically and Magnesium gravimetrically.
8. Separation of Copper and Magnesium and estimation of Copper gravimetrically and Magnesium gravimetrically.

Books Suggested:

1. Synthesis and Characterization of Inorganic Compounds. W.L. Jolly, Prentice Hall.
2. Synthesis and Physical studies of Inorganic compounds C.F. Bell, Pergamon Press.
3. A Textbook of Quantitative Analysis. A.I. Vogel, ELBS, London.
4. Inorganic Synthesis, Vol. 1-12, McGraw Hill.
5. Practical Inorganic Chemistry, G. Marr and B.W. Rocket.

ORGANIC CHEMISTRY LAB-VI

Paper Code: MCP-802 **Marks for Major Test (External): 70**
120 Hrs (8Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 6 Hrs

I Qualitative Analysis

Separation of an organic mixture by column chromatography.

Identification of structure of the compounds after separation by spectroscopic data (IR and NMR) and Chemical analysis.

II Organic preparations

Synthesis and characterization of organic compounds of medicinal interest:
Such as Isoniazide, Ibuprofen, Paracetamol, Benzocaine, Coumarin-3-carboxylic acid etc.

Books Suggested:

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, K.M. Masters, Cengage learning, Inc..
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
5. Introduction to Spectroscopy, D.L. Pavia, G.M. Lampman, G.S. Kriz and J.M. Vyvyan, Cengage Learning, Inc.

PHYSICAL CHEMISTRY LAB-VI

Paper Code: MCP-803 **Marks for Major Test (External): 70**
120 Hrs (8Hrs/week) **Marks for Minor Test (Internal): 30**
Credits: 4 **Total Marks: 100**
Time: 6 Hrs

I Conductometry

1. Study conductometric titration of (i) NH_4Cl / NaOH (ii) CH_3COONa / HCl and comment on nature of graph.
2. Study conductometric titration of (i) $MgSO_4$ / $Ba(OH)_2$ (ii) $BaCl_2$ / K_2SO_4 and comment on nature of graph.
3. To study stepwise neutralization of polybasic acid i,e oxalic acid, citric acid, succinic acid by conductometric titration and explain the variation in the graph.
4. Estimate concentration of each component of a mixture of $AgNO_3$ and HNO_3 by titrating against NaOH conductometerically.
5. Determine the hydrolysis constant of aniline hydrochloride.

II Colorimetry/Spectrophotometry

6. Determine the concentration of Crystal violet and Aurine in mixture of (crystal violet + aurine) solution.
7. Determine of strength of Fe (II) titrating against $KMnO_4$.

III Polarimeter

8. Study the inversion of cane sugar in presence of strong acid.
9. To determine the percentage of two optically active substances in a given mixture.

IV Potentiometry

10. Titrate Mohr's salt against $KMnO_4$ potentiometrically and carry out the titration in reverse order.
11. Determine the solubility and solubility product of an insoluble salt AgX (X=Cl, Br, I) potentiometrically.
12. Find out pH values of three buffer solution using (a) indicator (b) pH–Meter (c) Potentiometer.

V pH– metry

13. Find out the dissociation constant of weak acid.

VI Polymer Chemistry

14. Measurement of phase transition, glass temperature, heat transitions in polymers.
15. Determination of molecular weight by viscosity/any other methods.
16. Kinetics of polymerization/ polymer degradation.

VII Spectroscopy

17. Record the UV spectra of Benzene, pyridine and pyrimidine in methanol. Compare and discuss the various transitions observed.

Books Suggested:

1. Practical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, C. Garland, J.W. Nibler and D.P. Shoemaker, McGraw Hill.
6. Thermal Methods of Analysis: Principles, Application and Problems, P.J. Hains, Blackie Academic and Professional.

Dual Degree B.Sc.(Hons)Chemistry-M.Sc. chemistry

M.Sc. Chemistry

Ninth Semester

GROUP THEORY AND ITS APPLICATIONS

Paper code: MCL-901
60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam : 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with the basic concepts of symmetry, group theory and its applications.

UNIT – I **15 Hrs**

Molecular symmetry: Symmetry elements and symmetry operations, definition of group and its characteristics, subgroups, classes, similarity transformation.
Products of symmetry operations, equivalent atoms and equivalent symmetry elements, relations between symmetry elements and operations, classes of symmetry operations, point groups and classification.

UNIT – II **15 Hrs**

Symmetry: Optical activity and dipole moment.
Representation of groups, reducible and irreducible representations. The Great Orthogonality theorem, character tables, position vector and base vector as basis for representation.

UNIT – III **15 Hrs**

Wavefunctions as bases for irreducible representations (*p*- and *d*-orbitals). Direct product.
Spectral transition probability, vibronic coupling, non-centrosymmetric complexes, polarization of allowed transitions.

UNIT – IV **15 Hrs**

Application of Group Theory in Infrared and Raman Spectroscopy.
SALCs, projection operators, illustrative examples.
Hybridization and its applications, Hybrid orbitals as Linear Combinations of Atomic Orbitals. Selected examples. MO diagram using Group Theory.
Symmetry and chemical reactions.

Books Suggested:

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.
3. Chemical Applications of Group Theory, F.A. Cotton, Wiley Interscience.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
5. Basic Principles of Spectroscopy, G.M. Barrow, McGraw Hill.
6. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
7. Fundamentals of molecular spectroscopy, C.N. Banwell, Tata Macgraw Hill.
8. Symmetry in Chemistry, H.H. Jaffe and M. Orchin, Dover Publications.
9. Physical Methods in Chemistry, R.S. Drago, W. B. Saunders Co., U.K.

BIOORGANIC AND RETROSYNTHETIC ANALYSIS

Paper code: MCL-902 **Marks for Major Test (External): 70**
30 Hrs (2Hrs /week)
Credits: 2 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with the mechanism of action & applications of enzymes and study of steroids. It also deals with the disconnection approach and protecting group study.

UNIT-I 7 Hrs

Enzymes

Remarkable properties of enzymes like catalytic power, specificity and regulation. Fischer's lock and key and Koshland's induced fit hypothesis.

Mechanism of Enzyme Action

Acid-base catalysis, covalent catalysis. Enzymatic mechanisms for chymotrypsin

UNIT-II 8 Hrs

Biotechnological Applications of Enzymes

Introduction to purification of enzymes, methods for immobilization of enzymes, application of immobilized enzymes.

Steroids

Introduction, Diel's hydrocarbon and synthesis of Cholesterol

UNIT-III 8 Hrs

Disconnection Approach

An introduction to disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X disconnections and two-group C-X disconnections, chemoselectivity.

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UNIT-IV 7 Hrs

Protecting Groups

Principles of protection of amine and carboxyl groups

One Group C-C Disconnections

Alcohols, regioselectivity. Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

Books Suggested:

1. Understanding Enzymes, T. Palmer, Prentice Hall.
2. Enzyme Mechanisms Ed, M.I. Page and A. Williams, Royal Society of Chemistry.
3. Immobilized Enzymes: An Introduction and Applications in Biotechnology, M.D. Trevan, John Wiley.
4. Enzymatic Reaction Mechanisms, C. Walsh and W.H. Freeman.
5. Bioorganic Chemistry, G. Bertini and V. Lippard, Viva Low Priced Student Edition.
6. Natural products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman.
7. Organic Chemistry, Vol. 2, I.L. Finar, ELBS.
8. Some Modern Methods of Organic Synthesis, W. Carruthers, Foundation Books.
9. Advanced Organic Chemistry Part B, F.A. Carey and R.J. Sundberg, Springer.
10. Designing Organic Synthesis, S. Warren, Wiley.
11. Organic Synthesis- Concept, Methods and Starting Materials, J. Fhrhop and G. Penzillin, Verlage VCH.
12. New Horizons in Organic Synthesis, Nair V, New Age International.
13. Organic Synthesis through disconnection approach, P.S. Kalsi, Medtec.

INORGANIC CHEMISTRY ELECTIVE-I
(Organometallic Chemistry)

Paper code: MCL-903(IC)/MCL-532(IC) **Marks for Major Test (External): 70**
60 Hrs (4Hrs /week) **Marks for Internal Exam: 30**
Credits: 4 **Total Marks: 100**
Time: 3 Hrs

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with the basics of bonding of transition metal compounds and catalysis.

UNIT – I **15 Hrs**

Alkyls and Aryls of Transition Metals
Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis.

Compounds of Transition Metal-Carbon Multiple Bonds
Alkylidenes, alkylidynes, low valent carbenes and carbynes- synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.

UNIT – II **15 Hrs**

Transition Metal- π-Complexes
Transition metal π-complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, cyclopentadienyl (nature of bonding of ferrocene, MO description and aromatic character), arene and trienyl complexes, preparations, properties, nature of bonding and structural features.

UNIT – III **15 Hrs**

Fluxional Organometallic Compounds
Fluxionality and dynamic equilibria in compounds such as η^2- olefins, η^3- allyl and dienyl complexes.

Transition Metal Compounds with Bonds to Hydrogen
Bridging hydrides, dihydrogen complexes, synthesis and reactivity of hydride complexes.

UNIT - IV **15 Hrs**

Homogeneous Catalysis
Homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), water gas shift reaction, Fischer tropsch process, oxopalladation reactions.

Books Suggested:

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
4. Organometallics, A. Salzer, Ch. Elschenbrioch.VCH Publications.

ORGANIC CHEMISTRY ELECTIVE-I
Heterocyclic Chemistry and Photochemistry

Paper code: MCL-903(OC) / MCL-532 (OC)

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with (i). the nomenclature, methods of synthesis and reactions of smaller ring systems (heterocycles) containing one/ two heteroatoms, and (ii). basics of photochemistry, photochemical reactions of organic compounds containing double bond and carbonyl groups, and several photochemical name reactions.

Unit-I **15 Hrs**

Nomenclature of heterocyclic compounds

Systematic (Hantzsch-Widman) and replacement nomenclature for monocylic and fused ring systems containing heteroatom(s).

Three-membered heterocyclic compounds

General methods of synthesis and reactions including mechanism of aziridines, oxiranes and thiiranes.

Four-membered heterocyclic compounds

General methods of synthesis and reactions including mechanism of azetidines, oxetanes and thietanes.

Unit-II **15 Hrs**

Five-membered heterocycles containing two heteroatoms

Structures, comparison of basicity, general methods of synthesis and reactions (including mechanism) of pyrazoles, imidazoles, oxazoles, isoxazoles, thiazoles and isothiazoles.

Unit-III **15 Hrs**

Photochemical Reactions

Interaction of electromagnetic radiation with matter, excitations and excited states, fate of excited molecule (Jablonski diagram), quantum yield, transfer of excitation energy- sensitization and quenching.

Photochemistry of Alkenes

Intramolecular reactions of the olefinic bond– geometrical isomerization, sensitized cyclization reactions and rearrangement of 1,4-dienes (Di-π-methane rearrangement).

Unit-IV **15 Hrs**

Photochemistry of Carbonyl Compounds

Intramolecular reactions of carbonyl compounds– saturated, cyclic and acyclic, β, γ-unsaturated and α, β-unsaturated compounds. Cycloaddition to alkenes (Paterno-Buchi reaction).

Miscellaneous Photochemical Reactions

Photo-Fries rearrangement, Barton reaction, and Hofmann-Loffler-Freytag reaction.

Books Suggested:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
2. Heterocyclic Chemistry, J.A. Joule, ELBS.
3. The chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to Heterocyclic Chemistry, R.M. Acheson, John Wiley.
7. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, Pergamon Press.
8. Fundamentals of Photochemistry, K.K. Rohtagi-Mukherji, Wiley-Eastern
9. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill.
10. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
11. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
12. Photochemistry of Organic Synthesis, J. D. Coyle, Royal Society of Chemistry.

PHYSICAL CHEMISTRY ELECTIVE-I

Surface Chemistry and Non-Equilibrium Thermodynamics

Paper code: MCL-903 (PC) / MCL-532 (PC)

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with concept of surface chemistry and non-equilibrium thermodynamics.

Unit-I

Surface Chemistry-I **15 Hrs**

Adsorption: The extent of adsorption: Physisorption and Chemisorption, adsorption isotherms (Langmuir, BET, Freundlich isotherms), rates of surface processes (adsorption and desorption), mobility on surfaces, biosensor analysis. Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), surface films on liquids (Electro-kinetic phenomenon).

Unit-II

Surface Chemistry-II **15 Hrs**

Heterogeneous catalysis: Mechanisms of heterogeneous catalysis– Langmuir-Hinshelwood mechanism, Eley-Rideal Mechanism, catalytic activity at surfaces, Catalysis in chemical industry.

General features, structure of surfactants in solution, influence of chain length and salt concentration, surfactant parameters, surface active agents, classification of surface-active agents, micellisation, hydrophobic interactions, critical micellar concentration, factors affecting CMC of surfactants, CMC temperature dependence, counter ions binding to micelles, thermodynamics of micellization-phase, solubilization, microemulsion, reverse micelles.

Unit – III

Non-Equilibrium Thermodynamics-I **15 Hrs**

Introduction to non-equilibrium thermodynamics: Basic concept of entropy production and uncompensated heat and their relation to various thermodynamic functions, Entropy production in closed and open systems, entropy balance in continuous and discontinuous systems, transformation properties of fluxes and forces, coupled and uncoupled reactions and conditions, relaxation process.

Unit – IV **15 Hrs**

Non-Equilibrium Thermodynamics-II

Transport phenomena across membranes, thermochemical effects, thermal osmosis, electro-kinetic effect, thermo-mechanical and electrical effects.

Onsager theory and reciprocal relations, Onsager's formalism of non-equilibrium thermodynamics for multicomponent diffusion-Fick's law of diffusion, conductivity of electrolyte solutions, Onsager's formalism for transport phenomenon in electrochemical systems

Books Suggested:

1. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, Vikas Publication
2. Physical Chemistry, P.W. Atkins, Oxford University Press.
3. Thermodynamics for Chemists, S. Glasstone, Affiliated East-West Press.
4. Non-Equilibrium Thermodynamics-principles and applications, C. Kalidas and M.V. Sangaranarayanan, McMillan.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Physical Chemistry of Surfaces, A.W. Adamson, John Wiley and Sons.

INORGANIC CHEMISTRY LAB ELECTIVE-I

Paper code: MCP-901 (IC) **Marks for Major Test (External): 70**
120 Hrs (8Hrs /week) Marks for Internal Exam: 30
Credits: 4 Total Marks: 100
Time: 6 Hrs

I Spectrophotometric/Colorimetric determinations

1. To determine the strength of Cu(II) using EDTA.
2. To determine the strength of Fe(III) using EDTA.
3. Titration of Fe(II) against potassium permanganate.
4. To determine the concentration of nickel in given solution.
5. To analyse the given mixture of Cu(II) and Bi(III).
6. To determine simultaneously the As(III) and Sb(III) in the given mixture.
7. To determine the concentration of chloride ion.
8. To determine the concentration of sulphate ion.

II Chromatographic separations

1. Thin- layer chromatography-separation of nickel, manganese, cobalt and zinc. Determination of R_f values.
2. Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R_f value.

III Preparation of the following complexes

1. Hexamminecobalt(III) chloride
2. potassium trioxalatoaluminate(III)
3. Potassium trioxalatomangnate(III)
4. Potassium trioxalatocobaltate(III)
5. Tris(thiourea)cuprous (I) sulphate $[Cu(tu)_3]_2SO_4.2H2O$ (Where tu stands for thiourea)

Books Suggested:

1. Synthesis and Characterization of Inorganic Compounds. W.L. Jolly, Prentice Hall.
2. Synthesis and Physical studies of Inorganic compounds C.F. Bell, Pergamon Press.
3. A Textbook of Quantitative Analysis. A.I. Vogel, ELBS.

ORGANIC CHEMISTRY LAB ELECTIVE-I

Paper code: MCP-901 (OC)
120 Hrs (8Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 6 Hrs **Total Marks: 100**

I Qualitative Analysis

Characterization of organic compounds with the help of chemical analysis and confirmation of their structures by IR and PMR spectral data (IR & PMR spectra to be provided).

II Spectrophotometric (UV/VIS) Estimations of the following:

Glucose, amino acids, cholesterol, urea.

Books Suggested:

1. Experiments in Organic Chemistry, L.F. Fieser, O.C. Heath Company.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, K.M. Masters, Cengage learning.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
7. Analytical Organic Chemistry, Jag Mohan, Narosa Publishers.
8. Organic Spectroscopy, William Kemp. John Wiley & Sons.

PHYSICAL CHEMISTRY LAB ELECTIVE-I

Paper code: MCP-901(PC)
120 Hrs (8Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 6 Hrs **Total Marks: 100**

I Potentiometry

1. Titrate solution of (a) KCl / KI / KBr and (b) Mixture (KCl+KI+KBr) potentiometrically. Determine the concentration of each component in a mixture.
2. Titrate potentiometrically a solution of ferrous ions against $K_2Cr_2O_7$ carry out the titration in reverse order.
3. Titrate ($HCl+CH_3COOH$) solution potentiometrically and determine the concentration of each component in a mixture.

II Polarimetry

4. Investigate the muta rotation of Glucose catalysed by (a) an acid (b) base.
5. Investigate the inversion of cane sugar in presence of an acid.

III Conductometry

6. Determine the equivalent conductance at infinite dilution for acetic acid by applying Kohlrausch's law of independent migration of ions.
7. Study the conductometric titration of hydrochloric acid with sodium carbonate and determine the concentration of sodium carbonate in a commercial sample of soda ash.
8. Titrate a moderately strong acid (salicylic/ mandelic acid) by the (a) salt-line method and (b) double alkali method.

IV Refractometry

9. Refractometric determination of the composition of solutions.

V pH-metry

10. Titration of mixtures of acids ($HCl+ CH_3COOH$) against strong base.

VI Colorimetry/ Spectrophotometry

11. Study the kinetics of iodination of propanone in acidic medium.
12. Find the order and the energy of activation of the decomposition of the violet coloured Ce(IV) oxidation product of *N*-phenylanthranilic acid.
13. Study the kinetics of the reaction of phenolphthalein/ crystal violet with NaOH.
14. Study of absorption of picric acid on charcoal.
15. Study of dissociation constant of phenolphthalein.

VII Ultrasonic Interferrometry

16. Find the (i) ultrasonic sound velocity (u) and (ii) isentropic compressibility (K_s) for the following pure solvents as a function of temperature: Water, DMF, DMSO, Methanol, Ethanol, 1- propanol

(Note: Depending on availability of time/instruments, some experiments may be added/deleted /interchanged during the year/semester).

Books Suggested:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand McGraw Hill.

PROJECT PART-I

Paper code: MRP-901
Credits: 4 **Total Marks:100**

Note: It consists of preparing a project report under the supervision of allotted teacher on the latest development in chemistry by reviewing at least 15 research publications (SCI) in the relevant area followed by submitting the report by the end of 9th semester. The presentation in the form of Seminar will be held in front of the committee constituted by the staff council.

Dual Degree B.Sc.(Hons)Chemistry-M.Sc. chemistry

M.Sc. Chemistry

Tenth Semester

SPECTROSCOPY-II

Paper code: MCL-1001 **Marks for Major Test (External): 70**
60 Hrs (4Hrs /week) **Marks for Internal Exam: 30**
Credits: 4 **Total Marks: 100**
Time: 3 Hrs

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with the spectroscopy (EPR, Mossbaur, Molecular Fluorescence), Diffraction methods and hyphenated technique.

Unit – I 15 Hrs

Electron Spin Resonance Spectroscopy
Theory of ESR, instrumentation, ESR Spectra of DPPH, g value and factors affecting ESR lines, Hyperfine coupling, Hyperfine splitting constant, Zero field splitting and Kramer's degeneracy, applications of ESR, study of free radicals and inorganic compounds.

Mossbauer Spectroscopy
Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (i) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (ii) Sn^{+2} and Sn^{+4} compounds – nature M-L bond, coordination number, structure and (iii) detection of oxidation state and inequivalent MB atoms.

Unit – II 15 Hrs

Molecular Fluorescence Spectroscopy
Theory of molecular fluorescence, effect of concentration on fluorescence intensity, fluorescence instruments, application of fluorescence methods.
Molecular phosphorescence spectroscopy, chemiluminescence methods.

Unit--III 15 Hrs

Diffraction Methods
Bragg condition, Miller indices, Bragg method, Debye-Scherrer method (sodium chloride crystal), indexing reflections for a cubic system using powder method. identification of unit cells from systematic absences in diffraction pattern. Structure factor and its relation to intensity and electron density, introduction to phase problem. Description of the procedure for an X-ray structure analysis (NaCl).
Introduction to electron diffraction, low energy electron diffraction and neutron diffraction.

Unit-IV 15 Hrs

Hyphenated Techniques

Hyphenated techniques- GCMS, principle of HPLC, instrumentation and application, LCMS, TG-FTIR, TG-GC and advantages.

Books suggested:

1. Analytical Chemistry, G.D. Christian, J. Wiley.
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, W.B. Saunders.
3. Analytical Chemistry-Principles, J.H. Kennedy, W.B. Saunders.
4. Analytical Chemistry-Principles and Techniques, L.G. Hargis, Prentice Hall.
5. Principles of Instrumental Analysis, D.A. Skoog, J.L. Loary, W.B. Saunders.
6. Instrumental Methods of Analysis, H.H.Willard, L.L. Merrit, J.A. Dean, F.A. Settle, CBS Publishers.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood.
8. Principles of Instrumental analysis, Skoog, Holler, Niemen, Saunders college publication.
9. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M.West, F.J. Holler and S.R. Crouch, Cengage Learning.
10. Instrumental Methods of Analysis, H.H Willard, L.L. Merrit, J.A. Dean and F.A. Settle, CBS Publishers.
11. Thermal Methods of Analysis: Principles, Application and Problems, P.J. Hains, Blackie Academic and Professional.

BIOPHYSICAL CHEMISTRY

Paper code: MCL-1002
30 Hrs (2Hrs /week) **Marks for Major Test (External): 70**
Credits: 2 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with the concepts of biophysical chemistry.

UNIT – I 7 Hrs

Biological Cell and its Constituents: Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition.
Bioenergetics: Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP

UNIT – II 8 Hrs

Statistical Mechanics in Biopolymers: Chain configuration of macromolecules, statistical distribution end-to-end dimensions, calculation of average dimensions for various chain structures. Polypeptide and protein structures, introduction to protein folding problem
Biopolymer Interactions: Forces involved in biopolymer interactions, Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibrium and various types of binding processes in biological systems, Hydrogen ion titration curves

UNIT – III 7 Hrs

Thermodynamics of Biopolymer Solutions: Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechano-chemical nerve conduction.

UNIT – IV 8 Hrs

Cell Membrane and Transport of Ions: Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamics treatment of membrane transport. Nerve conduction
Biopolymers and their Molecular Weights: Molecular weight- Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity, electrophoresis and rotational motions

Books Suggested:

1. Biochemistry, L. Stryer, W.H. Freeman
2. Biochemistry, Voet and Voet, John Wiley
3. Lehninger Principles of Biochemistry, M.M. Cox and D.L. Nelson, Freeman and Company
4. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag

INORGANIC CHEMISTRY ELECTIVE-II
Chemistry of Materials

Paper code: MCL-1003(IC) / MCL-545 (IC)

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with inorganic polymers and materials.

Unit - I **15 Hrs**

Polyphosphazenes

Synthesis route and bonding features, ring opening mechanism for polyphosphazenes, Preparation of organo/ organometallic substituted phosphazenes and their applications.

Unit – II **15 Hrs**

Polysilanes

Preparation and characterization of polysilanes, sigma bond delocalization in polysilanes & its implications, applications of polysilanes.

Polysiloxanes

Method of synthesis by anionic and cationic polymerization properties & environmental aspects, structural flexibility, analysis and testing of polysiloxanes, industrial & medical application of Polysiloxanes.

Unit – III **15 Hrs**

Fibres

Carbon, boron, glass fibre synthesis, structural behavior and applications.

Glasses, Ceramics, composites and nanomaterials

Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications.

Microscopic composites, fibre-reinforced composites. Nanocrystalline phase, special properties, applications

Unit – IV **15 Hrs**

Polymeric Materials

Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric polymers.

Ionic Conductors

Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, superionic conductors, examples and applications of ionic conductors.

Books Suggested:

1. Inorganic Polymer, J.E. Mark.
2. Material Science and Engineering, An Introduction, W.D. Callister, Wiley.
3. Material Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
4. Polymer Characterization, B.J. Hunt and James I. Mark.
5. Introduction to Macromolecular Science- Peter Munk.
6. Introduction to Polymer Science, R.J. Young and P.A. Lovell.

7. Polymer Synthesis (Vol. I-III), Starley R. Somdler and Wolfkaro.
8. Polymer Science and Technology, J.R. Fried, Prentice, Hall of India.
9. Principles of Polymer Chemistry, A. Ravve, Kluwer Academic Plenum Publishers.

ORGANIC CHEMISTRY ELECTIVE-II
Medicinal Chemistry

Paper code: MCL-1003 (OC) / MCL-545 (OC)

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with the drug design and development, synthesis and uses of medicinally important molecules of various classes.

Unit-I **15 Hrs**

Drug Design

Introduction, development of chemotherapeutic agents, therapeutic index, LD50 and ED50.Elementary idea about drug action: Concept of drugs receptor, elementary treatment of drug receptor interactions, ion channels and their control. Design of agonists, antagonists and partial agonists.

Drug development: concept of lead compounds. structure-activity relationships (SAR), synthetic analogues, isosteres and bioisosteres. Introductory idea of quantitative structure-activity relationships (QSAR).

Brief overview of pharmacokinetics and pharmacodynamics, concept of prodrug and synergism.

Unit-II **15 Hrs**

Analgesics, Antipyretics and Anti-inflammatory agents

Synthesis and uses of the following drugs: Morphine and related compounds (codeine and heroin), meperidine, methadone, aspirin, acetaminophen, indomethacin, phenylbutazone, mefenamic acid, ibuprofen and diclofenac.

Cardiovascular Drugs

Introduction, calcium channel blockers and β-blockers. Synthesis and uses of nitroglycerine, isosorbide dinitrate (sorbitrate), atenolol, diltiazem and verapamil.

Antifertility agents

Ovulation inhibitors and related hormonal contraceptives- norethindrone, norethynodrel, estradiol, mestranol; non-hormonal contraceptive- centchroman (synthesis of all the drugs excluded).

Unit-III **15 Hrs**

Antibiotics

Cell wall biosynthesis and protein synthesis inhibitors. Penicillins: Synthesis and uses of the penicillin G, problems of sensitivity to acids, β-lactamases and narrow spectrum of activity solved by leading to the development of oxacillin, cloxacillin, ampicillin and amoxicillin. Synthesis and uses of cephalosporin-C.

Introduction to azithromycin, tetracyclines and streptomycin (structures and uses only).

Antineoplastic Agents

Introduction, role of alkylating agents and antimetabolites in treatment of cancer. Synthesis and uses of the following antineoplastic agents: mechlorethamine, cyclophosphamide, melphalan, carmustin, 5-fluorouracil and 6-mercaptopurine. Introduction to paclitaxel (synthesis of paclitaxel excluded).

Unit-IV **15 Hrs**

Antimalarials

Introduction, Synthesis and uses of the following antimalarial drugs: chloroquine, primaquine and chloroguanide.

Antimycobacterial Drugs

Synthesis and uses of the following drugs: isoniazid, ethambutol and dapsone.

Antimicrobial Drugs

Antibacterial and antifungal agents, Synthesis and uses of ciprofloxacin and fluconazole.

Anxiolytics (Tranquilizers)

Synthesis and uses of diazepam, alprazolam and buspirone.

AIDS and drugs against HIV

HIV infection to the system, structure and uses of important drugs against HIV (nucleoside reverse transcriptase inhibitors) - AZT, ddI, ddC, d4T and 3TC (synthesis only of AZT).

Books Suggested:

1. An Introduction to Medicinal Chemistry, G.L. Patrick, Oxford University Press.
2. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, J.N. Delgado and W.A. Remers, Lippincott-Raven.
3. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press.
4. An Introduction to Drug Design, S.S. Pandeya and J.R. Dmmock, New Age International.
5. Burger's Medicinal Chemistry and Drug Discovery, Vol. 1, Ed. M E Wolff, John Wiley.

PHYSICAL CHEMISTRY ELECTIVE-II
Physical Polymer Chemistry

Paper code: MCL-1003 (PC) / MCL-545 (PC)

60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 3 Hrs **Total Marks: 100**

Note: *The examiner is requested to set nine questions in all, selecting two questions from each unit and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each unit and the compulsory Question No.1.*

Objectives: This paper deals with the kinetics of polymerization, dimensions, state and physical properties of polymers.

Unit – I **15Hrs**

Kinetics of Polymerization

Introduction, Kinetics and statistics of step growth (condensation) polymerization, polyfunctional step-reaction polymerization, kinetics of radical chain (addition) polymerization, effect of temperature and pressure on chain polymerization, kinetics of ionic and coordination (addition) polymerization, kinetics of copolymerization.

Unit – II **15 Hrs**

Polymer Dimensions & Solutions

Average chain dimensions, freely jointed chain model, statistical distribution of end-to-end dimensions, chain stiffness, short range effects.

Polymer in solutions: thermodynamics of polymer solution, non-ideal solutions, Flory-Huggins theory, enthalpy change of mixing and free energy change of mixing, phase equilibria, fractionation, Flory-Krigbaum theory, theta temperature, lower and upper critical solution temperatures.

Unit – III **15 Hrs**

Polymer Stereochemistry

Introduction, orientation, configuration, geometric isomerism, conformation of stereoregular polymers, factors affecting stereo regulation, homogenous stereoselective and stereospecific cationic and anionic polymerizations.

Polymer State, Structure and Properties

Crystalline state: introduction, mechanism of crystallization, temperature and growth rate, melting, thermodynamic parameters, crystalline arrangement of polymers, morphology, kinetics of crystallization

Amorphous state: molecular motion, viscoelastic behaviour, effect of chain length, rubbry state and elastomeric state; glassy state, glass transition temperature (T_g), determination and factors affecting it, free volume theory, dependence of T_g on molar mass, relaxation process in glassy state.

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Unit – IV **15 Hrs**

Mechanical Properties

Mechanical Properties: viscoelastic state, mechanical properties, mechanical models describing viscoelasticity, linear viscoelastic behavior of amorphous polymers (creep, stress-strain and temperature effect), dynamic mechanical and dielectric thermal analysis (DMTA and DETA).

Elastomeric state

Introduction, thermodynamic aspects of rubber-like elasticity

Flow Properties of Polymer Melts

Terminology; effects on temperature, pressure and molecular weight on viscous flow properties, elastic effects in polymer melts.

Books Suggested:

1 Textbook of Polymer Science, F.W. Billmeyer (Jr), Wiley.
2 Principles of Polymer Chemistry, P J Flory, Cornell University Press.
3 Physical Chemistry of Polymers, A Tager, Mir Publishers, Moscow.
4 Physical Chemistry of Macromolecules, Tanford
5 Polymers: Chemistry & Physics of Modern materials, J.M.G. Cowie, Blackie Academic and Professional.
6 Plastic Materials, J.A. Brydson, Butter worth Heinemann.
7 Principles of Polymerisation, G. Odian, John Willey.
8 Fundamentals of Polymer Processing, S. Middleman
9 Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.
10 Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Otta

INORGANIC CHEMISTRY LAB ELECTIVE-II

Paper code: MCP-1001(IC) **Marks for Major Test (External): 70**
120 Hrs (8Hrs /week) Marks for Internal Exam: 30
Credits: 4 Total Marks: 100
Time: 6 Hrs

I Gravimetric estimation of three constituents when present together

1. Determine the strength of silver, copper and nickel in the given mixture solution.
2. Determine the strength of silver, copper and zinc in the given solution.
3. To find out the strength of copper, zinc and aluminium in the given mixture solution.
4. To estimate the strength of iron, nickel and zinc in the given sample.
5. Determine the strength of copper, nickel and magnesium in the given mixture solution.
6. To find out the strength of copper, nickel and zinc in the given mixture solution.
7. To find out the strength of silver, nickel and zinc in the given mixture solution.
8. To find out the strength of silver, nickel and magnesium in the given mixture solution.

II Quantitative analysis of elements

9. To estimate the available chlorine in bleaching powder.
10. To determine the chlorine, bromine and iodine in a given mixture.
11. Estimation of available oxygen in hydrogen peroxide

III Analysis of ores and alloys

12. Analysis of pyrolusite
13. Analysis of chrome-iron-ore
14. Analysis of Bronze-alloy
15. Analysis of Galena

Books Suggested:

1 Synthesis and Characterization of Inorganic Compounds. W.L. Jolly, Prentice Hall.
2 Synthesis and Physical studies of Inorganic compound C.F. Bell, Pergamon Press.
3 A Textbook of Quantitative Analysis. A.I. Vogel, ELBS.

ORGANIC CHEMISTRY LAB ELECTIVE-II

Paper code: MCP-1001(OC)
120 Hrs (8Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 6 Hrs **Total Marks: 100**

Qualitative Analysis

Separation of binary mixture (solid + solid, solid + liquid and liquid + liquid) and Characterization with the help of chemical analysis and confirmation of their structures with the help of UV, IR, NMR and MS spectral data.

Books Suggested

1. Experiments in Organic Chemistry, L.F. Fieser, O.C. Heath Company.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
7. Analytical Organic Chemistry, Jag Mohan, Narosa Publishers.

PHYSICAL CHEMISTRY LAB ELECTIVE – II

Paper code: MCP-1001(PC)
120 Hrs (8Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 6 Hrs **Total Marks: 100**

I Potentiometry

1. Titrate Phosphoric acid potentiometrically and comment on graph.
2. Determine the dissociation constant of acetic acid potentiometrically.
3. Titrate a mixture of
   (i) Weak acid (acetic acid) and dibasic acid (oxalic acid)
   (ii) Strong acid (hydrochloric acid) and dibasic acid (oxalic acid) versus sodium hydroxide.

II Chemical Kinetics

4. Investigate the reaction between acetone and iodine.
5. Determine the order and velocity constant of the reaction between potassium persulphate and potassium iodide.

III CONDUCTOMETRY

6. Determine the critical micelle concentration of a surfactant (sodium lauryl sulphate) by the conductivity method.
7. Study the effect of dielectric constant (ε) on the nature of the conductometric titration between maleic acid and sodium methoxide using different combinations of methanol and hexane as solvents.
8. Determine the velocity constant for the saponification of ethyl acetate conductometrically.

IV Colorimetry

9. Study the kinetics of oxidation of isopropyl alcohol/ ethanol by potassium dichromate. Determine the order, rate constant, energy of activation and possible mechanism for the reaction.
10. Find the stoichiometry of the complex formed between a metal ion (Fe^3) and a ligand (salicylate) by Job's continuous variation method and determine the stability constant of the complex formed.
11. Find the stoichiometry of the complex formed between a metal ion (Fe^{3+}) and a ligand (thiocyanate) by Job's continuous variation method and determine the stability constant of the complex formed.

V Spectrophotometry

12. Determine the solvent cut-off wavelengths for the given solvents.
13. Study the spectra of mesityl oxide/ benzophenone in different solvents and classify the observed transitions in terms of $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions. Discuss the shift in transitions relative to those in acetone.
14. Determine the dissociation constant of phenolphthalein spectrophotometrically.

VI Polarimetry

15. Determine the velocity constant for the mutarotation of D(+) glucose and determine the order of the reaction and the equilibrium concentrations of the two forms.
16. Compare kinetically the strengths of two acids (HCl and H_2SO_4) by study of the acid catalyzed inversion of cane sugar

(Note: Depending on availability of time/instruments, some experiments may be added/deleted /interchanged during the year/semester).

Books Suggested:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand McGraw Hill.

INORGANIC CHEMISTRY LAB ELECTIVE-III

Paper code: MCP-1002(IC) **Marks for Major Test (External): 70**
120 Hrs (8Hrs /week) Marks for Internal Exam: 30
Credits: 4 Total Marks: 100
Time: 6 Hrs

1. Synthesis of some ligands and their transition metal complexes and characterization of some compounds by UV-VIS and IR spectroscopic techniques.
2. Preparation of cis-and trans isomers of $[Co(en)_2Cl_2]Cl$ and interpretation of IR, electronic spectra and magnetic properties.
3. Preparation of cis-and trans isomers of $K[Cr(C_2O_4)(H_2O)_2].2H_2O$ and interpretation of IR, electronic spectra and magnetic properties.

Books Suggested:

1 Synthesis and Characterization of Inorganic Compounds. W.L. Jolly, Prentice Hall.
2 Synthesis and Physical studies of Inorganic compound C.F. Bell, Pergamon Press.
3 A Textbook of Quantitative Analysis. A.I. Vogel, ELBS.

ORGANIC CHEMISTRY LAB ELECTIVE-III

Paper code: MCP-1002 (OC)
120 Hrs (8Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 6 Hrs **Total Marks: 100**

Synthesis of Organic Compounds

The exercises should illustrate the use of organic reagents and may involve purification of products. The synthesized products may also be characterized by utilizing different spectral techniques like IR and NMR.

Photochemical reaction
Beckman rearrangements
Benzilic acid rearrangements
Synthesis of organic Compounds of medicinal and other importance, etc.

Books Suggested

1. Experiments in Organic Chemistry, L.F. Fieser, O.C. Heath Company.
2. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
4. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
5. Analytical Organic Chemistry, Jag Mohan, Narosa Publishers.

PHYSICAL CHEMISTRY LAB ELECTIVE – III

Paper code: MCP-1002(PC)
120 Hrs (8Hrs /week) **Marks for Major Test (External): 70**
Credits: 4 **Marks for Internal Exam: 30**
Time: 6 Hrs **Total Marks: 100**

I Potentiometry

1. Determine the mean activity coefficient ($\gamma\pm$) of 0.01 M hydrochloric acid solution.
2. Titrate phosphoric acid potentiometrically against sodium hydroxide.
3. Find the composition of the zinc ferrocyanide complex by potentiometric titration.
4. Titrate Fe^{2+} with Ce^{4+} potentiometrically.
5. Determine zinc in the presence of calcium by potentiometric titration.
6. Verify the Debye-Hückel theory through the solubility of ionic salts.

II Chemical Kinetics

7. Investigation of the reaction between hydrogen peroxide and hydrogen iodide.
8. Study of solid state reaction kinetics [Reactant(s) →Product(s) + Gas(g)].

III Viscometry

9. Determine the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.

IV Colorimetry

10. Study the kinetics of hydrolysis of 4-nitrophenyl ethanoate in the presence of base.
11. Determine the dissociation constant of an indicator (methyl red) *colorimetrically.*

V Spectrophotometry

12. Record the UV spectra of a weak acid (*p*-nitrophenol in 1:4 ethanol:water mixture) at different pH and determine the dissociation constant in the ground state.
13. Record the UV spectra of a weak acid (α-naphthol) at different pH and determine the dissociation constant in the ground state.
14. (a) Record the UV spectra of methyl orange at different pH and determine its dissociation constant.
    (b) Study the effect of surfactant on the pK_a value of methyl orange.
15. Find the stoichiometry of the charge transfer (CT) complex formed between thiocyanate ions (or salicylate ions) and iron(III) by Job's method of continuous variation. Determine the concentration equilibrium constant and extinction coefficient for the charge transfer complex by applying the Benesi-Hildebrand equation.

(Note: Depending on availability of time/instruments, some experiments may be added/deleted /interchanged during the year/semester).

Books Suggested:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Findley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand, McGraw Hill.
6. Thermal Methods of Analysis: Principles, Application and Problems, P.J. Hains, Blackie Academic and Professional.
7. Vogel's Qualitative Inorganic Analysis - 7th ed., A. I. Vogel, (revised by G. Svehla) Longmans
8. Vogel's Textbook of Quantitative Chemical Analysis - 5th Ed., A. I. Vogel, Longman.

PROJECT PART-II

Paper code: MRP-1001
Credits: 8 **Total Marks:200**

Note: The students have to opt MRP-1001 (Project part-II) or MCP-1001 & MCP-1002 (Practicals) for10^{th} semester. The allotment of Project part-II or Practical in the 10^{th} semester will be decided by the staff council as per the prevailing situation at that time in terms of number of students. Those students who have been allotted Project Part-II will have to submit the report of project by the end of 10^{th} semester under the supervision of allotted teacher. The viva-voce examination on the Project part-II will be conducted by a committee consisting of Chairperson, external examiner, one internal teacher in the relevant specialization preferably supervisor. If external examiner is not available, internal arrangment can be made by Chairperson.