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 Waves and optics	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.

PHYSICS-I: MECHANICS

Paper code: BPL 101
30 Hrs (2Hrs /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 – 1

15 Hrs

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion.Galilean transformations; Galilean invariance. Momentum of variable mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces.Potential Energy.Energy diagram.Stable and unstable equilibrium.Elastic potential energy. Force as gradient of potential energy. Work & Potential energy.Work done by non-conservative forces.Law of conservation of Energy.

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

UNIT - 2

15 Hrs

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque.Principle of conservation of angular momentum.Rotation about a fixed axis.Moment of Inertia.Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.Kinetic energy of rotation.Motion involving both translation and rotation.

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

UNIT – 3

15 Hrs

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy.Inertial and gravitational mass.Potential and field due to spherical shell and solid sphere.

Motion of a particle under a central force field.Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws.Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.Basic idea of global positioning system (GPS).

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution.Kinetic energy, potential energy, total energy and their time-average values.Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

UNIT - 4

15 Hrs

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.Coriolis force and its applications.Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity.Lorentz Transformations.Simultaneity and order of events.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.Transformation of Energy and Momentum.

BOOKS SUGGESTED:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Additional Books for Reference

1) Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
2) University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
3) Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
4) Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

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

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

BOOKS SUGGESTED:

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

बी.एक्स.एल–201: हिन्दी

कुल अंक: 70 क्रैडिट –2

आंतरिक मूल्यांकन–30 समय–3 घण्टे

खण्ड (क)

निर्धारित कवि

1 कबीरदास 2 सूरदास

3 मीराबाई 4 रसखान

खण्ड (ख)

हिन्दी साहित्य का इतिहास भक्तिकाल: पाठ्यकम में निर्धारित आलोचनात्मक प्रश्न–

1 सन्तकाव्य की प्रवृतियाँ 2 सूफी काव्य की प्रवृतियाँ

3 कृष्ण काव्य की प्रवृतियाँ 4 राम काव्य की प्रवृतियाँ

5 भक्तिकाल का: स्वर्णयुग

खण्ड (ग)

अलंकार–अनुप्रास, श्लेष, यमक, उपमा, रूपक, अतिश्योक्ति, मानवीकरण, अन्योक्ति, समासोक्ति आदि।

खण्ड (घ)

मुहावरे एवं लोकोक्तियाँ।

खण्ड(क) के लिए निर्धारित पाठ्यपुस्तक–मध्यकालीन काव्य–कुंज : सं. डॉ रामसजन पाण्डेय प्रकाशन:खाटू श्याम प्रकाशन, 1276/5 पीर जी मोहल्ला, प्रताप टाकीज, रोहतक।

निर्देश:– सभी प्रश्न अनिवार्य हैं।

1. खण्ड (क) में निर्धारित पाठ्यपुस्तक में से व्याख्या के लिए चार अवतरण पूछे जाएँगे, जिनमें से परीक्षार्थी को किन्हीं दो की सप्रसंग व्याख्या करनी होगी। प्रत्येक व्याख्या 6 अंक की होगी। पूरा प्रश्न 12 अंक का होगा।
2. खण्ड (क) में निर्धारित कवियों में से किन्ही दो कवियों के साहित्यिक परिचय पूछे जाएँगे, जिनमें से किसी एक कवि का साहित्यिक परिचय लिखना होगा। यह प्रश्न 8 अंक का होगा।

3. खण्ड (क) में पाठ्यपुस्तक से निर्धारित आलोचनात्मक प्रश्नों में से दो प्रश्न पूछे जाएँगे, जिनमें से परीक्षार्थी को एक प्रश्न का उत्तर देना होगा। यह प्रश्न 10 अंक का होगा।

4. खण्ड(ख) में निर्धारित आलोचनात्मक प्रश्नों में से दो प्रश्न पूछे जाएँ गे , जिनमें से किसी एक का उत्तर देना होगा। यह प्रश्न 10 अंक का होगा।

5. खण्ड(ख) से 12 अति लघूत्तरात्मक प्रश्न पूछे जाँएगे। प्रत्येक प्रश्न एक–एक अंक का होगा। पूरा प्रश्न 12 अंक का होगा।

6.खण्ड (ग) में निर्धारित अलंकारों में से दो अलंकार पूछे जाएँगे,जिनमें से एक अलंकार उदाहरणो सहित लिखना होगा। जो 8 अंक का होगा।

7. खण्ड (घ) से दस मुहावरों और लोकोक्तियों में से किन्ही पांच मुहावरों का अर्थ एंव वाक्य प्रयोग लिखना होगा। जो 10 अंक का होगा।

PHYSICS-II: WAVES AND OPTICS

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

15 Hrs

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

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

UNIT-II

15 Hrs

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound.Laplace's Correction.
Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.
Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

UNIT- III

15 Hrs

Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only)

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.
Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

UNIT-IV

15 Hrs

Interference: Division of amplitude and wave front. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

BOOKS SUGGESTED:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

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

BPP 201: PHYSICS LAB - II

Paper code: BPP 201
60 Hrs (4Hrs /week) **Marks for Major Test (External): 70**
Credits: 2 **Marks for Internal Exam: 30**
Time: 4Hrs **Total Marks: 100**

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ2 /T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster`s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

BOOKS SUGGESTED:

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

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 3rd Ed.,* John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements,* Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry,* Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry,* Cengage Learning 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 2nd Ed.,*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

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) *Biochemistr*y. 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.

Colorimetry

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