FACULTY OF SCIENCES

SYLLABUS

FOR

B.Sc. (Medical &Non Medical)

Programme Code: BSMD/BSNM

(Semester I-VI)
Session: 2021-22

ESTD. 1892

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

Index

B. Sc. (Medical &Non-Medical) CHEMISTRY
Semester-I
INORGANIC CHEMISTRY–I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions **(7 x 1 = 7 Marks)**

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks)

COURSAE OBJECTIVE:
The aim of the course is to enhance the basic knowledge of students on the topics of the structure of atom, periodic properties, chemical bonding and its types and molecular interactions taking place in solids.

COURSE CONTENTS:

SECTION–I

I. Atomic Structure 15 Hrs.
Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of ψ and ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s,p,d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements and ions.
II. Periodic Properties
Position of elements in the periodic table; effective nuclear charge and its calculations. Atomic and ionic radii, ionization energy, electron affinity and electronegativity –definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

SECTION–II

III. Chemical Bonding 15 Hrs
Covalent Bond –Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, $SnCI_2$, XeF_4, BF_4^-, $SnC1_6^{2-}$. Valence shell electron pair repulsion (VSEPR) theory to NH3, H3O+, SF4, CIF3, ICl2 and H2O. MO theory, homonuclear (elements and ions of 1st and 2nd row), and heteronuclear (BO, CN–, CO, NO+, CO+, CN), diatomic

molecules, multicenter bonding in electron deficient molecule (Boranes). Percentage ionic character from dipole moment and electronegativity difference.

SECTION–III

IV. Ionic Solids 15 Hrs

Concept of close packing, Ionic structures, (NaCI type, Zinc blende, Wurtzite, CaF_2 and antifluorite, radius ratio rule and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born–Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic –b ofnrede electron, valence bond and band theories.

Weak Interactions –Hydrogen bonding, Vander Waals forces.

BOOKS PRESCRIBED:

1. Inorganic Chemistry by Weller, Overton, Rourke and Armstrong, 7th Ed. Oxford University Press.
2. Concise Inorganic Chemistry by J. D. Lee, 5th Ed., Wiley India.
3. Advanced inorganic Chemistry by F. Albert Cotton, Geoffrey Wilkinson 6th Ed.,Wiley.
4. Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey 4th Ed., Pearson

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Gain knowledge about the atomic structure, Schrodinger wave equation, quantum numbers, shapes of orbitals, rules governing the filling of electrons in orbitals and electronic configuration of elements and ions.
CO2	Get knowledge about positioning of elements in the periodic table, slater's rule, periodic properties such as ionisation energy, electron affinity, electronegativity and its calculations and chemical behaviour of elements.
CO3	Acquire knowledge of valence bond theory, hybridisation, shapes of molecules, VSEPR theory, MO theory, bonding in boranes and determination of percentage ionic character.
CO4	Learn about close packing in solids, ionic structures, coordination number, radius ratio rules, born haber cycle, solvating power and polarising power of ions by Fajan's rule.
CO5	Acquire knowledge of metallic bonding, electron sea model, valence bond, band theories, hydrogen bonding and vander wall interactions.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-I
ORGANIC CHEMISTRY–I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

The question paper shall consist of two parts as detailed below:–
Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions **(7 x 1 = 7 Marks)**

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

(i) To expand the knowledge of basic concepts in organic chemistry.
(ii) To know the structure and formation of all the intermediates involved in chemical reaction.

COURSE CONTENTS:

SECTION–I

I. Structure and Bonding (5 Hrs.)
Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Vander Waals interactions, resonance, hyperconjugation, aromticity hydrogen bonding and Inductive and electrometric effects.
II. Mechanism of Organic Reactions (6 Hrs.)
Curved arrow notation, drawing electron movements with arrows, half–headed and double–headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles. Types of organic reactions. Energy considerations.Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arenes and nitrenes(with examples). Assigning formal charges on intermediates and other ionic species.
III. Alkanes (4 Hrs.)
Isomerism in alkanes, sources, methods of formation (with special reference to Wurtzreaction,Kolbe reaction, Corey–House reaction and decarboxylation of carboxylic acids), physicalproperties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes:orientation, reactivity and selectivity.

SECTION-II

IV. Alkenes and Alkynes (8 Hrs.)

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration reduction.Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO4. Substitution at the allylic and vinylic positions of alkenes.Nomenclature, structure and bonding in alkynes.Methods of formation.Chemical reactions ofalkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions,hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

V. Alkyl and Aryl Halides (7 Hrs.)

Nomenclature and classes of alkyl halides, chemical reactions. Mechanisms of nucleophilic substitution reaction of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vsallyl, vinyl and aryl halides.

SECTION–III

VI. Cycloalkanes: (5 Hrs.)

Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropaneand cyclobutane), theory of strainless rings. The case of cyclopropanering : banana bonds.

VII. Arenes and Aromaticity (10 Hrs.)

Nomenclature of benzene derivatives.The aryl group. Aromatic nucleus and side chain.Structure of benzene: Molecular formula and Kekule structure. Stability and carbon carbon bond lengths of benzene, resonance structure, MO picture.Aromaticity : the Huckel's rule, aromatic ions.Aromatic electrophilic substitution–general pattern of the mechanism, role of σ and π complexes.Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Crafts reaction.Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/pararatio.Side chain reactions of benzene derivatives.Methods of formation and chemicalreactions of alkylbenzenes.

BOOKS PRESCRIBED:

1. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, 2nd Ed., Oxford university Press.
2. Advanced Organic Chemistry, by F. A. Carey, R. J. Sundberg, 2nd Ed., Springer.
3. Organic Chemistry by T. W. G. Solomons, 10 Ed., Wiley
4. Advanced Organic Chemistry by Jerry march, 4th Ed., Wiley

COURSE OUTCOMES:

Sr. No.	**On completing the course, the students will be able to**
CO1	Learn the basics of Organic chemistry starting from bonding in organic compounds and notations in a reaction/ reaction mechanism

CO2	Identify the type of organic reaction and properties and structures of reactive intermediates involved in mechanisms.
CO3	Know the methods of preparation and chemical as well as physical properties of Alkanes, Alkenes, Alkynes
CO4	Understand the basic nucleophilic substitution mechanisms in case of alkyl halides as well as aryl halides and their relative reactivities.
CO5	Understand the concept of aromaticity and aromatic electrophilic substitution mechanism.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-I
PRACTICAL

Credit Hours: 4.5 Hrs/week
Total Hours: 60
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will set two questions first based upon Inorganic Analysis and second based upon Laboratory Techniques
II. Students will be asked to complete write up of both practical within first 20 minutes on the first sheet provided.
III. On the second sheet provided after 20 minutes, students will perform and note the record on second sheet during the conduct of practical exam
IV. The split of marks will be as under:
(Salt Analysis = 10, Lab Tech., M. Pt./B. Pt. = 8, Viva-voce = 4, Practical note book = 3)

COURSE OBJECTIVES:

1. The students will learn about semi micro analysis. Cation analysis, Separation and identification of ions from groups I, II, III, IV, V, and VI.
2. The students will also learn to determine the melting and boiling point of compounds.

COURSE CONTETNS:

Inorganic Chemistry**:** Semi Micro analysis. Cation analysis, Separation and identification of ions from groups I, II, III, IV, V, and VI. Anionic analysis.Four ions with no interference.

Organic Chemistry Laboratory Techniques

Determination of Melting Point
Naphthalene 80–82^{o}C Cinnamic acid 132.5–133^{o}C
Benzoic acid 121.5–122^{0}C Salicylic acid 157.5–158^{o}C
Urea 132.5–133^{o}C Acetanilide 113.5–114^{o}C
Succinic Acid 184.5–185^{o}C m–dinitro benzene 90^{o}C
P–dichlorobenzene 52^{o}C Aspirin 135^{o}C

Determination of Boiling Point
Ethanol 78^{o}C Cyclohexane 81.4^{o}C,
Benzene–80^{o}C Toluene 110°C

BOOKS PRESCRIBED:

1. Salts and Their Reactions a Class-Book of Practical Chemistry, D. Leonard, Forgotten Books.
A Systematic Qualitative Chemical Analysis a Theoretical and Practical Study of Analytical Reactions of the More, Common Ions of Inorganic Substances, Forgotten Books.
3. Salt Analysis Chart by Sibaji Sarkar.

4. Physical Chemistry Laboratory Manual - An Interdisciplinary Approach 1 Edition by A. Anand, R. Kumari, 1st Ed. Dreamtech Press

COURSE OUTCOMES:

Sr. No.	On completing the course,
CO1	Gain knowledge about semi micro analysis.
CO2	Learnabout cation analysis, separation and identification of ions from groups I, II, III, IV, V, VI.
CO3	Learn about anion analysis.
CO4	Understand about the technique for determination of melting points of various compounds.
CO5	Acquire knowledge on the technique for determination of boiling points of various compounds.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-II
INORGANIC CHEMISTRY–II

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

The aim of the course is to enhance the basic knowledge of students on the topics S-block elements, p-block elements, Transition elements and advance theories of acids, bases and Lux-Flood solvent systems.

COURSE CONTENTS:

SECTION–I 15 Hrs.

I. p–Block Elements–I
Comparative study (including diagonal relationship) of groups 13–17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13–16, hydrides of boron–diborane and higher boranes, Borazine, borohydrides, fullerenes.

SECTION–II 15 hrs.

II. s-Block Elements
Comparative studies, diagonal relationship, salient features of hydrides, salvation and complexation tendencies.
III. p–Block Elements-II
Carbides, fluorocarbons, silicates (structural principle), tetrasulphurtetranitride, basic properties of halogens, interhalogens and polyhalide**,** Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.
IV. Acids and Bases
Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

SECTION–III 15 Hrs.

V. Chemistry of Transition Elements

Characteristic properties of *d*–block elements. Properties of the elements of the first transition series, their simple compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. General characteristics of elements of Second and Third Transition Series, comparative treatment with their *3*d analogues in respect of ionic radii, oxidation states, magnetic behaviour.

BOOKS PRESCRIBED:

1. Inorganic Chemistry by Weller, Overton, Rourke and Armstrong, 7th Ed. Oxford University Press.
2. Concise Inorganic Chemistry by J. D. Lee, 5th Ed., Wiley India.
3. Advanced inorganic Chemistry by F. Albert Cotton, Geoffrey Wilkinson 6th Ed.,Wiley.
4. Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey 4th Ed., Pearson

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Understand the physical and chemical properties of s-block, p-block and d-block elements.
CO2	Learn the basic similarities and differences between different groups of the periodic table.
CO3	Understand the acid-base concepts in inorganic chemistry like Arrhenius concept, Bronsted-lowry and Lewis concepts. Students will also be able to differentiate between acids and bases.
CO4	Learn about the colour, oxidation states, catalytic and magnetic properties of transition elements.
CO5	Acquire knowledge about important topics like inorganic benzene, boranes, silicones and phosphazenes.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-II
PHYSICAL CHEMISTRY–I

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

The course is well designed to learn about the various states of matter-liquids, gases, and colloidal state, along with the colligative properties. The main aim of the course is to give the theoretical background as well as the application perspective of the physical parameters.

COURSE CONTENTS:

SECTION–I

I. Gaseous States 15 Hrs.
Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waal's equation of state.
Critical Phenomena**:** PV isotherms of real gases, continuity of states, the isotherms of van der Waal's equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state.
Molecular Velocities**:** Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases.

SECTION–II

II. Liquid State 10 Hrs.
Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquids crystal, solid and liquid.Classification, structure of nematic and cholestricphases. Thermography and seven segment cell.

III. Colloidal State 5 Hrs.
Definition of colloids, classification of colloids. Solids in liquids (Sol): kinetic, optical and electrical, properties, stability of colloids,protective action, Hardy Schulze law, gold number. Liquids in liquids (emulsions): Types of emulsions, preparation. Emulsifiers. general applications of colloids.

SECTION–III

IV. Solutions, Dilute Solutions and Colligative Properties 15 Hrs.
Ideal and non–ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, Law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass degree of dissociation and association of solutes.

BOOKS PRESCRIBED:

1. Physical Chemistry by P.W. Atkins, 8th Ed., Oxford University Press, 2006 (Indian Print).
2. Physical Chemistry by T. Engel & P. Reid, 1st ed., Pearson Education, 2006.
3. Physical Chemistry by Castellan, 3rd Ed., Addison Wisley/Narosa, 1985 (Indian Print)
4. Physical Chemistry by G. M. Barrow, 6th Ed., New York, McGraw Hill, 1996.
5. Physical Chemistry by R. J. Silbey, R. A. Albert &Moungi G. Bawendi, 4th Ed., New York: John Wiley, 2005.

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Learn the concepts of gaseous state, kinetic theory, and van der Waals equations to real systems.
CO2	Learn about the applications of Liquid crystals in LCDs and Digital Electronics
CO3	Know how the Colloidal solutions, their preparation, and properties would be helpful in understanding various physical parameters.
CO4	Understand about preparation of solutions based on different measurement basis and colligative properties
CO5	Learn to handle and carry out the physical estimation of solutions, and molecular weight determination from colligative properties

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-II
PRACTICAL

Credit Hours: 4.5 Hrs/week
Total Hours: 60
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will set two questions first based upon Crystallization and second based upon Physical Chemistry
II. Students will be asked to complete write up of both practical within first 20 minutes on the first sheet provided.
III. On the second sheet provided after 20 minutes, students will perform and note the record on second sheet during the conduct of practical exam
IV. The split of marks will be as under:
(Crystallization = 8, Physical Chem. Practical = 10, Viva-voce = 4, Practical note book = 3)

COURSE OBJECTIVES:

The main objective of the course is to create Crystallization skills in students so that they are able to purify the compounds selecting suitable solvent system. Student will also learn about physical techniques like Viscometry, Tensiometry, Calorimetry.

COURSE CONTENTS:

Crystalisation:
Concept of indication of crystalisation. Phthalic acid from hot water (using fluted filter paper & stem less funnel)
Acetanilide from boiling water.
Naphthalene from Ethanol
Benzoic acid from water

Physical Chemistry
1. To determine the specific reaction rate of hydrolysis of ethyl acetate catalysed by Hydrogen ions at room temperature.
2. To study the effect of acid strength on hydrolysis of an ester.

Viscosity, Surface Tension (Pure Liquids)

3. To study the viscosity and surface tension of CCI glycerine solution in water.
4. To determine the solubility of benzoic acid at different temperatures and to determine H of the dissolution process.
5. To determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
6. To determine the enthalpy of dissolution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.

BOOKS PRESCRIBED:

1. Practical Physical Chemistry by J. B. Yadav

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Measure important physical properties like surface tension, viscosity, density, enthalpy, heat of neutralization etc.
CO2	Learn to examine various physical parameters by different methods.
CO3	Learn to handle important apparatus like stalagmometer,Ostwalds viscometer and calorimeter.
CO4	Learn how to perform acid-base titrations.
CO5	Learn to examine the rate of reactions (hydrolysis of ester).

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-III
ORGANIC CHEMISTRY–II

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

This course is planned to provide students
i) an understanding of the stereochemistry of organic compounds.
ii) a complete knowledge of nomenclature, structure and bonding, methods of preparation and chemical reactions of compounds related to functional groups including alcohols, phenols, aldehydes and ketones.

COURSE CONTENTS:

SECTION–I

I. Stereochemistry of Organic Compounds (15 Hrs.)
Concept of isomerism.Types of isomerism. Optical isomerism, elements of symmetry,molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers,chiral and achiral molecules with two stereogeniccentres, diastereomers, threo and erythrodiasteremeors, meso compounds, resolution of enantiomers, inversion, retention and racemization.Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.Geometric isomerism–determination of configuration of geometric isomers.E & Z system ofnomenclature.Conformational isomerism–conformational analysis of ethane and n–butane;conformation of cyclohexane, axial and equatorial bonds, conformation of mono substitutedcyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedgeformulae. Difference between configuration and conformation.

SECTION-II

II. Alcohols (8 Hrs.)
Classification and nomenclature.Monohydric alcohols—nomenclature.Acidic nature. Reactions of alcohols. Dihydric alcohols—nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAC)_4$] and [HIO_4] and pinacol-pinacolonerearrangement.
III. Phenols (7 Hrs.)
Nomenclature, structure and bonding, Preparation of phenols, physical properties and acidiccharacter, Comparative acidic strengths of alcohols and phenols, resonance stabilization ofphenoxide ion.Reactions of phenols—electrophilic aromatic substitution, acylation andcarboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis,
Reimer Tiemann reaction.

SECTION-III

IV. Aldehydes and Ketones (15 Hrs.)
Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones withparticular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and
ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids.
Physical properties.Mechanism of nucleophilic additions to carbonyl group with particularemphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation withammonia and its derivatives. Witting reaction.Mannich reaction.Use of acetals as protectinggroup.Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaroreaction.MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions.Halogenation of enolizableketones.Halogenation of enoliable ketones.

BOOKS PRESCRIBED:

1. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, 2nd Ed., Oxford university Press.
2. Advanced Organic Chemistry, by F. A. Carey, R. J. Sundberg, 2nd Ed., Springer.
3. Organic Chemistry by T. W. G. Solomons, 10 Ed., Wiley
4. Advanced Organic Chemistry by Jerry march, 4th Ed., Wiley

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Understand the Structure & bonding of organic compounds and mechanism of organic reactions.
CO2	Understand the Stereochemistry of organic compounds.

CO3	Understand the nomenclature, synthesis, physical and chemical properties of alcohols.
CO4	Understand the nomenclature, synthesis, physical and chemical properties of aldehyde and ketones.
CO5	Understand the nomenclature, synthesis, physical and chemical properties of phenols.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-III
PHYSICAL CHEMISTRY–II

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

This course focuses to provide students
i) an understanding of the basic concepts of thermodynamics involving fundamental laws.
ii) a complete knowledge related to phase as well as chemical equilibrium.

COURSE CONTENTS:

SECTION-I

1. Thermodynamics-I 15 Hrs.

Definition of thermodynamic terms: System, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials.Thermodynamic process. Concept of heat and work.
First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law-Joule-Thomson coefficient and inversion temperature, Calculation of w,q,dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.
Thermochemistry: Standard state, standard enthalpy of formation-Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

SECTION-II

II. Thermodynamics-II & III 15 Hrs.

Second Law of Thermodynamics: Need for the law, different statements of the law, Carnot cycle

and its efficiency, Carnot theorem. Thermodynamic scale of temperature.
Concept of Entropy : Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.
Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A &G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P,V and T.

SECTION-III

Equilibrium
III. Chemical Equilibrium 5 Hrs.
Equilibrium constant and free energy.Thermodynamic derivation of law of mass action. Determination of Kp, Kc, Ka and their relationship, Clausius-Clapeyron equation, applications.
IV Introduction to Phase Equilibrium 10 Hrs.
Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO2 and S systems. Phase equilibria of two component systems-solid-liquid equilibria, simple eutectic-Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H2O), FaCl3-H2O) and CuSO4-H2O) system. Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-Ideal liquid mixtures, Raoult's and Henry's law.Non-ideal system-azeotropes-HCl-H2O and ethanol-water system. Partially miscible liquids Phenol-water, trines-thylamin-water, Nicotine-water System. Lower and upper consulate temperature, Effect of impurity on consolute temperature, immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation and applications.

BOOKS PRESCRIBED:

1. Physical Chemistry by P.W. Atkins, 8th Ed., Oxford University Press, 2006 (Indian Print).
2. Physical Chemistry by T. Engel & P. Reid, 1st ed., Pearson Education, 2006.
3. Physical Chemistry by Castellan, 3rd Ed., Addison Wisley/Narosa, 1985 (Indian Print)
4. Physical Chemistry by G. M. Barrow, 6th Ed., New York, McGraw Hill, 1996.
5. Physical Chemistry by R. J. Silbey, R. A. Albert &Moungi G. Bawendi, 4th Ed., New York: John Wiley, 2005.

COURSE OUTCOEMS:

Sr. No.	On completing the course, the students will be able to:
CO1	Learn about various thermodynamic terms and processes.
CO2	Understand the first law of thermodynamics and learn to calculate various thermodynamic properties for reversible isothermal and adiabatic expansion of ideal gases. It enable them to solve various numerical problems related to these topics.

CO3	Learn the enthalpy of formation, neutralization, solution, reaction, bond dissociation enthalpy, kirchhoff's law and solve various numerical problems related to the topic.
CO4	Learn about the second and third law of thermodynamics, Carnot cycle, concept of entropy and free energy and numerical problems associated with these concepts.
CO5	Understand the chemical equilibrium and phase equilibrium. They will learn to draw and explain the phase diagrams of one and two component systems, ideal mixtures and non ideal mixtures in detail with examples.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-III
PRACTICAL

Credit Hours: 4.5 Hrs/week
Total Hours: 60
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will set two questions first based upon Crystallization and second based upon Physical Chemistry
II. Students will be asked to complete write up of both practical within first 20 minutes on the first sheet provided.
III. On the second sheet provided after 20 minutes, students will perform and note the record on second sheet during the conduct of practical exam
IV. The split of marks will be as under:
(Crystallization = 8, Physical Chem. Practical = 10, Viva-voce = 4, Practical note book = 3)

COURSE OBJECTIVES:

This course provides the knowledge of Laboratory set up, safe handling of chemicals and understanding of volumetric analysis, gravimetric analysis and thin layer chromatography.

COURSE CONTENTS:

Quantitative Analysis
Volumetric Analysis
a. Determination of acetic acid in commercial vinegar using NaOH.
b. Determination of alkali content-antacid tablet using HCI.
c. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
d. Estimation of hardness of water by EDTA.
e. Estimation of ferrous and ferric by dichromate method.
f. Estimation of copper using sodiumthiosulphate.

Gravimetric Analysis
Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime)

Organic Chemistry Laboratory Techniques
Thin Layer Chromatography
Determination of Rf values and identification of organic compounds.
a. Separation of green leaf pigments (spinach leaves may be used).
b. Preparation and separation of 2, 4. dinitrophenylhydrazones of acetone, 2-butone, 2-Butanone, hexan-2 and 3-one using toluene and light petroleum (40 : 60).
c. Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

BOOKS PRESCRIBED:

1. Salts and Their Reactions a Class-Book of Practical Chemistry, D. Leonard, Forgotten Books.

A Systematic Qualitative Chemical Analysis a Theoretical and Practical Study of Analytical Reactions of the More, Common Ions of Inorganic Substances, Forgotten Books.
3. Salt Analysis Chart by Sibaji Sarkar.
4. Physical Chemistry Laboratory Manual - An Interdisciplinary Approach 1 Edition by A. Anand, R. Kumari, 1st Ed. Dreamtech Press

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Learn the preparation of organic compounds, their purifications and run TLC.
CO2	Determine the physical constants like Melting point and boiling point.
CO3	Understand different purification techniques in organic chemistry like recrystallization.
CO4	Become aware of safety techniques and handling of chemicals.
CO5	Understand how to carry out different types of volumetric titrations.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-IV
INORGANIC CHEMISTRY–III

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

The students will learn about coordination compounds, reactions in non ionic solvents, oxidation and reduction, lanthanides and actinides and bio inorganic chemistry

COURSE CONTENTS:

SECTION-I

I. Coordination Compounds 10 Hrs.
Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.
II. Non-aqueous Solvents 5 Hrs.
Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH3 and liquid SO2.

SECTION-II

III. Oxidation and Reduction 8 Hrs.
Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, Latimer and Pourbaix diagrams.
IV. Chemistry of Lanthanide Elements 7 Hrs.
Electronic structure, oxidation states and ionic radii and lanthanide contraction. Electronic absorption and magnetic properties of lanthanides.

SECTION-III

V. Chemistry of Actinides 5 Hrs.

General features and chemistry of actinides, similarities between the later actinides and the later lanthanides. Electronic and magnetic properties of actinides and their general comparison with the lanthanide elements.

VI. Bioinorganic Chemistry 10 Hrs.

Essential and trace elements in biological processes, metalloporphyrins and special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.

BOOKS PRESCRIBED:

1. Inorganic Chemistry by Weller, Overton, Rourke and Armstrong, 7th Ed. Oxford University Press.
2. Concise Inorganic Chemistry by J. D. Lee, 5th Ed., Wiley India.
3. Advanced inorganic Chemistry by F. Albert Cotton, Geoffrey Wilkinson 6th Ed.,Wiley.
4. Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey 4th Ed., Pearson

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Learn about Werner's theory, effective atomic no., chelation, nomenclature and isomerism in coordination compounds, valence bond theory of transition metal complexes.
CO2	Learn about types of solvents, physical properties of solvents, reactions in liquid ammonia and sulphur dioxide.
CO3	Learn about electronic structures, oxidation states of lanthanides and actinides, electronic and magnetic properties of lanthanides and actinides, lanthanide contraction.
CO4	Understand oxidation and reduction, redox potential data, frost, latimer and pourbaix diagrams.
CO5	Learn about different elements in biological processes, metalloporphyrins, haemoglobin, myoglobin, biological role of alkali and alkaline earth metals.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-IV
ORGANIC CHEMISTRY–III

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

The main aim of this course is to study

a. Synthesis, chemical reactions, Mechanisms for different functional groups like carboxylic acid and its derivatives, ethers and epoxides.

b. The structure, nomenclature, reactivity, synthesis and reactions of heterocyclic compounds. Heterocyclic structures in biologically active compounds

c. Various aspects of the principles of organic chemistry in the structure, classification, nature of bonding and functions of organometallic compounds

COURSE CONTENTS:

SECTION-I

I. Carboxylic Acids (8 Hrs.)
Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Reactions of carboxylic acids.Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides.Reduction of carboxylic acids. Mechanism of decarboxylation.

II. Carboxylic Acids Derivatives (7 Hrs.)
Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides, Relative stability& reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives bynucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

SECTION-II

III. Ethers and Epoxides (5 Hrs.)

Nomenclature of ethers and methods of their formation, physical properties. Chemical reaction- cleavage and autoxidation, Ziesel's method. Synthesis of epoxides. Acid and basecatalyzed
ring opening of epoxides, orientation of epoxide ring opening, reactions of
Grignard and organolithium reagents with epoxiedes.
IV. Organic Compounds of Nitrogen (10 Hrs.)
Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes, Mechanisms of nucleophilc substitution in nitroarenes and their reduction in acidic, neutral and alkaline media. Reactivity, Structure and nomenclature of amines, Methods of preparation of amines by Reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction and Hofmann bromamide reaction.Physical properties.Stereochemistry of amines.separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts.

SECTION-III

V. Organometallic Compounds (7 Hrs.)
Organomagnesium Compounds: The Grignard reagents formation, structure and chemical reactions.
Organolithium Compounds: Formation and chemical reactions.
Organozinc and Organocoppercompounds: Nomenclature , Structural features, methods of formation, and chemical reactions.
VI. Heterocyclic Compounds (8 Hrs.)
Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

BOOKS PRESCRIBED:

1. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, 2nd Ed., Oxford university Press.
2. Advanced Organic Chemistry, by F. A. Carey, R. J. Sundberg, 2nd Ed., Springer.
3. Organic Chemistry by T. W. G. Solomons, 10 Ed., Wiley
4. Advanced Organic Chemistry by Jerry march, 4th Ed., Wiley

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Get knowledge on the nomenclature, general physical properties, synthesis and chemistry of carboxylic acids, and carboxylic acid derivatives
CO2	Have fundamental theoretical understanding of heterocyclic chemistry
CO3	Know aromatic and non aromaticheterocycles, their structural and chemical properties and synthesis.

CO4	Understand about the structure and chemical Reactions of Organomagnesium, Organolithium, Organozinc and Organocoppercompounds
CO5	Study Nomenclature, properties, synthesis and reactions of ethers, epoxides and nitrogen containing compounds

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-IV
PRACTICAL

Credit Hours: 4.5 Hrs/week
Total Hours: 60
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will set two questions
II. Students will be asked to complete write up of both practical within first 20 minutes on the first sheet provided.
III. On the second sheet provided after 20 minutes, students will perform and note the record on second sheet during the conduct of practical exam
IV. The split of marks will be as under:
(Elements = 8, Functional Group = 10, Viva-voce = 4, Practical note book = 3)

COURSE OBJECTIVES:

This course aims to impart the knowledge of Laboratory set up, safe handling of chemicals and workup procedures. The detection of elements and various functional groups.

COURSE CONTENTS:

Qualitative Analysis

Detection of elements (N, S and halogens)

Detection of functional groups in simple organic compounds and preparing their derivatives.

a) Phenolic
b) Carboxylic
c) Carbonyl
d) Esters
e) Carbohydrates
f) Amines
g) Amides
h) Nitro
i) Anilide

BOOKS PRESCRIBED:

1. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
2. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
3. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Perform various functional group tests in identification of organic compounds
CO2	Understand the systematic qualitative analysis of organic compounds for the detection of elements
CO3	Learn about the identification of the compound and preparation of derivative and determination of its melting point.
CO4	Develop the ability to apply the principles of Chemistry.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-V
INORGANIC CHEMISTRY–IV

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

This course helps to understand the concepts of metal ligand bonding in transition complex compounds as well as thermodynamics and kinetic aspects of metal complexes. Moreover students get enlightened with the nomenclature, classification, properties and preparations of coordination compounds.

COURSE CONTENTS:

SECTION-I

1. Metal-ligand Bonding in Transition Metal Complexes (10 Hrs)
Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.
2. Magnetic Properties of Transition Metal Complexes (5 Hrs)
Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of μs and μeff values, orbital contribution to magnetic moments, application of magnetic moment data for characterization of 3d-metal complexes.

SECTION-II

3. Thermodynamic and Kinetic Aspects of Metal Complexes (5 Hrs.)
A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.
4. Electronic Spectra of Transition Metal Complexes (10 Hrs)
Term symbols for p^2 and d^2 systems, Spectroscopic ground states for d1-d10 electronic configurations.

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states.Orgel diagram for d^1-d^5.

SECTION-III

5. Organometallic Compounds: (15 Hrs)
Definition, nomenclature and classification of organometallic compounds. EAN rule, Preparation, properties, and applications of alkyls aryls of lithium and aluminium, Bonding in metal-ethylenic complexes, Mechanism of homogeneous hydrogenation reactions.

BOOKS PRESCRIBED:

1. Inorganic Chemistry by Weller, Overton, Rourke and Armstrong, 7th Ed. Oxford University Press.
2. Concise Inorganic Chemistry by J. D. Lee, 5th Ed., Wiley India.
3. Advanced inorganic Chemistry by F. Albert Cotton, Geoffrey Wilkinson 6th Ed.,Wiley.
4. Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey 4th Ed., Pearson

COURSE COUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Learn about crystal field theory and valence bond theory.
CO2	Understand the magnetic properties of transition metal complexes.
CO3	Learn about metal ligand bonding and thermodynamic and kinetic aspects of metal complexes.
CO4	Understand the electronic spectra of transition metal complexes.
CO5	Understand the concepts of organometallic chemistry

*B. Sc. (Medical &NonMedical)*CHEMISTRY
Semester-V
PHYSICAL CHEMISTRY–III

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

The main objective of the course is to develop the skill of designing electrochemical cells and evaluating its EMF along with studying the factors that can later the EMF of the cell. Students will also study the electrolytic aspects of the chemistry and its applications. Theoretical skill on the spectroscopic aspects of Physical Chemistry and solving related problems will also be the aim of this course/

COURSE CONTENTS:

SECTION-I

1. Electrochemistry-I (7 hrs.)
Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.
2. Electrochemistry – II (8 hrs.)
Types of reversible electrodes-gas metal ion, metal ion, metal insolblue salt-anion and redox electrodes. Electrode reactions. Nernst equation, derivation of cell E.M.F. and Single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cellsreversible

ndirreverisible cells, conventional representation of electrochemi cells. EMF of a cell and its measurements. Computation of cell. EMF, Calculation of thermodynamic quantities of cell reactions (ΔG ΔH and K), polarization, over potential and hydrogen overvoltage. Concentration cells with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.
Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods. Buffers-mechanism of buffer action, Henderson-Hazel equation, Hydrolysis of salts. Corrosion-types, theories and methods of combating it.

SECTION-II

3. Nuclear Chemistry (15 Hrs.)
Introduction: Radioactivity, Nuclear Structure, Size of Nucleus, Mass Defects and Binding Energy, Nuclear Stability, Nuclear Forces, Nuclear Spin and Moments of Nuclei, Nuclear Models, Nuclear Decay Processes, The Laws of Radioactive Decay, Soddy-Fajans Group Displacement Law, Rate of Nuclear Decay and Half Life Time (Kinetics of Radioactive Decay), Induced Nuclear Reactions, Types of Nuclear Processes, High Energy Nuclear Reactions, Nuclear Reaction Cross-Section, Artificial radioactivity, Detection and Measurement of Radioactivity, Nuclear Fission, Nuclear Fusion, Applications of Radioactivity.

SECTION-III

4. Spectroscopy (15 Hrs.)
Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.
5. Rotational Spectrum
Diatomic molecules. Energy levels of a rigid rotor (semiclassical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.
6. Vibrational Spectrum
Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.
Raman Spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.
7. Electronic Spectrum
Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle. Qualitative description of s, p, and n M.O., their energy levels and the respective transitions.

BOOKS PRESCRIBED:

1. Physical Chemistry by P.W. Atkins, 8th Ed., Oxford University Press, 2006 (Indian Print).
2. Physical Chemistry by T. Engel & P. Reid, 1st ed., Pearson Education, 2006.
3. Physical Chemistry by Castellan, 3rd Ed., Addison Wisley/Narosa, 1985 (Indian Print)
4. Physical Chemistry by G. M. Barrow, 6th Ed., New York, McGraw Hill, 1996.

5. Physical Chemistry by R. J. Silbey, R. A. Albert &Moungi G. Bawendi, 4th Ed., New York: John Wiley, 2005.

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Learn basic definitions of specific conductance, equivalent conduction ;Kohlrausch law, Arrhenius theory, Oswald's dilution law and Debye Huckel Onsager's equation
CO2	Learn different reversible and irreversible electrodes, Nernst equation, Electrolytic and galvanic cells, Conductometric and potentiometric titrations.
CO3	Learn radioactivity, nuclear stability, nuclear forces, nuclear decay processes and their applications.
CO4	Understand spectroscopic techniques, electromagnetic radiations such as Microwave, Infra red, Raman and UV- Visible.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-V
PRACTICAL

Credit Hours: 4.5 Hrs/week
Total Hours: 60
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will set two questions first based upon Synthesis and second based upon Physical Chemistry
II. Students will be asked to complete write up of both practical within first 20 minutes on the first sheet provided.
III. On the second sheet provided after 20 minutes, students will perform and note the record on second sheet during the conduct of practical exam
IV. The split of marks will be as under:
(Synthesis = 8, Physical Chem. Practical = 10, Viva-voce = 4, Practical note book = 3)

COURSE OBJECTIVES:

This course aims at Synthesis of Co-ordination complexes of d-block elements like Fe, Ni, Cu and Cr. Student will also learn some Physical methods of analysis like Conductometry, Viscometry, Refractometry, Phse distribution, Adsorption, Rast method and their applications

COURSE CONTENTS:

(I) Synthesis and Analysis
(a) Preparation of Sodium trioxalatoferrate (III)
(b) Preparation of Ni-DMG Complex
(c) Preparation of Copper tetrammine complex
(d) Preparation of cis-bisoxalatodiaquachromate (III) ion

(II) Physical Chemistry

(a) Conductometric Titrations
(i) Determine the end point of the following titrations by the conductometric methods.
Strong acid-Strong base
Strong acid-Weak base
Weak acid-Strong base
Weak acid-Weak base
(ii) Determine the composition of a mixture of acetic acid and the hydrochloric acid by conductometric titration.
(b) (i) Molecular Weight Determination of acetanilide, napthalane, using camphor as solvent **(Rast's methods).**
(ii) To determine the molecular weight of a polymer by viscosity measurements.
(c) Adsorption (i) To study the adsorption of acetic acid oxalic/acid from aqueous solutions by charcoal.

(d) Phase Equilibria to determine the distribution coefficient of iodine between CCI_4 and water.
(e) Refractometry
(i) Determination of refractive index of a liquid by Abbe refractometer, and hence the specific and molar refraction.
(ii) To determine the composition of unknown mixture of two liquids by refractive index measurements.

BOOKS PRESCRIBED:

1. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.
2. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill.
3. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
4. Advanced Experimental Chemistry, Vol. I, Physical, J.N. Guru and R. Kapoor, S. Chand & Co.

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Learn to synthesize and analyze different inorganic complexes.
CO2	Determine the strength of solution by conductometric titrations.
CO3	Learn to determine molecular weight by Rast method and viscosity measurements
CO4	Learn to determine refractive index by Abbe refractometer.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-VI
ORGANIC CHEMISTRY– IV

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

This course aims to provide students
i) an understanding of the spectroscopy of organic compounds including spectroscopic techniques: NMR, UV, IR and spectral analysis.
ii) a complete knowledge of amino acids, peptides and nucleic acids.

COURSE CONTENTS:

SECTION-I

1. Spectroscopy (15 hrs.)
Nuclear Magnetic Resonance (NMR) spectroscopy.
Proton Magnetic Resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.
2. Electromagnetic Spectrum: Absorption Spectroscopy
Ultraviolet (U.V.) absorption spectroscopy introduction- (Beer-Lambert law), molar absorptivity, analysis of UVspectra, types of electronic transitions effect of conjugation. Concept of chromophores and auxochrome, Bathochrome, hypsochrome, hyperchrome, hypochromic shifts-UV spectra of conjugated compounds, Infrared (IR) Absorption spectroscopy-introduction, Hooke's law, Selection rules, intensity and IR bands, measurement of IR spectrum time characteristic absorption of various fundamental band interpretation of IR spectra of simple organic compounds.

SECTION-II

3. Problems based on spectroscopy (4 Hrs.)

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

4. Organosulphur Compounds (3 Hrs.)

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

5. Synthetic Polymers (4 Hrs.)

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

6. Organic Synthesis *via* Enolates (4 Hrs.)

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethylacetoacetate: the Claisen condensation. Keto-enoltautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes. Alkylation and acylation of enamines.

SECTION-III

7. Carbohydrates (8 Hrs.)

Classification and nomenclature.Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides.Erythro and threodiastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

8. Amino Acids, Peptides, Proteins and Nucleic Acids (7 Hrs.)

Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins.Classification of proteins. Peptide structure determination, and group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins.Levels of protein structure. Protein denaturation/renaturation.

Nucleic acids : Introduction. Constituents of nucleic acids.Ribonucleosides and ribonucleotides. The double helical structure of DNA.

BOOKS PRESCRIBED:

1. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, 2nd Ed., Oxford university Press.
2. Advanced Organic Chemistry, by F. A. Carey, R. J. Sundberg, 2nd Ed., Springer.
3. Organic Chemistry by T. W. G. Solomons, 10 Ed., Wiley
4. Advanced Organic Chemistry by Jerry march, 4th Ed., Wiley

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:

CO1	Understand the concept, principle and applications of UV, IR and NMR Spectroscopy and the problems pertaining to the structure elucidation of simple organic compounds.
CO2	Learn about structure of carbohydrates
CO3	Understand Organic Synthesis via organometallic compounds and Enolates.
CO4	Learn about structure of amino acids, Peptides and Nucleic acids
CO5	Learn about synthetic polymers.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-VI
PHYSICAL CHEMISTRY–IV

Credit Hours: 3 Hrs/week
Total Hours: 45
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

Part A :- (Compulsory)
It shall consist of 9 very short answer type questions (Q. Nos. 1 to 9) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. Students are required to attempt 7 Questions (7 x 1 = 7 Marks)

Part B:-
It shall consist of three sections (Section I, II & III) having 9 questions in total (Q. Nos. 10 to 18) from the entire syllabus. Each section will consist of three questions from each unit of the syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying three marks. (6 x 3 = 18 Marks).

COURSE OBJECTIVES:

The main objective of the course is to train the students for applying the principles of Quantum Mechanics on different type of motions like translation, rotation, vibration and electronic motions to show the quantisation of related energies. Moreover the simple solution of Uni-electron system will be also be carried out. Students will learn the crystal analysis and parameter prediction using XRD studies. Photochemical reactions and Photophysical processes and related concepts will also be discussed.

COURSE OUTCOMES:

SECTION-I

1. Quantum Mechanics-I (15 hrs.)
Black-body radiation, Planck's radiation law, Photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box, quantization of energy levels, extension to two and three dimensional boxes, degeneracy.

SECTION-II

2. Quantum Mechanics-II (15 hrs.)
Simple harmonic oscillator model of vibrational motion, setting up Schrodinger equation and discussion of solution and wave functions. Rigid rotator model of rotation of diatomic molecules transformation to spherical polar coordinates spherical harmonics and their discussion.

Qualitative investigation H-atom, setting up Schrodinger equation, radial and angular part, radial distribution functions of 1s, 2s, 2p, 3s, 3p and 3d.

SECTION-III

3. Solid State (8 Hrs.)

Definition of space lattice and unit cell, Law of crystallography- (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices, (iii) Symmetry elements in crystals. X-ray diffraction by crystals.Derivation of Bragg's Law in Reciprocal space. Determination of crystal structure of NaCl, KCl by use of Powder method; Laue's method.

4. Photochemistry (7 Hrs.)

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus–Drapper law, Stark–Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of flourescence, phosphorescence, non–radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions–energy transfer processes (simple examples).

BOOKS PRESCRIBED:

1. Physical Chemistry by P.W. Atkins, 8th Ed., Oxford University Press, 2006 (Indian Print).
2. Physical Chemistry by T. Engel & P. Reid, 1st ed., Pearson Education, 2006.
3. Physical Chemistry by Castellan, 3rd Ed., Addison Wisley/Narosa, 1985 (Indian Print)
4. Physical Chemistry by G. M. Barrow, 6th Ed., New York, McGraw Hill, 1996.
5. Physical Chemistry by R. J. Silbey, R. A. Albert &Moungi G. Bawendi, 4th Ed., New York: John Wiley, 2005.

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Know about the importance and need of quantum chemistry.
CO2	Learn about various laws governing quantum chemistry.
CO3	Understand the derivation of Schrodinger wave equation and its applications to Simple Harmonic oscillator, rigid rotator and hydrogen atom. This will help the students to solve various problems related to quantum chemistry.

CO4	Learn about the basics of solid state chemistry, laws of crystallography and the methods to determine crystal structure with examples.
CO5	Understand the laws of photochemistry Jablonski diagram and various radiative and nonradiative processes.

B. Sc. (Medical & Non-Medical) CHEMISTRY
Semester-VI
PRACTICAL

Credit Hours: 4.5 Hrs/week
Total Hours: 60
Maximum Marks: 25

INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:

I. Examiner will set two questions first based upon Column Chromatography and second based upon Organic Synthesis
II. Students will be asked to complete write up of both practical within first 20 minutes on the first sheet provided.
III. On the second sheet provided after 20 minutes, students will perform and note the record on second sheet during the conduct of practical exam
IV. The split of marks will be as under:
(Column Chromatography = 8, Organic synthesis = 10, Viva-voce = 4, Practical note book = 3)

COURSE OBJECTIVES:

The course is intended to provide knowledge of laboratory set up and safe handling of chemicals. the practicals ivcludes various preparations of organic compounds and separation techniques including column chromatography

COURSE CONTENTS:

Organic Chemistry Laboratory Techniques

1. Column Chromatography

Separation of o & p nitrophenol
Separation of Leaf pigments from Spinnach leaves
Separation of o & p nitro aniline
Separation of dyes.

2. Synthesis of Organic Compounds

Preparation of p-nitroacetanilide
Preparation of p-bromoacetanilide
Green Chemistry Experiment: Preparation of benzilic acid from Benzyl-using greenapproach.
Preparation of Methyl Orange, Methyl Red
Preparation of benzilic acid from benzyl-using green approach

BOOKS PRESCRIBED:

1. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
2. A Systematic Qualitative Chemical Analysis a Theoretical and Practical Study of Analytical Reactions of the More, Common Ions of Inorganic Substances.
3. Physical Chemistry Laboratory Manual - An Interdisciplinary Approach 1 Edition by A. Anand, R. Kumari, 1st Ed. Dreamtech Press

COURSE OUTCOMES:

Sr. No.	On completing the course, the students will be able to:
CO1	Understand the preparation of various organic compounds.
CO2	Learn about TLC or the separation of various components in mixture.
CO3	Learn about Column chromatography for the separation of various components in mixture.
CO4	Understand different purification techniques in organic chemistry like recrystallization
CO5	Get awareness of safety techniques and handling of chemicals..

FOR FURTHER STUDIES

Books Suggested (Theory Courses)

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. McDaniel and J. Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver, P.W. Alkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield Addison-Wesley.
6. Inorganic Chemistry, A.G. Sharpe, ELBS.
7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall.
8. Organic Chemistry, Morrison and Boyd, Prentice-Hall.
9. Organic Chemistry, L.G. Wade Jr. Prentice-Hall.
10. Fundamentals of Organic Chemistry, Solomons, John Wiley.
11. Organic Chemistry Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
12. Organic Chemistry, F.A. Carey, McGraw-Hill, Inc.
13. Introduction to Organic Chemistry, Sireitwieser, Heathcock and Kosover, Macmilan.
14. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
15. Basic Programming with Application, V.K. Jain, Tata McGraw Hill.
16. Computers and Common Sense, R. Hunt and Shelly, Prentice Hall.
17. University General Chemistry, C.N.R. Rao, Macmillan.
18. Physical Chemistry R.A. Alberty, Wiley Eastern Ltd.
19. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
20. Physical Chemistry Through Problems, S.K. Dogra and S. Dogra, Willey Eastern Ltd.

V Books Suggested (Laboratory Courses)

1. Vogel's Qualitative Inorganic Analysis, revised, Svehla, Orient Longman.
2. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Jeffery and J. Mandham, ELBS.
3. Standard Methods of Chemical. Analysis, W.W. Scott: The Technical Press.
4. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
5. Handbook of preparative Inorganic Chemistry, Vol. I & II, Brauer, Academic Press.
6. Inorganic Synthesis, McGraw Hill.
7. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
8. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
9. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
10. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.
11. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill.
12. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
13. Advanced Experimental Chemistry, Vol. I, Physical, J.N. Guru and R. Kapoor, S. Chand & Co.
14. Selected Experiments in Physical Chemistry, N.G. Mukherjee, J.N. Ghosh& Sons.
15. Experiments Physical Chemistry, J.C. Ghosh, BharatiBhavan.