ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU

(AFFILIATED TO UNIVERSITY OF MYSORE)

REACCREDITED BY NAAC WITH A GRADE

Three-year six semesters Choice Based Credit System (CBCS) with
Learning Outcome Based Curriculum framework (LOCF)

and Continuous Assessment & Grading Pattern (CAGP) Undergraduate Programme under Autonomous Structure

Programme- B.Sc.

The academic year 2018-19 onwards

DEPARTMENT OF CHEMISTRY

VISION AND MISSION OF THE COLLEGE

VISION:

The college is guided by the visionary zeal of providing value- based education to everyone irrespective of religion, caste, creed or sex by which the character is formed, intellect is explained and one can stand on his/her feet**.**

MISSION:

To transform young men and women who come to learn not from books, but also from life and to share the experience of working and playing together, this inculcates life skills to become good citizens with integrity and discipline.

Programme Educational Objective (PEO)

PEO-1	Graduates will be able to master and display competency and leadership to become successful professionals, employees and entrepreneurs or pursue higher education and research.
PEO-2.	Graduates will be able to demonstrate the commitment towards professional ethics, gender sensitivity, preservation of environment and sustainable development.
PEO-3	Graduates will continue to learn and advance their careers through activities such as participation in professional organizations, attainment of professional certification and seeking higher education.

Programme Outcomes (PO): BSc. Programme

PO-1	**Disciplinary Knowledge:** The BSc. graduates will acquire the knowledge with facts and figures related to pure and applied sciences. Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
PO-2	**Cognitive and Communicative skills:** Students learn two languages along with three major subjects. At the end of the programme, the students would have developed reading, writing, speaking, interpretive and composition skills. They would be able to communicate with others using appropriate media; confidently share one's views and express themselves
PO-3	**Research Related Skills:** The BSc. students will acquire the skills in handling scientific instruments, planning and performing in laboratory experiments.
PO-4	**Ethics**: The BSc. students will be imbibed ethical, moral and social values in personal and social life leading to highly cultured and civilized personality.
PO-5	**Problem Solving:**The BSc. graduates will develop the ability to analyze and solve Course-related problems and also the ability to evaluate situations and react responsibly to communicate, cooperate and lead a team among peers and others.

PO-6	**Critical Thinking:** The qualities of a science student – observation, precision, analytical mind, logical thinking, clarity of thought and expression, systematic approach, qualitative and quantitative decision making are enhanced.
PO-7	**Social Interaction:** The BSc. graduates shall appreciate the role of science in society; and its personal, social and global importance.
PO-8	**Analytical Skills**: The graduates will master the skills of observations and drawing logical inferences from the scientific experiments. Analyzed the given scientific data critically and systematically and the ability to draw the objective conclusions.
PO-9	**Environment and Sustainability:** Graduates will be able to understand the issues of environment and work towards sustainable development.
PO-10	**Employability:** After completing the programme, graduates will have the competency to be employed or to be an entrepreneur.
PO-11	**Leadership Quality:** In the graduation programme students are inculcated moral and ethical values, managerial skills, adoptability, problem solving, taking initiative, decision making, risk taking to make them confident leaders.

Programme Specific Outcomes (PSO)- BSc. Programme

PSO-No	After the completion of BSc. programme by studying PCM/CBZ/BtCZ/CBFn students will be able to	Cognitive level
PSO-1	Develop critical thinking and skills for problem solving leading to scientific attitudes and initiate research. They will be able to develop experimental and data analysis skills through a wide range of experiments in the practical laboratory	apply
PSO-2	Develop analytical skills and problem solving skills required for the application of **chemical principles**. They will be able to perform scientific experiments skillfully by application of procedural knowledge.	Analysis
PSO-3	Integrate modern techniques (Maxima, Scilab, etc.) with the knowledge of Mathematics for solving problems in the relevant areas. They will be able to apply the acquired principles and knowledge of mathematical sciences to execute work to manage projects in multidisciplinary areas.	Evaluate

PSO-4	Apply the knowledge of basic science, life sciences and fundamental process of plants to study and analyze any plant form. Create, select, and apply appropriate techniques, resources, and modern instruments and equipments for **Plant Tissue** culture experiments, cellular and physiological activities of plants with an understanding of the	Apply
PSO-5	Understand the basic concepts of Taxonomy, Physiology, Genetics, Cytology, Histology, Embryology, Ecology and Evolution. Be able to apply their knowledge of classical and applied aspects of **Zoology** in allied fields like Economic Zoology, Biotechnology, Pathology, Public Health, Environmental Toxicology and Wildlife conservation	Analyse
PSO-6	Demonstrate and apply their knowledge of cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of B**iotechnology.**	Apply
PSO-7	Recognize the interrelationship between **food, nutrition** and health and the food choices to make that will optimize the health and prevent diseases. Display basic and translational research skills with technical excellence and which make them research and industry ready.	Understand and apply

Mapping of Mission of the College with PEO			
Mission	PEO-1	PEO-2	PEO-3
Mission -1	✓	✓	✓

Mapping of PEOs with Programme Outcocome(PO)											
PEO-No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
PEO-1		✓	✓		✓					✓	✓
PEO-2	✓			✓					✓		
PEO-3						✓	✓	✓			

SCHEME OF INSTRUCTION AND EXAMINATION
Discipline Specific Core (DSC) or Hard Core (HC)

Semester	Title of the Paper	TYPE	Subject Code	Teaching Hours per Week Theory/Practical	Credits Theory/ Practical	Exam Duration in Hours Theory/ Practical	Max. Marks Theory/Practical		
							Theory/Practical	I A Theory/Practical	Total Marks
I	Paper-I Title: General Chemistry I	DSC	18MA260	03	03	03	50	20	100
	Practical Paper-I Volumetric estimations	DSC	18MA262	03	1.5	03	20	10	
II	Paper-II Title: General Chemistry II	DSC	18MB260	03	03	03	50	20	100
	Practical Paper-II Qualitative Organic Analysis	DSC	18MB262	03	1.5	03	20	10	
III	Paper-III Title :General Chemistry III	DSC	18MC260	03	03	03	50	20	100
	Practical Paper-III Semi-microInorganic Salt Mixture Analysis	DSC	18MC262	03	1.5	03	20	10	
IV	Paper-IV Title :General Chemistry IV	DSC	18MD260	03	03	03	50	20	100
	Practical Paper-IV Physical Chemistry- Non - instrumental	DSC	18MD262	03	1.5	03	20	10	
V	Paper-V Title :Inorganic Chemistry	DSC	18ME260	02	02	03	50	20	300
	Paper-VI Title:Organic Chemistry	DSC	18ME262	02	02	03	50	20	
	Paper-VII Title:Physical Chemistry	DSC	18ME264	02	02	03	50	20	
	Practical Paper-V Gravimetric Estimations & Chromatographic separation	DSC	18ME266	03	1.5	03	30	15	
	Practical Paper-VI Ore & Organic Estimation	DSC	18ME268	03	1.5	03	30	15	
VI	Paper-VIII Title: Industrial Inorganic Chemistry	DSC	18MF260	02	02	03	50	20	300

	Paper-IX Title :Bio-Organic Chemistry	**DSC**	**18MF262**	**02**	**02**	**03**	**50**	**20**	
	Paper-X Title :Electrochemistry and its Applications	**DSC**	**18MF264**	**02**	**02**	**03**	**50**	**20**	
	Practical Paper–VII Physical Chemistry-Instrumental-Electrical	**DSC**	**MF266**	**03**	**1.5**	**03**	**30**	**15**	
	Practical Paper–VIII Organic and inorganic complex formation	**DSC**	**MF268**	**03**	**1.5**	**03**	**30**	**15**	
		DSE 1		**02**	**02**	**02**	**30**	**20**	**100**
		DSE 2		**02**	**02**	**02**	**30**	**20**	
		Total			**40**	**-**			**1100**

Discipline Specific Elective (DSE or Soft Core (SC)

SL. No	**Title of the Paper**	**Course COde**	**TYPE**	**Semester**	**Theory**	**Credits**	**Examination Scheme**			
							Exam Duration in Hours	**Theory Max. Marks**	**I A Max Marks**	**Total Marks**
1.	**Title:Water Quality and its Treatment**	**M26Y03**	**DSE**	**II to VI**	**2**	**2**	**02**	**30**	**20**	**50**
2.	**Title: Elements of Pharmaceutical Chemistry**	**M26Y04**	**DSE**		**2**	**2**	**02**	**30**	**20**	**50**
3.	**Title:Basics of Food Chemistry**	**M26Y02**	**DSE**		**2**	**2**	**02**	**30**	**20**	**50**
4.	**Title:Applied Chemistry of Leather Industry and Corrosion**	**M26Y01**	**DSE**		**2**	**2**	**02**	**30**	**20**	**50**
5.	**Title:Chemistry in Cosmetics**	**M26Y05**	**DSE**		**2**	**2**	**02**	**30**	**20**	**50**
6.	**Title:Elements of Polymer Chemistry**	**M26Y06**	**DSE**		**2**	**2**	**02**	**30**	**20**	**50**
7.	**Title:Basics of Nano Chemistry**	**M26Y07**	**DSE**		**2**	**2**	**02**	**30**	**20**	**50**
8.	**Title:Dissertation/Project in the Final Year**	**M26Y08**	**DSE**		**2**	**2**	**02**	**30**	**20**	**50**

Note:

Sl .No	**Type**	**Type**
1.	**DSC or HC**	**Discipline Specific Core (DSC) or Hard Core (HC)**
2.	**DSE or SC**	**Discipline Specific Elective (DSE) or Soft Core**
3.	**SEC or OE**	**Skill Enhancement Course (SEC) or Open Elective**

PREAMBLE

For the development of any society, Science education plays an important role. Chemistry, being a major component of Science, is one of the increasingly important disciplinary areas of Science. Chemistry, which is also studied at the Bachelor's degree programme for years, has been witnessing a slow transition from an analogue to a much-needed one. It is an experimental science and students need to be trained both in the theoretical & practical aspects to get expertise. Moreover, the topics prescribed should provide in-depth knowledge of the subject and also the relevant basic allied subjects.

Under this context, to make the U. G. teaching more effective and meaningful, revamping the syllabus is the need of the hour. It is certain that systematic and planned curricula from first to the third year shall motivate and encourage students for pursuing higher studies in various disciplines of chemistry such as inorganic, organic, Physical, Analytical and Bio-Chemistry. This curriculum also enables the students to shoulder the responsibilityof chemists in the chemical industry.

Thus, an updated and content revision of UG Chemistry syllabus is essential to improve its quality at the National and International level and also to meet the present-day challenges of PG and research-oriented work after the PG programme.

CHOICE BASED CREDIT SYSTEM (CBCS): under the CBCS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of the number of credits to be completed by the students.

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising a core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. This will benefit the students to move across institutions within India,to begin with, and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates.

This syllabus has been designed to stimulate the interest of the students in chemistry and to equip the students with a potential to contribute to the academic and industrial requirements of the society. The new, updated syllabus is based on an interdisciplinary approach and is infused with new vigour and more depth. Chemistry is an experimental science, due importance is given to the development of laboratory and instrumentation

1. In the first-year course (I & II Semester) the basic topics related to the fundamentals of chemistry are covered. Since, Chemistry is an experimental subject, practical classes intended to achieve the basic skills are incorporated. This will serve as an important tool in understanding the concepts and authenticating the basic laws and principles of Chemistry.

2. In the second year (III& IV Semester) of under graduation, the levels of theory and practical aspects should be one step ahead of the I year course. Keeping this in mind, the

topics have been upgraded. Also, for the development of vertical growth in the subject, advanced level topics are introduced so as to make the students mature enough to pursue a career in Chemistry.

3. In the third year (V& VI Semester) of B. Sc. Course, theory papers in each semester deal with the further detailed studies of various branches of chemistry as well as some specialized topics like spectroscopy, polymers etc. Such a designing, of course,the structure enables the student to understand fundamentals as well as applied components that are pertinent to chemistry.

Practical classes are framed towards the development of synthetic as well as analytical skills that are essential for academic and professional life.
An elective course designed to acquire special/advanced knowledge, such as project work, is introduced. The student will take a course on his own with advisory support by a teacher/faculty member/ industrial instructor andsubmit theproject reportas the dissertation.

FIRST SEMESTER

GENERAL CHEMISTRY PAPER –I (DSC)

CLASS DURATION -03 HOURS PER WEEK 48 HOURS

Marks – Theory 50 + Internal Assessment 20 = 70

COURSE OBJECTIVE:

- **To recognize and understand quantum numbers, periodic table and asses the trends in periodic properties. To understand different terms and principle involved in volumetric analysis and to define primary and secondary standard.**
- **Categorize , discuss the different types of organic reactions and to interpret reaction mechanisms of some well known reactions. Classify hydrocarbons, diens and to discuss their reactions.**
- **Apply the kinetic molecular theory of gases to explain the behavior of ideal gases and their deviation. To formulate mathematical expression for various molecular velocities exist in gas molecules. To correlate thermodynamic principle and liquefaction of gas by understanding the principle of Joul-Thomson effect.**

Course Learning Outcome (CO):

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	Assign quantum numbers to any electron in an atom and to describe the structureof atom. To conceptualize the periodic trends and to predict the chemical behaviour of different elements based on their periodic properties.	Apply
CO-02	Establish sound knowledge of organic chemistry . Apply the IUPAC system of nomenclature for naming Organic Compounds. Predict reaction mechanisms.	Understand
CO-03	To apply Kinetic theory of gas molecules to explain the relationship between Kinetic energy, molecular velocities and temperature.	Apply
CO-04	To interpret possible choice of indictors suitable for a given titration.	Understand

	Inorganic Chemistry -16 hours	
1.1	**Unit- 1** **Elements of Quantum Mechanics**	8hrs
	Atomic Structure: Electromagnetic Radiation; features of the wave, electromagnetic spectrum, Bohr's equation for radius and energy of an electron in an orbit (derivation not required) Particle and wave character of the electron: de Broglie's equation (to be derived) Heisenberg's uncertainty principle, the Schrodinger equation, significance of wave function	
1.1.1	**Quantum numbers and their significance:**Pauli's exclusion principle with an example, Hund's rule of maximum multiplicity with an example, Effective nuclear charge, Screening effect - based on Slater's rule (problems to be worked out up to second-period elements) Aufbau's principle, the sequence of energy levels, Electronic configuration upto Z=40). Stability of filled, half-filled and empty subshells (explain the concept of pairing energy, promotional energy and symmetrical charge distribution).	
1.2	**Periodic Table and Periodicity**: Periodic law and arrangement of elements in the periodic table, IUPAC nomenclature, group number, horizontal, vertical and diagonal relationships in the long form of the periodic table, classification of elements into s, p, d, and f block elements.	**6 hrs**
1.2.1	**Atomic radius:**covalent, ionic and van der Waal's radii – Definition, explanation with examples. Variation of covalent radii in a group and a period-explanation for the observed trends. Comparison of the size of atoms with the corresponding anions and cations. **Isoelectronic ions:** Definition, Variation of ionic radii in isoelectronic ions	
1.2.2	**Ionisation energy:** Definition,explanation and the factors influencing ionisation energy, Variation of ionisation energy in a group and a period, Electron affinity-explanation-variation in a group and in a period (observed trends in the values to be accounted for)	
1.2.3	**Electronegativity:**Definition, explanation-variation in a group and a period Pauling's and Mulliken's scales of Electronegativity. Applications of the concept of electronegativity-electronegativity difference and partial ionic character, electronegativity difference and stability of the bond.	
1.3	**Analytical Chemistry:** Definitions of Molarity, Normality, Molality and Mole fraction - their calculations. Definition and examples for primary and secondary standards. Calculation of equivalent weight of the acid, base, oxidizing agent. Principle of Volumetric Analysis.	**2 hrs**

	Organic Chemistry – 16 hours	
	Unit – 2	
2.1	**Introduction to organic chemistry: -** Definition-Importance of Organic compounds to life and applications in food, fuels, textiles, dyes, drugs, cosmetics etc., with examples. Nomenclature (IUPAC) of bifunctional, aliphatic and aromatic compounds	**3hrs**
2.2	**Electronic effects and reactive intermediates:** Arrow notations, drawing electron movements with arrows (Curved, half headed, double-headed, crooked). Generation, hybridisation, shape and stability of carbonium ions, carbanion and carbon-free radicals**.** **Electrophiles and Nucleophiles** - definitions and their nature with examples. **Inductive effect**: definition (+I effect and -I effect) explanation with examples by taking halogen derivatives and halogenated acids up to 4 carbon atoms. **Resonance effect**: definition-explanation with examples by taking electron-donating groups (-OH and $-NH_2$) and electron-withdrawing groups ($-NO_2$ and -COOH). **Hyperconjugation**: definition-explanation by taking propene and toluene as an example. Influence of these on the properties of molecules.	**5 hrs**
2.3	**Aliphatic Hydrocarbons:**	**8 hrs**
2.3.1	**Alkanes:** Preparation by catalytic hydrogenation of alkenes with the mechanism. Preparation by Corey-House reaction. Conversion of alkanes to aromatic compounds via alkenes and alkynes- aromatization and pyrolysis.	
2.3.2	**Alkenes:** Synthesis from alcohols (dehydration) and alkyl halides (dehydrohalogenation), Preparation of alkenes by Wittig's reaction, Stereoselectivity. Mechanism of electrophilic addition, Oxymercuration, Reduction, Hydroboration- Oxidation,and Epoxidation. Oxidation with $KMnO_4$ and OsO_4, Ozonolysis. Industrial applications of ethene and propene	
2.3.3	**Dienes:** Types- isolated, conjugated and cumulative dienes with examples, Synthesis of 1,3 butadiene from 1,4-Butanediol. Addition of HBr to 1,3 butadiene (1,2 & 1,4-addition), Diels-Alder reaction with one example .	

2.3.4	**Alkynes:** Acidity of alkynes- terminal alkynes and non-terminal alkynes. Reactions of alkynes – Electrophilic additions with HCN, CH_3COOH and H_2O. Polymerization	
	Physical Chemistry-16 hrs	
	Unit-3	
	Note: - S l Units to be used. Problems to be worked out and diagrams to be drawn wherever necessary	
3.1.1	**Gases:** Postulates of Kinetic theory of gases (Mention $PV= 1/3\ mnc^2$), Maxwell-Boltzmann distribution of molecular velocities (no derivation), the effect of temperature on the distribution of molecular velocities (graph), Boltzmann factor, Energy distribution as a function of temperature. Types of molecular velocities – average velocity (Uav), root mean square (Urms) and most probable (Ump) velocity, their definition and equations (no derivation) Relation between probable, average and root mean square velocities of molecules and their calculation (based on temperature dependence). Problems based on the calculation of different velocities.	**5 hrs**
3.1.2	**The Critical Phenomenon** - Andrew's experiments on carbon dioxide, Critical constants - T_c, P_c and V_c– definitions-experimental determination of critical temperature and critical pressure by using Cagniard-de la Tour's apparatus, Critical volume by *Cailletet*-Mathiasmethod – van der Waal's equation-relation between van der Waal's constants 'a' and 'b' and critical constants T_c, P_c and V_c to be derived-using isotherm of CO_2 . Law of corresponding states and the reduced equation of state (to be derived). **Liquefaction of gases**: Intermolecular forces - a brief account of - dipole-dipole interactions, dipole-induced dipole, induced dipole-induced dipole, van der Waal's forces. Liquefaction of gases - principle underlying liquefaction of gases, Joule-Thomson effect, Joule-Thomson experiment, Inversion temperature (definition) and its relation with van der Waal's constants a & b (Problems to be worked out on T_i, T_c, P_c and V_c)	**6 hrs**
3.2	**Indicators:** Definition, types (acid-base, redox, adsorption indicators) examples for each type, Theory of indicators - Ostwald's theory and Quinonoid theory- indicator constant, the action of phenolphthalein and methyl orange in acid-base solutions.	**3hrs**
3.3	**pH titration curves** -calculation of pH during acid-base titration by taking titration between strong acid vs strong base & weak acid vs strong base.pH titration curves for strong acid vs strong base, weak acid vs strong base, weak base vs strong acid-choice of indicators in these types of titrations - colour change and pH range - Universal indicator – definition , example	**2hrs**

Reference Books

Sl No	Title of the Book	Author	Publisher
1.	A Text book of Inorganic Chemistry	P.L.Soni	Sultan Chand &Sons
2.	A Text book of Inorganic Chemistry	B.R.Puri&L.Sharma	Shobhanlal Nagin Chand Co
3.	Principles of Inorganic Chemistry	Puri, Sharma, & Kalia	Shobhanlal Nagin Chand Co
4.	Concise Inorganic chemistry	J.D.Lee	B-Block well Science Ltd
5.	A Text book of Inorganic Chemistry	GurudeepRaj	Goel Prakashan. Meerut
6.	A Text book of Inorganic Chemistry	Sathya Prakash	S. Chand & Company
7.	Fundamental concepts of Inorganic Chemistry Vol 1 – 7	Asim K Das & Mahua Das	CBS Publishers & Distributors.
8.	A text book of Organic Chemistry	M.K.Jain	S. Chand & Company
9.	A text book of Organic Chemistry	Bahl&Bahl	S. Chand & Company
10.	A text book of Organic Chemistry	P.L.Soni	S. Chand & Company
11.	Organic Chemistry	K.K. Sharma	Shobhanlal&Nagan Company
12.	Organic Chemistry	Puri& Sharma	Shobhanlal&Nagan Company
13.	Physical Chemistry	M.Kundan&S.K.Jain	S. Chand & Company
14.	Text book of Physical Chemistry	K.K.Sharma&C.K.Sharma	Vani Educational Books

15.	Physical Chemistry	R.L.Madan& G.D.Tuli	S. Chand & Company
16.	Text book of Advanced Physical Chemistry	GurudeepRaj	Goel Prakashan. Meerut
17.	Engineering Chemistry	Jain & Jain	Dhanpal& Sons,New Delhi
18.	Text book of Physical Chemistry	B.D.Khosla	R.Chand& Publications
19.	Physical Chemistry	S Bahl& Arun Bahl	S. Chand & Company
20.	A Textbook of Physical Chemistry	P LSoni&Dhasmarah	S. Chand & Company
21.	Textbook of Chemistry (Vol. I – VI)	K. K. Padmanabha	Chetana Book House, Mysore

SECOND SEMESTER
GENERAL CHEMISTRY PAPER-II (DSC)

CLASS DURATION -03 HOURS PER WEEK 48 HOURS

Marks- Theory – 50 + Internal Assessment – 20 = 70marks

COURSE OBJECTIVES:

- To classify different types of bonding interactions present in molecules, explain different theories of chemical bonding with examplesand to predict the number and nature of bond exists in a given molecule.
- To describe structure of benzene with respect to resonacetheory , to identify functional groups present in alcohols, phenols and to understand the chemical reactions with their mechanisms.
- To relate dilute solutions and their properties to gases. To derive expression for molar mass by measuring colligative properties such as relative lowering of vapour pressure, elevation of boiling point, depression in freezing point, osmotic pressure.

COURSE LEARNING OUTCOME (CO):

CO	After the completion of this course the student will be able to	Cognitive level

CO-01	Conceptualize various theories of chemical bonding with example and interpret the type of bonding involved in different molecules.	Understand
CO-02	Recognize different functional groups responsible for the unique chemical properties of organic compounds. Classify alcohols, phenols and to convert them into different compounds through understanding their reaction mechanisms	Analyse
CO-03	Show relationship between colligative properties and molecular mass. To derive expression for Molar mass of a solute and colligative property and thereby to calculate molar mass of a solute.	Apply

Inorganic Chemistry – 16 hours		
1.1	**Unit - 1** **Chemical Bonding** **Ionic bonding-**Definition. Factors that favour the formation of an ionic bond.,Lattice energy: definition, Born-Lande equation (derivation not required), Born-Haber cycle, setting up of Born-Haber cycle for NaCl, Role of lattice energy and hydration energy on the solubility of ionic compounds, Numerical calculation of lattice energy & electron affinity based on Born-Haber cycle for 1:1 solids. Stoichiometric defects in ionic crystals:Schottky defects and Frenkel defects, Consequences of Stoichiometric defects Radius ratio concept: Calculation of radius ratio for CN 4 and CN=6	**4 hrs**
1.2	**Covalent bonding -1**: Definition and explanation with a suitable example, Valence bond Theory-salient features and explanation with simple examples (H_2, F_2, HF), Sigma and Pi bonds-Definitions,and explanation by taking O_2 and N_2 as examples.Variable covalency, Maximum covalency	
1.2.1	**Covalent bonding-2:**Hybridisation-directional property and geometry of sp, sp^2, sp^3, sp^3d and sp^3d^2 hybrid orbitals taking $BeCl_2$, BF_3, $SiCl_4$, PCl_5 and SF_6 as examples respectively (also hybridization in CH_4, C_2H_4,and C_2H_2 to be mentioned).The VSEPR theory with NH_3, H_2O SF_4 and ClF_3 as examples. The partial ionic character of covalent bond - the percentage of ionic character - Hanny and Smyth equation.	**4 hrs**
1.3	**Polarisation:** Fajans rules of polarization, effects of polarization- solubility, melting points and thermal stability of typical ionic compounds and their explanation. The polarity of a covalent bond, polar and non-polar molecules . Dipole moment and polarity of molecules to be explained by taking HCl,CO_2, NH_3 , CCl_4,and H_2O as examples. Bond length, bond order, and bond energy and their significance. Coordinate bond: Explanation with examples H_3O^+, NH_4^+, NH_3, -BF_3 molecule	**4 hrs**
1.4	**Molecular Orbital Theory** An elementary account of MOT, Linear combination of atomic orbitals (no mathematical approach), Bonding and antibonding molecular orbitals, Conditions for the combination, Molecular orbital structures and bond orders of simple species like H_2, He_2, N_2, O_2 ,heteroatomic molecules like HF and CO.	**4 hrs**
Organic Chemistry-16 hours		
2.1	**Unit -2** **Cycloalkanes:** Definition, examples, relative stability Bayer's strain theory and its limitations. Sachse-Mohr's theory of strainless rings. Chair and boat conformations of cyclohexane and their stability. Conformations of cyclopentane	**4hrs**

2.2	**Aromatic hydrocarbons:**Modern concept of the structure of benzene including molecular orbital theory, Aromaticity, Resonance energy, Electrophilic substitution reactions: - Friedel-Craft's alkylation reaction by taking n-propyl bromide as an example with the mechanism. Electronic interpretation of orientating influence of electron donating groups (-CH_3, -Cl, -NH_2, -OH) and electron withdrawing groups (-NO_2, -SO_3H, -COOH, -CHO) on electrophilic substitution reactions with energy profile diagram. Birch reduction with the mechanism, Resonance structures of naphthalene, anthracene, phenanthrene and oxidation reaction of naphthalene, anthracene. Biphenyls: Preparation – Ullmann reaction	**4hrs**
2.3	**Alcohols:**Definition - Classification with examples. Monohydric alcohols: Preparation of alcohols from aldehydes and ketones using $LiAlH_4$ (With mechanism). Distinguishing tests between primary, secondary and tertiary alcohols (Oxidation and Victor Meyer's method). Pinacols: Pinacol-pinacolone rearrangement & Mechanism, **Trihydric alcohols:** Glycerol-synthesis from propene, Reactions with conc. HNO_3, conc. H_2SO_4, oxalic acid and HI, Uses of glycerol.	**4 hrs**
2.4	**Phenols:** Definition-Classification with examples. Mechanism of Reimer-Tiemann's and Kolbe-Schmidt reactions, Reaction and mechanism of Fries and Claisen rearrangement reaction. Conversion of phenol to phenolphthalein and resorcinol to fluorescein.	**4 hrs**
Physical Chemistry – 16 hours		
3.1	**Unit-3** **Liquid mixtures:** Classification of binary mixtures into - partially miscible, completely miscible and completely immiscible pairs of liquids (explanation with examples for each type), Raoult's law, the definition of ideal and non-ideal solutions based on Raoult's law. Partially miscible liquids: Critical solution temperature (C.S.T.) - types, phenol-water system, triethylamine-water system, the nicotine-water system (mutual solubility temperature - M.S.T vs. composition curves to be drawn). Effect of addition of non-volatile solute on C.S.T of Phenol & water system Binary mixtures of completely miscible liquids:Vapour Pressure - definition, Vapour pressure-composition diagrams, and vapourpressure-temperature diagrams, classification into types - obeying Raoult's Law (type I), showing positive deviation from Raoult's law (type II) and showing negative deviation from Raoult's law (type III) - examples for each type. Principles of fractional distillation, fractional distillation of type I, type II, and Type III liquid mixtures (with examples), azeotropic mixtures - definition.	**4 hrs**

3.2 **3.2.1**	**Colligative properties:**Concept of vapour pressure, a variation of vapour pressure with temperature, temperature – vapour pressure curves, the effect of dissolution of a non-volatile solute on the vapour pressure of the solvent, lowering of vapour pressure, Raoult's Law-Relation between the relative lowering of vapour pressure and molar mass (to be derived). Determination of the molar mass of solute by dynamic method,(Problems to be worked out). **Elevation in boiling point:** Definition of boiling point, a variation of boiling point with pressure, elevation in boiling point and its relation to lowering of vapour pressure and molar mass (to be derived). The ebullioscopic constant of the solvent and its relation to the boiling point (only equation), determination of the molar mass of the solute by Walker-Lumsden's method, (problems to be worked out)	**2 hrs**
3.3	**Depression in freezing point:**Definition of freezing point, depression in freezing point and its relation to lowering of vapour pressure and molar mass (to be derived). Cryoscopic constant and its relation to the melting point (equation). Determination of the molar mass of a non-volatile solute by Beckmann's method. (Problems to be worked out)	**5 hrs**
3.4	**Semi-permeable membrane:** natural and artificial, preparation of copper Ferrocyanide membrane by Morse-Frazer method, the definition of osmosis, osmotic pressure, applications of osmosis, determination of osmotic pressure by Berkely-Hartley's method, laws of osmotic pressure-analogy with gas laws, molar mass from osmotic pressure measurement (relation to be derived), isotonic solutions, plasmolysis, Reverse osmosis and its applications, abnormal molecular weights-causes-Van't Hoff's factor- Expression for the degree of dissociation and degree of association in terms of Van't Hoff's factor and problems based on it. Problems with isotonic solutions.	**4 hrs**

Reference Books

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1.	A Text book of Inorganic Chemistry	P.L.Soni	Sultan Chand &Sons
2.	A Text book of Inorganic Chemistry	B.R.Puri&L.Sharma	Shobhanlal Nagin Chand Co
3	Principles of Inorganic Chemistry	Puri, Sharma, & Kalia	Shobhanlal Nagin Chand Co
4.	Concise Inorganic chemistry	J.D.Lee	B-Block well Science Ltd
5.	A Text book of Inorganic Chemistry	Gurudeep Raj	Goel Prakashan

6.	A Text book of Inorganic Chemistry	Sathya Prakash	S. Chand & Company
7.	Fundamental concepts of Inorganic Chemistry Vol 1 – 7	Asim K Das & Mahua Das	CBS Publishers & Distributors.
8.	A text book of Organic Chemistry	M.K.Jain	S. Chand & Company
9.	A text book of Organic Chemistry	Bahl&Bahl	S. Chand & Company
10.	A text book of Organic Chemistry	P.L.Soni	S. Chand & Company
11.	Organic Chemistry	K.K. Sharma	Shobhanlal&Nagan Co.
12	Organic Chemistry	Puri& Sharma	Shobhanlal&Nagan Company
13	Physical Chemistry	M.Kundan&S.K.Jain	S. Chand & Company
14.	Text book of Physical Chemistry	K.K.Sharma&CKsharma	Vani Educational Books
15.	Physical Chemistry	R.L.Madan& G.D.Tuli	S. Chand & Company
16.	Text book of Advanced Physical Chemistry	GurudeepRaj	Goel Prakashan. Meerut
17.	Engineering Chemistry	Jain & Jain	Dhanpal&Sons ,New Delhi
18.	Text book of Physical Chemistry	B.D.Khosla	R.Chand& Publications
19.	Physical Chemistry	S Bahl& Arun Bahl	S. Chand & Company
20.	A Text book of Physical Chemistry	PLSoni&Dhasmarah	S. Chand & Company
21.	Text book of Chemistry (Vol. I – VI)	K. K. Padmanabha	Chetana Book House, Mysore

THIRD SEMESTER

GENERALCHEMISTRY PAPER-III

CLASS DURATION-03 HOURS PER WEEK 48 HOURS

Marks – Theory – 50 + Internal Assessment – 20 = 70

COURSE OBJECTIVES:

- To summarise special bonding interactions such as Hydrogen bonding and metallic bond.To compare and contrast the chemical properties of p- block elements. To upgrade the knowledge on new advancements in nanoscience.

- ❖ To identify carbonyl compounds and to predict possible products formed. To convert amines to diazonium copmounds and diazonium compounds to alcohols phenols halobenzenes etc.
- ❖ To categorise polymerswith respect to their source , structure and mechamnism of polymerization. To understand and to apply knowledge of chemical kinetic studies to know the reaction mechanism. To apply distribution law as separation technique during solvent extraction process.

COURSE LEARNING OUTCOME:

CO No.	After the completion of this course the student will be able to	Cognitive Level
CO-01	Justify the cause of anamolousbehavior of water. Distinguish conductors, semiconductors and insulators. Discuss chemistry of p-block elements and to compare nano materials and their advantages over contemporary materials	Evaluate
CO-02	Apply various name reactions of carbonyl compounds to develop new products and reaction mechamnisms.classify carboxylic acids and to understand name reactions of carboxylic acids ,amines and hydroxy acids. To synthesize new compounds by using diazonium compound.	Apply
CO-03	Derive an expressionand to calculate rate constant for II order reaction. To determine order of reaction and to arrive at the reaction mechanism. To apply the principle of Nernst distribution law .	Analyse

Inorganic Chemistry - 16 hours		
1.1	**Unit -1** **Hydrogen bonding:** Definition,Types of hydrogen bonding, Hydrogen bonding in HF, H_2O, NH_3, Anomalous properties like physical state, boiling point, solubility in H_2O, alcohols andnitrophenols, Structure of ice.	**5 hrs**
1.1.1	**Metallic bond:** Band theory, Explanation of electrical conductance of metals, Semiconductors (n and p types), Insulators and Superconductors (explanation and applications with suitable examples)	

1.2	**Compounds of *s*-block metals**: oxides, hydroxides, peroxides, superoxides of alkali metals-preparation and properties; anomalous behaviour of Li and Be, **p-block elements:** Boron hydrides - definition general formula, Diborane-preparation (Electric discharge and chemical reduction method), uses structure and bonding. **Carbon** - Fullerene (**C_{60}**) Properties, structural features,and applications, Silicon - Silicates-types and structure with one example for each type, Ultramarines,and Zeolites **Nitrogen**-preparation (any two methods), properties, uses and structures of hydrazine, hydroxylamine.	**5 hrs**
1.3	**Halogens:** Interhalogen compounds – Classification. Preparation, structures of - ClF_3, BrF_5 and lF_7. **Pseudo halogens** - Definition and type with examples of basic properties of halogens- positive iodine – evidence. **Bioinorganic chemistry** - Biological aspects of Fe, Zn, Mg, Co and Mo - Role of Na, K, Ca, and P - Biological functions and toxicity of some elements	**3hrs**
1.4	**Nano-technology:** Introduction to nanoscience, nano size, different types of nanomaterials(nanoparticles and 2-dimensional materials), properties of nanomaterialsand effect of reduction of dimension. Synthesis of nanomaterials. Top-down and bottom-up approach. Carbon nanotubes: preparation, properties, types,and uses. Application of nanomaterials: uses of nanoparticles of titanium (iv) oxide and silver nanoparticles	**3hrs**
Organic Chemistry-16 hours		
2.1	**Unit -2** **Carbonyl compounds:** Nomenclature, structure,and reactivity of carbonyl group, addition reaction with HCN, $NaHSO_3$, Condensation reactions with 2, 4-DNP, NH_2OH, KnoevenagelReaction with the mechanism, Aldol condensation, Perkin's reaction, Cannizzaro's reaction with the mechanism. Crossed Cannizzaro's reaction. Wolf-Kishner reduction, oppenauer oxidation reaction, Reformatsky reaction and benzoin condensation.	**5 hrs**
2.2	**Carboxylic acids:** Definition - Classification with examples, Synthesis by Arndt-Eistert reaction, Acidity of carboxylic acids - resonance structure of carboxylate ion and its stability, Effect of substituents on acidity (both aliphatic and aromatic carboxylic acids). Esterification and amide formation with the mechanism.	**5 hrs**
2.2.1	**Hydroxy acids:** Synthesis of lactic, citric and tartaric acid - one method each and their importance, the effect of heat on alpha, beta and gamma, - hydroxy acids.	

2.3	**Amines:** Separation of amines mixture by Hinsberg's method using toluene sulphonyl chloride. Distinction tests for 1^o, 2^o and 3^o amines [acylation & Hoffmann's exhaustive methylation]. The action of nitrous acid on different amines (both aliphatic and aromatic 1^o, 2^o and 3^o amines), Basicity of amines, Effect of substituents on the basicity of aliphatic and aromatic amines, Hoffmann-Martius rearrangement.	**6 hrs**
2.3.1	**Diazonium compounds:** Preparation with the mechanism and synthetic applications of benzene diazonium chloride (conversion to phenol, halobenzene, azobenzene, phenylhydrazine and coupling reaction).Reduction reactions of nitrobenzene in acid, neutral and alkaline medium.	
Physical Chemistry-16 hours		
3.1	**Unit-3** **Polymers:** Introduction, monomer, repeating units, types (linear, branches and network) with examples, degree of polymerization, classification (arrangement and shape) with examples, polymerization reaction (addition and condensation), molar masses of polymers – types (number average and mass average), determination of molar mass (viscosity and osmotic pressure method) (Numerical problems).	**5 hrs**
3.2	**Chemical Kinetics:** Review of chemical kinetics. (Definition of the rate of a reaction,order,molecularity, rate constant,rate equation or law, half-life)– differential and integrated rate equations for second-order kinetics, derivation of second-order rate equation when a=b and a≠b, unit of the rate constant, Methods of calculation of order of a reaction - i) integral and graphicalmethod, ii) Half-life period method ($t_{1/2}$ for an n^{th} order to be derived), isolation method.Experimental verification of second-order reactions – the study of the kinetics of saponification of an ester, Experimental methods of chemical kinetics: conductometric – example - saponification of esters. Potentiometric - example – kinetics of bromination of N,N-dimethyl aniline and spectrophotometric – example – the colourimetric study of the kinetics of oxidation of Indigocarmine by chloramine-T. **Application of kinetic studies:** Arriving at the mechanism of urea formation from ammonium cyanate.	**6 hrs**
3.3	**Distribution law:** Statement of Nernst distribution law – Explanation and verification of distribution law taking a distribution of I_2 between H_2O & CCl_4 - limitations of the Law, Conditions for the validity of distribution law, an association of the solute in one of the solvents, dissociation of solute in one of the solvents. Application of distribution law with respect to solvent extraction process (Numerical problems).	**5 hrs**

Reference Books

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1.	A Text book of Inorganic Chemistry	P.L.Soni	Sultan Chand &Sons

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18.	Physical Chemistry	S Bahl& Arun Bahl	S. Chand & Company
19.	A Text book of Physical Chemistry	P LSoni&Dhasmarah	S. Chand & Company
20.	Text book of Chemistry (Vol. I – VI)	K. K. Padmanabha	Chetana Book House, Mysore
21.	Colloidal Chemistry	D. K. Sharma	Goel Prakashan, Meerut
22.	Kinetics of Chemical reactions	S K Jain	Vishal Publications
23.	A text book of Chemical Kinetics	Laidier	New Age Publications

FOURTH SEMESTER

GENERAL CHEMISTRY PAPER –IV (DSC)

CLASS DURATION-03 HOURS PER WEEK 48 HOURS

Marks – Theory – 50 + Internal Assessment – 20 = 70

Course Outcome: In this module of chemistry paper IV, students will learn to,

- Justify and compare the chemical behavior of noble gases. To choose an ideal solvent for a specific reaction.
- Identify acids and bases based on various theories of acids and bases and to categorise soft acids and bases by understing HSAB concept.
- Explore field of nuclear chemistry and to apply the same in the field of Agriculture , Medicine, energy transformation etc.
- Identify different class of organic compounds such as active methylene compounds,organometallic compounds and to understand their reactions.Differentiate dyes, pigments based on their origin and application.
- Apply the concept of green chemistry as a substitute for the hazardous chemicals and to sysnthesize and to adapt ecofriendly methods for the chemical synthesis.
- Explore thermodynamic concepts like energetics of chemical reactions whether the reaction can proceed in the forward or backwards direction. To calculate physical properties of liquids and there by to choose possible structure for a given molecule.

Course Learning Outcome (CO):

CO No.	After the completion of this course the student will be able to	Cognitive level
CO-01	Explain chemistry of Noble gases and to comment on their reactivity.	Analyse
CO-02	Classify solvents based on their properties and to choose suitable solvent for a particular reaction.	Apply
CO-03	Interpret the characteristics of acids and bases based on different theories of acids and bases.	Understand
CO-04	To apply concept of nuclear chemistry in the field medicine, agriculture, energy transformation.	Apply
CO-05	Identify different organometallic compounds and apply their reactions to synthesize new compounds.	Apply
CO-06	Formulate mathematical expressions for workdone, efficiency of heat engine, entropy change, free energy etc. To solve problems based on different concepts of thermodynamics.	Apply

Inorganic Chemistry - 16 hours		
1.1	**Unit- 1** **Noble gases:** Their least reactivity and reasons for occurrence, Preparation, structure,and applications of compounds of fluorides of xenon (XeF_2, XeF_4, XeF_6, one method of preparation for each). Clathrates:explanation with suitable examples, essential conditions for the formation and uses	**2hrs**
1.2	**Non-aqueous solvents:** Solvents- Types of solvents with examples. Characteristics of good polar solvents Liquid ammonia -reasons for the solvent properties, typical reactions - solubility of alkali metals, acid-base, precipitation, ammonolysis, and ionisation of weak acids, advantages,and disadvantages. Liquid sulphur dioxide Reasons for the solvent properties, typical reactions - acid-base, solvolysis, precipitation, and amphoteric	**4 hrs**
1.3	**Acids and Bases, HSAB Concept:** Arrhenius and Lewis concept with e.g., the Lux – Flood, Solvent concept with an example, Usanowichconcept of acids and bases. The concept of Hard and Soft Acids & Bases. The relative strength of acids and bases	**3 hrs**
1.4	**Nuclear Chemistry:** Fundamental particles of nucleus-nucleons, isotopes, isobars and isotones, (definition with suitable examples), nuclear forces (brief explanation), nuclear stability-n/p ratio, mass defect, binding energy, magic numbers, the energy associated with amu. Problems on the calculation of B.E to be worked out Nuclear fission (definition with suitable examples), calculation of energy released in nuclear fission, nuclear fusion and its advantages over nuclear fission reactions, the hydrogen bomb. **Radioactivity:**Natural &artificial radioactivity, The rate of disintegration, decay constant, half-life period,nuclear transmutation reaction induced by alpha, neutron, gamma, proton and deuteron particles .	**7hrs**
1.5	**Detection and measurement of radioactivity:** G.M. counter, nuclear reactor, Important components of a reactor, breeder reactor, uses of radio isotopes-tracer technique, agriculture, medicine, food preservation and dating (explanation)	
Organic Chemistry-16 hours		
2.1	**Unit-2** **Active methylene compounds:** Definition, Preparation of ethyl acetoacetate (Claisen condensation), Keto-enol tautomerism in ethyl acetoacetate - its evidence. Synthetic applications (acid hydrolysis, ketonic hydrolysis - monocarboxylic acids, dicarboxylic acids-succinic acids, adipic acids-antipyrine, uracil, acetylacetone, crotonicacid and cinnamicacid**.**	**4 hrs**
2.2	**Organometallic compounds –**Definition with examples. Grignard's reagent-preparation of C_2H_5MgI and its synthetic applications [conversion to alkanes, 1 º, 2 º and 3 º alcohols, aldehydes, ketones,and acids] Organolithium compounds –preparation, properties [reaction with water, ethylene oxide, aldehydes, including HCHO, ketones, and CO_2]	**3hrs**

2.3	**Dyes:** Colour and constitution, chromophore-auxochrome theory, Classification of dyes based on applications with examples, Synthesis of malachite green and indigo, Structural elucidation of alizarin and its synthesis**.** **Natural pigments:** Structural formulae and their importance of anthocyanin, flavonesand carotenoids.	**4hrs**
2.4	**Green Chemistry**: Purpose, principles to be followed for green chemistry. Synthesis of acetamide, ibuprofen, benzoin, benzylic acid and para-Bromo acetanilide. **Ethers and Epoxides:** Nomenclature of ethers, one method of synthesis, chemical reaction-cleavage, and oxidation **Epoxides**: - one method of synthesis, acid, and base catalysed ring-opening reaction of epoxides Crown ethers: - Introduction with examples**.**	**5 hrs**
Physical Chemistry- 16 hours **Note: Sl Units to be used** **Problems to be worked out and diagrams to be drawn wherever necessary**		
3.1	**Unit -3 Thermodynamics:** **Concept of thermodynamic reversible and irreversible processes** - Thermodynamic reversible and irreversible processes - their definitions, differences with examples, state function - definition with examples, work and heat - definitions and explanation, interconversion of work and heat – Joule- mechanical equivalent, units of heat, new sign convention of heat and work, the expression for work done during the reversible isothermal expansion of an ideal gas.w = -2.303 nRT log (V_2/V_1) or w= -2.303 nRT log (P_1/P_2) (to be derived) expression for work done during reversible adiabatic expansion of an ideal gas (to be derived).Numerical problems to be worked out.	**4 hrs**
3.1.1	**The first law of thermodynamics**-statements, mathematical expression q = dE +w to be derived, enthalpy of a system (definition, H=E+PV), heat capacity - heat capacity of gases - types, heat capacity at constant pressure Cp & heat capacity at constant volume Cv and their definitions, the relation between Cp and Cv (derivation using thermodynamic concept), Cp/Cv ratio and molecular complexity.	
3.2	**The second law of thermodynamics*:*** Limitations of the first law of thermodynamics - Need for II law of thermodynamics, spontaneous, non-spontaneous and equilibrium processes (definitions and examples for each), different methods of stating II law, heat engine (explanation with example), Carnot cycle - definition - efficiency of Carnot cycle (derivation), the concept of entropy - definition and physical significances of entropy - criteria of spontaneity in terms of entropy change, statements of II law in terms of entropy (numerical problems to be worked out on entropy calculations and efficiency of Carnot engine).	**4 hrs**

3.3	**Free energy:** Helmholtz and Gibb's free energy - their definitions and their relationship, Gibb's-Helmholtz equation at constant pressure and volume (derivations), thermodynamic criteria of equilibrium and spontaneity, a variation of free energy with temperature and pressure, Clausius-Clapeyron equation (differential form to be derived). The integrated form of Clausius-Clappeyron equation (to be assumed) and its applications - (enthalpy of vapourisation, boiling point and freezing point at different temperatures, numerical problems on these applications).	**4 hrs**
3.4.1	**Physical properties and chemical constitution:** Additive and constitutive properties, properties of liquids-viscosity, the definition of the coefficient of viscosity, factors affecting viscosity-temperature, size, weight, the shape of molecules, intermolecular forces, determination of viscosity of liquids by Ostwald's method.	**4hrs**
3.4.2	**Surface tension:** Definition, the effect of temperature on surface tension, the effect of solute on surface tension, determination of surface tension of liquids using stalagmometer.	
3.4.3	**Parachor:** Definition - Sugden equation, calculation of parachor and its application with respect to the structural elucidation of benzene and quinone - numerical problems based on surface tension and viscosity &parachor applications.	
3.4.4	**Refractive index:** Definition, Specific refractivity and molar refractivity and its application in determining the structure of compounds. **Polarisation**: - Induced orientation and molar polarisation –Definitions, Clausius-Mosotti equation (no derivation) and its applications.	

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1.	A Text book of Inorganic Chemistry	P.L.Soni	Sultan Chand &Sons
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6.	A Text book of Inorganic Chemistry	Sathya Prakash	S. Chand & Company
7.	Elements of Nuclear Chemistry	R Gopalan	Vikas Publishing House
8.	Essentials of Nuclear Chemistry	H JArnikar	New Age Publications

9.	A text book of Organic Chemistry	M.K.Jain	S. Chand & Company
10.	A text book of Organic Chemistry	Bahl&Bahl	S. Chand & Company
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13.	Organic Chemistry	Puri& Sharma	Shobhanlal&NaganCo.
14.	Chemistry of Natural Products	Agarwal	Goel Publishing House
15.	Physical Chemistry	M.Kundan&S.K.Jain	S. Chand & Company
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22.	A Text book of Physical Chemistry	P LSoni&Dhasmarah	S. Chand & Company
23.	Text book of Chemistry (Vol. I – VI)	K. K. Padmanabha	Chetana Book House, Mysore
24.	Text book of Thermodynamics	Glasstone	ELBS

FIFTH SEMESTER
CHEMISTRY PAPER –V (DSC)
INORGANIC CHEMISTRY
CLASS DURATION-02 HOURS PER WEEK 32 HOURS
Marks – Theory – 50 + Internal Assessment -20 = 70

Course Objectives:

1. To explain the typical physical and chemical properties of the transition metals, inner transition metals and to understand the trends in properties.
2. To Explain and the nomenclature, classification, properties of coordination compounds.
3. To Recognize the bonding in coordination compounds by VBT and CFT theories.
4. To identify different types of isomers.
5. Calculate the magnetic moment of various ions.
6. To explain the principle, the experimental setup and applications of TGA and elctro gravimetry.

Course Learning Outcome (CO)

CO No.	After the completion of this course the student will be able to	Cognitive level
CO-01	Distinguish between transition and non transition elements as well as magnetic and nonmagnetic complexes	Analyse
CO-02	Explain the principle and process of gravimetric analysis.	Understanding
CO-03	Define the coordination number, coordination sphere, ligand, types of ligands	Remember
CO-04	Apply IUPAC names to the complexes.	Apply
CO-05	Discuss the VBT and CFT various theories of coordination complexes. predict the geometry of coordination compounds and type of hybridization and magnetic prosperities	Create
CO-06	Compare the stability of complexes.	Evaluate
CO-07	To create an experimental setup for electrogravimetry exptand interpret the analytical information from TGA curves.	Evaluate
CO-08	Students will be skilled in problem solving (magnetic moment), critical thinking and analytical reasoning .	Analyse

	Unit 1	**6 hrs**
1.1	**d- Block elements:** Position in the periodic table, electronic configuration, general characteristics, ionisation energy, variable oxidation states, spectral properties, colour and magnetic properties, catalytic activity, complex formation and interstitial compound formation	
1.2	**f-Block elements:** Position and electronic configuration in the periodic table, general characteristics, oxidation states, spectral properties, magnetic properties, complex formation and, lanthanide contraction-cause and its consequences, General survey of actinides-comparison with lanthanides, transuranic elements	
1.3	**Ion exchange:** Introduction, the action of ion-exchange resins- cation exchange resins/anion exchange resins, Separation lanthanides by ion exchange method	

2.1	**Unit 2** **Gravimetry:** precipitation methods (various steps involved to be discussed), advantages of gravimetric analysis), super-saturation and precipitate formation (mechanism of precipitation - supersaturation, nucleation and crystal growth), purity of the precipitates, co-precipitation and post-precipitation, conditions of precipitations (mention the conditions), washing and ignition of the precipitate (general discussions only).	**6 hrs**
2.2	**Organic reagents in the inorganic analysis:** Advantages of organic precipitants over inorganic precipitants. DMG,8-hydroxyquinoline (oxine), Structure of Ni^{2+}-DMG and Mg^{2+}-oxine complexes.	
2.3	**Specific and selective precipitants** - DMG, cupferron, salicylaldehyde, ethylenediamine - use of sequestering agents. The principle involved in thermogravimetric analysis, Applications of thermogravimetry - Electrogravimetry - principle and applications	
3.1	**Unit-3** **Basic concepts of Co-ordination Chemistry:** Definition of the terms- ligands, coordination number, co-ordination sphere, classification of ligands, chelation, nomenclature of co-ordination compounds, stability of complex ions-stability constant, factors affecting the stability of a complexion, Irving-Williams series. polynuclear or bridged complexes, isomerism in coordination compounds – (a) stereoisomerism - geometrical and optical isomerism exhibited by coordination compounds of coordination number 4 and 6. (b) Structural isomerism - ionisation isomerism, hydrate isomerism, co-ordination isomerism, linkage isomerism.Role of Fe in hemoglobin and myoglobin, the role of Mg in chlorophyll and Cobalt in Vit-B_{12}.Applications of complexes in metallurgy, qualitative and quantitative analysis.	**8 hrs**
3.2	**Valence Bond Theory (VBT):** Salient features of V. B. T, Outer and inner orbital octahedral complexes, Formation of octahedral complexes on the basis of VBT, $[Cr(NH_3)_6]^{3+}$ $[Fe(CN)_6]^{3-}$, $[Co(CN)_6]^{3-}$, $[CoF_6]^{3-+}$ Formation of tetrahedral and square planar complexes on the basis of VBT-$[Ni(CN)_4]^{2-}$, and $[Ni(CO)_4]$, Limitations of VBT.	**4 hrs**
3.3	**Crystal Field Theory (CFT):** Important features of crystal field theory, crystal field splitting of d-orbitals in tetrahedral and octahedral complexes, crystal field stabilisation energy (CFSE),calculation of CFSE - (d^1 to d^{10}), factors affecting the magnitude of Δo - (nature of the ligand, oxidation state of the metal ion, size of the orbitals, geometry of the complex), spectrochemical series , high spin (HS) and low spin (LS) complexes, magnetic properties of metal complexes based on crystal field theory; $[Co(NH_3)_6]^{3+}$ and, $[CoF_6]^3$	**4 hrs**

3.4	**Electronic Spectra of Transition Metal Complexes:** Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$complex ion.	**4 hrs**

FIFTH SEMESTER

CHEMISTRY PAPER –VI (DSC)
ORGANIC CHEMISTRY
CLASS DURATION-02 HOURS PER WEEK32 HOURS

Marks – Theory – 50 + Internal Assessment – 10 = 60

COURSE OBJECTIVES:

- To provide deep knowledge of stereochemistry of organic molecules and understandthe terms like optical activity, a tetrahedral carbon atom, the concept of chirality, enantiomerism.
- To classify drugs and to understand general properties and functions. To synthesis few common drugs
- To describe methods of isolation, purification and structural elucidation of natural products like alkaloids, terpenoids.
- To appreciate the use of polymers in our day to day life and to learn about synthetic polymers such as rubber fibres and plastic.

Course Learning Outcome (CO):

CO No.	After the completion of this course the student will be able to	Cognitive Level
CO-01	Identify and classify stereo isomers and to apply the knowledge of stereochemistry in organic synthesis.	Understand
CO-02	Apply reactions of heterocyclic compounds in the systhesis of new compounds.	Apply
CO-03	Create awareness of the contribution that medicinal chemistry makes towards maintaining the health and well being of humanity.	Create
CO-04	Appreciate the use of polymers in our day to day life and to learn about synthetic polymers such as rubber fibres and plastic.	Understand

1.1	**Unit-1** **Stereochemistry:** Introduction - definition, elements of symmetry (plane, centre, simple axes and alternative axes), asymmetry and dissymmetry, chiral carbon atom. Determination of configuration by R-S notation. Optical activity- cause of optical activity (non-superimpossability), enantiomers, diastereomers, Optical isomerism in tartaric acid and biphenyls, Racemisation, resolution, methods of resolution (Biochemical and chemical methods), Walden inversion, Asymmetric synthesis (partial and absolute).	**7 hrs**
1.2	**Geometrical isomerism:** Definition withexamples, Designation of cis-trans E-Z notations with examples, Geometrical isomerism of oximes (aldoximes & ketoximes), Beckmann rearrangement	
1.3	**The conformation of ethane:** Staggered, eclipsed & skew conformations. Newmann projection formula. Stability of different conformations, the plot of the potential energy of ethane molecule as a function of rotation about the C-C bond	
2.1	**Unit-2** **Heterocyclic compounds:** Definition, Classification with examples, synthesis of furan, thiophene, pyrrole, pyridine, Indole (Fischer method), quinoline (Skraup's synthesis), isoquinoline, pyrimidine (one method each). Aromaticity and basicity of pyrrole and pyridine. Electrophilic and nucleophilic substitution reactions of pyrrole and pyridine	
2.2	**Uric acid**: Synthesis by Fischer's method, conversion of uric acid to purine and caffeine,Synthesis of guanine and theobromine**.**	
2.3	**Alkaloids:** Definition, classification based on heterocyclic rings - isolation, Synthesis and structural elucidation of nicotine and Coniine. Structural formulae of quinine, atropine, piperine, cocaine and morphine and their physiological importance**.**	**7hrs**
3.1	**Unit 3** **Vitamins:** Definition, Classification, structural elucidation and synthesis of vitamin-A, synthesis of vitamin-C, structural formulae of vitamins B_1, B_2, B_6, calciferol, E, K- and their importance	**8 hrs**
3.2	**Hormones:** Definition, classification, synthesis of adrenaline, Structural formulae of thyroxine, estradiol, progesterone, and testosterone - and their importance.	
3.3	**Terpenes:** Definition, Isoprene rule, Classification, isolation (solvent extraction, steam distillation), structural elucidation of citral, limonene and its synthesis, Structural formulae of □-terpineol, camphor, and menthol.	

3.4	**Drugs:** Introduction, classification based on action, chemotherapy and chemotherapeutic agents, Definition of drugs, types of drugs: antipyretics, analgesics, anaesthetics, sedatives, Narcotics, antiseptics, antibacterials, antibiotics, antimalarials, sulpha drugs with examples, Synthesis of paracetamol, sulphanilamide, sulphaguanidine, and aspirin.	
4.1	**Unit 4** **Polymers:** Definition, Polymerization, types **Synthetic rubbers:** synthesis of butyl rubber, Neoprene, Buna-S. **Synthetic fibers:** partial structural formulae of Nylon 66, saran, orlon&vinyon. **Synthetic plastics:** thermoplastics and thermosetting resins with examples, synthesis of polystyrene, urea-formaldehyde, polyurethane, phenol-formaldehyde resins	**4hrs**
5.1	**Unit-5** **Spectroscopy: UV-Spectroscopy:** Types of electronic transitions, the effect of conjugation, the concept of chromophore and auxochrome, bathochromic, hypsochromic and hyperchromic shifts.Woodward-Hoffmann's rule and applications acyclic dienes, homo and hetero annular dienes with alkyl substituents taking as an example.	**6 hrs**
5.2	**IR-Spectroscopy:** Introduction, intensity, and position of IR bands, characteristic absorptions of functional groups in simple organic compounds (ketones, esters, amides, phenols, alcohols, and amines	

FIFTH SEMESTER

CHEMISTRY PAPER –VII (DSC)

PHYSICAL CHEMISTRY

CLASS DURATION-02 HOURS PER WEEK 32 HOURS

Marks – Theory – 50 + Internal Assessment – 20 = 70

COURSE OBJECTIVES:

- To explain the laws of Photochemistry, the differentiate thermal reactions and photochemical reactions,to measure quantum yield.
- To apply knowledge of molecular spectroscopy to analyse and to identifymolecules. To use the selection rules to predict the number of IR active bands in IR spectroscopy .
- To explore the classical origins of molecular interactions and to understandthe dynamics of linear, vibrational and rotational molecular motion, using concepts of force, energy and momentum.

- To interprete molecular spectra and determine spectroscopic constants and characteristics of molecules.

Course Learning Outcome (CO)

CO No.	After the completion of this course the student will be able to,	Cognitive Level
CO-01	Apply laws of photochemistry in chemical analysis, to distinguish thermal and photochemical reactions	Apply
CO-02	Analyse and to identify structure , bonding using IR spectroscopic technique.	Analyse
CO-03	Explore the classical origins of molecular interactions .	Apply
CO-04	Interprete molecular spectra and to determine spectroscopic constants, characteristics of molecules.	Evaluate

Note: Sl Units to be used Problems to be worked out and diagrams to be drawn wherever necessary		
1.1 **1.2**	**Unit-1** **Crystallography:** Elements of symmetry-plane, axis and centre, elements of symmetry in cubic crystals, law of rational indices-Weiss and Miller indices, lattice planes in cubic crystals, crystal lattice and unit cell, types of lattice-Bravais lattices, X-ray diffraction and Bragg's law (to be derived), determination of crystal structure of rock salt by rotating crystal method using Bragg's spectrometer, application of X-ray studies-distance between lattice planes, densityof crystals, determination of Avogadro number (Numerical problems on applications). **Liquid crystals**- definition, classification of thermotropic liquid crystals into smectic and nematic with examples, molecular arrangement of these and their uses.	**10 hrs**
2.1	**Unit-2** **Spectrophotometry and Photochemistry:** Lambert-Beer's law - statement and mathematical form (to be derived) molar extinction coefficient - definition- spectrophotometer construction and working and its application, Laws of the photochemistry-Grotthus-Draper law of photochemical activation and Einstein's law of photochemical equivalence. Quantum efficiency, reasons for low quantum yield (taking HBr decomposition as an example) and high quantum yield (HCl formation as an example), actinometry-uranyl oxalate actinometer.	**8 hrs**

2.2 **2.2.1**	**Photophysical processes:** Consequences of the light absorption-Jablonski diagram, Photosensitization (eg.photosynthesis in plants), photo-inhibition, fluorescence, phosphorescence, chemiluminescence, and bioluminescence with examples. Determination of absorbed intensity-schematic diagram of the apparatus used. Detectors- thermopile, photoelectric cell & actinometer (Uranyl oxalate). **Radiation Chemistry:** Definition, primary and secondary stages in radiochemical reactions, ionic yield, energy yield, comparison with photochemistry, units of radiation-rad, gray and roentgen, Dosimeter-Fricke-dosimeter. Theories of radiolysis-Linds and EHT theories.	
3.1	**Unit-3** **Molecular Spectroscopy:** Regions of spectra, types of spectra, microwave spectra-rotational spectra of diatomic molecules, moment of inertia (expression to be derived) expression for rotational energy, selection rule and transition, calculation of bond length, IR-Spectra-vibrational spectra of diatomic molecules-force constant (no derivation) expression for vibrational energy, zero point energy, selection rules and transitions. Vibrational modes of polyatomic molecules taking H_2O and CO_2 molecules as examples. Applications of IR spectroscopy. (Mention).	**8 hrs**
4.1	**Unit - 4** **Phase Equilibria:** Phase rule-statement, Gibb's phase rule-definition of the terms with examples, application to one component systems (water system), reduced phase rule-statement, reduced systems, two component system-simple eutectic type KI-water system, freezing mixtures, Pb-Ag system, (desilverisation of argentiferous lead)	**6 hrs**

Reference Books

Sl No	Title of the Book	Author	Publisher
1.	A Text book of Inorganic Chemistry	P.L.Soni	Sultan Chand &Sons
2.	A Text book of Inorganic Chemistry	B.R.Puri&L.Sharma	Shobhanlal Nagin Chand Co
3.	Principles of Inorganic Chemistry	Puri, Sharma, & Kalia	Shobhanlal Nagin Chand Co
4.	Inorganic chemistry	James E Heey	Pearson Education
5.	A Text book of Inorganic Chemistry	GurudeepRaj	Goel Prakashan
6.	A Text book of Inorganic Chemistry	Sathya Prakash	S. Chand & Company
7.	Fundamentals of Inorg. Chemistry Vol 4	A K Das & Mahua Das	CBS Publishers.

8.	Coordination chemistry	D Banerjee	Asian Books Private limited
9.	A Textbook Quantitative analysis	A.I.Vogel	ELBS
10.	Organometallic chemistry	R C Mehrotra	new age international publications
11.	A text book of Organic Chemistry	M.K.Jain	S. Chand & Company
12.	A text book of Organic Chemistry	Bahl&Bahl	S. Chand & Company
13.	A text book of Organic Chemistry	P.L.Soni	S. Chand & Company
14.	Organic Chemistry	K.K. Sharma	Shobhanlal&NaganCo.
15.	Organic Chemistry	Puri& Sharma	Shobhanlal&NaganCo.
16.	Chemistry of Natural Products	Agarwal	Goel Publishing House
17.	Heterocyclic Chemistry	Raj K Bansal	New Age Publication
18.	Organic Chemistry Vol.I&II	I.L.Finar	ELBS
19.	Organic Spectroscopy	Willliam Kemp	
20.	Spectroscopy	Pavia, Lampman, Kriz& Vyvyan	Cengage Learning
21.	Stereo Chemistry	Eliel	John Weily Eastern Publications
22.	Physical Chemistry	M.Kundan&S.K.Jain	S. Chand & Company
23.	Text book of Physical Chemistry	K.K.Sharma&C.K.Sharma	Vani Educational Books
24.	Physical Chemistry	.Madan& Tuli	S. Chand & Company
25.	Text book of Adv. Physical Chemistry	GurudeepRaj	Goel Prakashan. Meerut
26.	Engineering Chemistry	Jain & Jain	Dhanpal&Sons ,New Delhi
27.	Text book of Physical Chemistry	B.D.Khosla	R.Chand& Publications
28.	Physical Chemistry	S Bahl& Arun Bahl	S. Chand & Company
29.	A Text book of Physical Chemistry	PLSoni&Dhasmarah	S. Chand & Company
30.	Text book of Chemistry (Vol. I – VI)	K. K. Padmanabha	Chetana Book House, Mysore
31.	Fundamentals of Molecular Spectroscopy	Colin .N.Banwell&Elleine.M. Meeash	Himalaya Publishing House
32.	Text book of Photochemistry	W. Bansal	S. Chand & Company

SIXTH SEMESTER

CHEMISTRY PAPER –VIII (DSC)

INDUSTRIAL INORGANIC CHEMISTRY

CLASS DURATION-02 HOURS PER WEEK 32HOURS
Marks – Theory – 50 + Internal Assessment – 20 = 70

Course Objectives

- To understand the compostion , synthesis and uses of inorganic polymers like Freon,Teflon, silicones, phosphzenes. Recognize natural and man-made polymers.
- Appreciate the significance of commercial polymers.
- Summarizes calorific value of fuel gases, composition and manufacturing of fuel gases.
- To explain the manufacture of paints and pigments
- To explain the term mineral ore concentration, roasting etc., To understand the thermodynamic concepts of metallurgy. To explain why specific reducing agents are used for the reduction purposes.
- . . To understand the nature of bonding of different metals with carbon atom. M-C bond
- .To understand the applications of organometallic compounds in the homogenouscatalysis and industrial applications such as Wilkinson catalyst and Ziegler Natta catalyst.
- .To explain the term mineral ore concentration, roasting etc.

Course Learning Outcome (CO)

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	Identify natural and synthetic polymers, and uses of different inorganic polymers in making of tyres, toys, plastics bags	Apply
CO-02	Compare the calorific value of the various fuel gases and evaluate the calorific value of fuel gases	Analyse
CO-03	Develop the skills to count total of electrons in organometallic compounds	Apply
CO-04	To learn about the applications of organometallic chemistry, including catalytic reactions for organic synthesis and polymerization	Understand
CO-05	The knowledge of thermodynamic concepts of metallurgy, uses of few inorganic polymers and their preparation is acquired by the students.	Remember

CO-06	Gain knowledge and skills to work in polymer industries, paint industry and metallurgical industry	Create
CO-07	To reason out why specific reducing agents are used for the reduction purposes.	Evaluate

1.1	**Unit-1** **Inorganic polymers**Definition, examples, differences between inorganic and organic polymers, glass transition temperature (Tg). Factors affecting the Tg	**8 hrs**
1.2	**Fluorocarbons:** Definition- examples - Preparation, properties, and uses of Freon 12, Freon 22, PTFE	
1.3	**Phosphorous based polymers:**Phosphazenes - Definition - types and structures, applications	
1.4	**Boron-based polymers:** Borazine preparation, prop and uses & structure	
1.5	**Silicones:** Classification (based on physical state and structure) - preparation, properties, and uses of silicones, silicone rubbers, silicone fluids and silicone	
2.1	**Unit -2** **Gaseous fuels:** Definition of fuels, Characteristics, calorific value and advantages, compressed natural gas (CNG), water gas, producer gas and LPG- their production, composition,and applications	**6 hrs**
2.2	**Propellants:** Definition, Characteristics, classification and application	
2.3	**Abrasives:** Definition,characteristics Classification with examples - hardness, Manufacture and applications of carborundum, and tungsten Carbide.	
2.4	**Refractories:** Definition, properties, classification with examples and applications	
2.5	**Paints:** Constituents and their functions, manufacture of lithopone	
3.1	**Unit-3** **Metallurgy:** Types of metallurgy: **Pyrometallurgy:** Extraction of Nickel from sulphide ore- general metallurgy followed by Mond's process (purification), Manganese from oxide ores - reduction by the alumino-thermite process - refining by an electrolytic process	**10 hrs**
3.2	**Hydrometallurgy:** Extraction of gold from native ore by cyanide process and refining by quartation process.	

3.3	**Electrometallurgy:** extraction of lithium by fusion method followed by electrolysis of lithium chloride	
3.4	**Extraction of rare metals:** (1) Thorium from monazite sand - purification by iodine method, (2) Uranium from pitchblende - production of U_3O_8 by carbonate method, U_3O_8 to UO_2 by hydrogen reduction, UO_2 to U by fluoride method	
3.5	**Powder metallurgy:** Importance, metal powder production and application, production of tungsten powder	
4.1	**Unit -4** **Organometallic Compounds and Catalysis** Definition, classification based on natureofmetal-carbon bond:Ionic organometallics,sigma bonded covalent organometallics,pi bonded organometallic compounds and bridged – bonded organometallic compounds, classification based on hepticity	**8 hrs**
4.2	**16 and18 electron rule and counting of electrons in complexes** Nomenclature of organometallic compounds, Structure and bonding of metal olefin Transition metal alkyls, carbenes, and carbynes, and metallocenes. Wilkinson's catalyst and alkene hydrogenation, Ziegler-Natta catalyst and polymerization of olefins	

SIXTH SEMESTER

CHEMISTRY PAPER –IX (DSC)

BIO-ORGANIC CHEMISTRY

CLASS DURATION-02 HOURS PER WEEK 32 HOURS

Marks – Theory – 50 + Internal Assessment – 20 = 70

Course Objectives:

- To provide an introduction to theory and applications of pericyclic reactions.
- To enable the student to develop a sound knowledge of fundamental concepts in biochemistry and its relevance to agricultural chemistry
- To acquire deep knowledge of reaction mechanisms of selective functional groups along with theory .
- To promote the understanding of biomolecules which play a significant role in our daily life – such as carbohydrates classification, properties and structure.
- To understand principles of different spectroscopic techniques like NMR, Mass and UV and IR of some simple molecules and identify the parent ion through the study of mass spectra.

- To imbibe and apply the principles of chromatographic techniques such as column, gas and HPLC as a tool for the separation of different components present in a mixture.

Course Learning Outcome (CO)

CO	After the completion of this course the student will be able to,	Cognitive Level
CO-01	Understand the reaction mechanism of reactions of some selective functional groups, to understand and relate interatcion of light with the matter through photochemical reactions.	Understand
CO-02	Classify and illustrate structures of cahrbohydrates , to understand the chemistry of carbohydrates and their applications as biomolecules.	Apply
CO-03	Categorize organic compounds as Insecticide, fungicides and herbicides and to show their applications in the field of agriculture.	Analyse
CO-04	Apply spectroscopic principles to interprete the structure of the molecules and to predict the functional groups present in organic molecules	Apply
CO-05	Apply principle of chromatographic techniques such as paper, gas HPLC ,TLC to separate and identify various componets present in a mixture .	Apply

1.1	**Unit-1** **Photochemistry:** Introduction, Jablonski diagram, sensitizers, quenchers, sensitized and the non-sensitised reaction of 1,3-butadienes. Photochemical reaction and mechanism of carbonyl compounds Norrish type-I (one example) Norrish type-II (one example). Photochemistry of olefins, Barton reaction. Paterno Buchi reaction, photo-reduction of benzophenone.	**8 hrs**
1.2	**Pericyclic reaction:** Introduction, types of pericyclic reactions. Symmetry in linear conjugate π systems. Frontier molecular orbitals- symmetry properties of HOMO and LUMO. Electrocyclic reactions – conrotatory &disrotatory motions in ring-opening & ring-closing reactions. FMO method – cyclisation of the 4nπ system (conversion of 1,3-butadiene to cyclobutene)-thermal and photoinduced cyclisation. Electrocyclic ring-opening in the 4nπ system (conversion of cyclobutene to butadiene (thermal & photochemical) Cycloaddition reactions: introduction, [2+2] cycloaddition reactions (thermal and photochemical)	

2.1	**Unit-2** **Carbohydrates:** Definitions, Importance, Classification based on composition with examples (including the definition) - reducing & non-reducing sugars. **Monosaccharides:** Reactions of glucose and fructose (with NH_2OH, HCN, $C_6H_5NHNH_2$, Br_2-water, conc. HNO_3, complete reduction with HI/Red P, CH_3OH/dry HCl), acetic anhydride and reduction reactions	**8 hrs**
2.1	**Structural elucidation of glucose** - Open chain structure, configuration (no elucidation - assume). Drawbacks of open chain structure (including mutarotation). Ring structure - Fischer and Haworth's structure. Definition and mechanism of mutarotation, Determination of ring size by methylation method. **Structural elucidation of fructose** - Open chain structure, configuration (no elucidation - assume). Ring structure- Fischer and Haworth's structure- both pyranose form and furanose form. **Conversion reactions:** Ascending (Killiani's synthesis), descending (Wohl's degradation), aldose to ketose and ketose to aldose, Epimerisation. **Disaccharides:** Structural elucidation of sucrose, Structural formulae of maltose and lactose (Haworth's structure). **Polysaccharides:** Partial structural formulae of starch, cellulose and their uses**.**	
3.1	**Unit-3** **Insecticides, Fungicides, and Herbicides**: Definition, Classification, synthetic organic insecticides and fungicides, structural formulae and their importance of aldrin, BHC, Lindane, Malathion, **Herbicides:** Definition, structural formulae and their importance of Diuren, 2,4-D [2,4- dichlorophenoxy acetic acid] and their importance. **Wood protectants:** Definition, the importance of creosote oil, pentachlorophenols	**6 hrs**
3.2	**Aromaticity of non-benzenoids:**Huckel's rule for aromaticity, the aromaticity of 3 membered, 5 membered and 7 membered carbocyclic compounds. Aromatic, anti-aromatic and non-aromatic compounds. Annulenes:-Defenition, [10]-, [12]-, [14]-, [18]-annulenes**.**	
4.1	**Unit-4** **NMR-spectroscopy:** Introduction- Nuclear shielding and deshielding, chemical shift, (□-scale), spin-spin coupling, coupling constant. Areas of signals, interpretation of PMR spectra of simple organic molecules like ethyl alcohol, ethyl bromide, acetaldehyde and toluene.	**7 hrs**
4.2	**Mass spectroscopy:-**Basic principles, molecular ion/ parent ion, fragmentations/daughter ion. Theory-formation of parent ion. Representation of mass spectrum. Identification of parent ion, (M + 1), (M + 2), metastable ion, base peaks (relative abundance 100%) and nitrogen rule, Fragmentation of simple organic compounds: - Alcohols (1^0, 2^0, 3^0), carbonyl compounds, toluene	

5.1	**Unit-5** **Chromatography:** Paper: introduction to ascending, descending and circular, R_f value and it's applications	**3hrs**
5.2	**TLC:** Introduction and applications	
5.3	**Column Chromatography:** Introduction, principle and applications	
5.4	**Gas Chromatography:** Introduction, apparatus, programmed temperature gas chromatography	
5.5	**HPLC:** Introduction, a schematic diagram of instrumentation and application.	

SIXTH SEMESTER

CHEMISTRY PAPER –X (DSC)

ELECTROCHEMISTRY AND ITS APPLICATIONS

CLASS DURATION-02 HOURS PER WEEK 32 hours

Marks – Theory – 50 + Internal Assessment – 10 = 70

COURSE OBJECTIVES

- To introduce the concepts essential to the understanding of electrode reactions and to illustrate some applications of electrochemistry.
- To understand some of the fundamental concepts of electrochemistry.
- To Use electrochemical data ina redox system
- To interprete the practical importance of electrochemistry for solving challenges such as those faced in modern power sources
- To introduce the fundamental aspects of fuel cells and to understand the electrochemical energy conversions.
- To understand the concepts of ionic equilibria and to appreciate the role of these concepts in biological processes.
- To understand the interconversion of chemical and electrical energy and to link thermodynamics with electrochemistry.

COURSE LEARNING OUTCOME (CO):

CO No.	After the completion of this course the student will be able to	Cognitive level
CO-01	Define terms involved, to determine conductance , equivalent conductance and transport number.	Analyse
CO-02	Measure conductance of various electrolytic solutions, solve numerical problems based on conductance, describe conductometric titration with suitable exaples.	Evaluate

CO-03	Apply the concept of electrochemical cells as tool for energy transformation. Support the idea of fuel cell as alternative source of energy, solve numerical problems.	Apply
CO-04	Classify different types of electolytes, acquire deep knowledge of principle behind the potentiometric titrations.	Analyse

Sl Units to be used Problems to be worked out and diagrams to be drawn wherever necessary		
1.1	**Unit-1** **Electrochemistry-I:** Introduction, conductance - specific conductance, equivalent conductance and molar conductance, their definitions & SI units, a variation of specific and equivalent conductance with dilution, Conductance cell and cell constant. Determination of equivalent conductance by the meter-bridge method, ionic mobility, ionic conductance, Kohlrausch's law and its significance - determination of equivalent conductance at infinite dilution for a weak electrolyte.	**8hrs**
1.2	**Transport number** –Definition & explanation of transport number, anomalous transport number - explanation with examples - the relationship between ionic conductance and transport number (to be derived), determination of transport number by moving boundary method - transport number of H^+ using $CdCl_2$ as supporting electrolyte. (Numerical problems on equivalent conductance, transport numbers,and Kohlrausch's law**.)**	
2.1	**Unit-2** **Electrochemistry-II:** **Application of conductance measurements** -(a) Solubility and solubility product of sparingly soluble salt, (b) ionic product of water, (c) degree of ionization of weak electrolyte. Numerical problems, for the applications of a, b & c to be worked out. **Conductometric titrations** - Strong acid Vs strong base, weak acid Vs strong base, strong acid Vs weak base with suitable examples for each.	**6 hrs**
3.1	**Unit-3** **Electromotive force-I:** Electrolytic and electrochemical cells, electrode reaction of Daniel cell, single electrode potential, a sign of electrode potential-convention (reduction potential to be adopted), Convention of representing a cell, EMF and standard EMF of a cell, cell reaction, reversible and irreversible cells, Nernst equation (to be derived) and calculation of electrode potential, standard hydrogen gas electrode, reference electrodes-calomel and Ag-AgCl electrode-construction and working, electrochemical series and its significance, equilibrium constant and free energy of cell reaction, the spontaneity of a cell reaction, concentration cells.	

3.2	**EMF of concentration cells** - Definition with an explanation - with transference and without transference concentration cells - with examples. Liquid junction potential and a salt bridge. Numerical problems on Nernst equation & EMF calculation. **Fuel cells** - working of H_2-O_2 fuel cell and its importance.	**6 hrs**
4.1	**Unit-4** **Electromotive force-II:** **Application of EMF measurements:** (a) Determination of pH of a solution using quinhydrone electrode and glass electrode (using dip type Calomel electrode) - Explanation with Principle & procedure. (b) Potentiometric titration-principle, location of endpoints in- 1). Neutralization reactions,[NaOH Vs HCl].(2) Oxidation-reduction reactions, [$K_2Cr_2O_7$ Vs FAS].(3) Precipitation reaction [KCl Vs Ag NO_3] and (4) Complexation reactions- (Zn SO_4 Vs K_4 [Fe $(CN)_6$])	**6hrs**
4.2	**Polarisation:** Decomposition potential, over-voltage, determination of H_2-over-voltage, factors affecting over-voltage, importance.	
5.1	**Unit 5** **Ionic equilibria:** Ionic equilibria in aqueous solutions, strong and weak electrolytes – definition and examples. Ostwald's dilution law (to be derived) and its limitations (numerical problems). Activity and activity coefficients – definition and their relation. Mean ionic activity coefficients – ionic strength – determination and its calculation. Debye-Huckel theory of strong electrolytes (relaxation time effect, electrophoretic effect,and viscous effect). Debye-Huckel-Onsagar equation (no derivation), Debye-Huckel Limiting equation for activity coefficients (no derivation). Solvent system concept of acids and bases. Role of solvents in altering the strengths of acids and bases. Hydrolysis of salts – derivation of hydrolysis constant and degree of hydrolysis of the salt of a weak acid and weak base (ammonium acetate), the effect of temperature on the degree of hydrolysis.	**6hrs**

Reference Books

Sl No	Title of the Book	Author	Publisher
1.	Inorganic chemistry	James E Heey	Pearson Education
2.	Organometallic chemistry	R C Mehrotra	new age international publications
3.	Comprehensive Industrial chemistry	Dr. Prakash G. More	Pragathi edition

4.	Inorganic Polymers	C.R. Chatwal	Himalaya Publishing House
5.	Industrial Chemistry	B.K.Sharma	Goel Prakashan
6.	Engineering Chemistry	Jain & Jain	Dhanpal&Sons ,New Delhi
7.	Engineering Chemistry	Jayaprakash & Venugopal	
8.	Handbook of Industrial Chemistry	Riegel's James.A.Kent	B.S.Publishers& Distributors
9.	Instrumental methods of Chemical analysis	B.K.Sharma	Goel Publishing House
10.	Elements of Nuclear Chemistry	R.Gopalan	Vikas Publishing House
11.	Fundamentals of Inorg. Chemistry Vol 4	A K Das & Mahua Das	CBS Publishers.
12.	Coordination chemistry	D Banerjee	Asian Books Private limited
13.	Industrial Chemistry	B.N. Chakrabarty	Oxford &IBH Publishers
14.	Introduction to nanoScience& nanotechnology	Chattopadhyay	PHI
15.	Nanotechnology Fundamentals & applications	Manasi Karkare	IKI NTPC
16.	Nanotechnology	Richard Brooker	EARL BoysonWiley Dream Tech India
17.	Advances in Nano Science & Nanotechnology	Dr Ashutosh Sharma & DrBellari	CSIR public
18.	A text book of Organic Chemistry	M.K.Jain	S. Chand & Company
19.	A text book of Organic Chemistry	Bahl&Bahl	S. Chand & Company
20.	A text book of Organic Chemistry	P.L.Soni	S. Chand & Company
21.	Organic Chemistry	K.K. Sharma	Shobhanlal&NaganCo.
22.	Organic Chemistry	Puri& Sharma	Shobhanlal&NaganCo.
23.	Chemistry of Natural Products	Agarwal	Goel Publishing House
24.	Heterocyclic Chemistry	Raj K Bansal	New Age Publication
25.	Organic Chemistry Vol.I&II	I.L.Finar	ELBS
26.	Organic Spectroscopy	Willliam Kemp	

27.	Spectroscopy	Pavia, Lampman, Kriz& Vyvyan	Cengage Learning
28.	Stereo Chemistry	Eliel	John Weily Eastern Pub.
29.	Photochemistry& Pericyclic reactions	J Singh & Jaya Singh	New Age Int. Publishers.
30.	Advanced Organic Chemistry	J Singh & LD. Yadav	Pragati Prakashan
31.	Lab Manual of Organic Chemistry	Raj.K.Bansal	New Age Publication
32.	Laboratory Manual of Organic	Jayaraman	S. Chand & Company
33.	Medicinal Chemistry	Ashutosh Kar	Tata Magro Hill Publications
34.	Organic Chemistry	Hendrickson	Tata Magro Hill Publications
3.	Physical Chemistry	M.Kundan&S.K.Jain	S. Chand & Company
35.	Text book of Physical Chemistry	K.K.Sharma&C.K.Sharma	Vani Educational Books
36.	Physical Chemistry	.Madan& Tuli	S. Chand & Company
37.	Text book of Adv. Physical Chemistry	GurudeepRaj	Goel Prakashan. Meerut
38.	Engineering Chemistry	Jain & Jain	Dhanpal&Sons ,New Delhi
39.	Text book of Physical Chemistry	B.D.Khosla	R.Chand& Publications
40.	Physical Chemistry	S Bahl& Arun Bahl	S. Chand & Company
41.	A Text book of Physical Chemistry	P LSoni&Dhasmarah	S. Chand & Company
42.	Text book of Chemistry (Vol. I – VI)	K. K. Padmanabha	Chetana Book House, Mysore
43.	Physical Chemistry	Glasstone	ELBS
44.	Text book of Electro Chemistry	Glasstone	East-West Press Pvt. Ltd

SYLLABUS FOR PRACTICALS

FIRST SEMESTER

CHEMISTRY PRACTICAL – I

Title of the Paper: Volumetric Estimations.

Practical Duration -03 Hours per week Examination - 03 Hours Total Marks– 30

Practical Proper-20 Internal Assessment - Record-05 + Class Test-05 = 10

COURSE OBJECTIVE:

- **To calibrate burette and pipette.**
- **To prepare standard solution and standardize a given solution.**
- **To develop skills which are essential for the volumetric analysis.**

COURSE LEARNING OUTCOME (CO)

CO No.	After the completion of this course the student will be able to	Cognitive level
CO-01	Prepare solutions of known concentration	Apply
CO-02	Estimate amount of a substance present in a given sample solution using titrimetric method.	Evaluate
CO-03	Determine BOD, DO and Hardness of water	Apply

Calibration of burette and pipette.

1	Calibration of burette and pipette.
2	Preparation of 2N solutions of H_2SO_4, HCl, HNO_3, CH_3COOH, and NH_3.
	Acidimetry / Alkalimetry titrations
3	Estimation of NaOH present in the solution using approximately N/10 HCl and Na_2CO_3 crystals
4	Estimation of oxalic acid present in the solution using approximately N/10 NaOH and Potassium biphthalate crystals
5	Estimation of NaOH and Na_2CO_3 present in a mixture (analysis of commercial caustic soda) by double indicator method, using approximately N/10 HCl
	Permanganometry titrations:
6	Estimation of Ferrous Ammonium Sulphate present in the solution using approximately N/10 $KMnO_4$ and oxalic acid crystals
7	Estimation of Hydrogen peroxide present in the solution using approximately N/10 $KMnO_4$ and oxalic acid crystals. Calculation of strength of H_2O_2 in volume
	Cerimetry titration:
8	Determination of percentage purity of $NaNO_3$ by Ceric ammonium sulphate
	Iodometry titrations
9	Estimation of available chlorine in the bleaching powder sample
10	Estimation of copper in copper sulphate solution using $K_2Cr_2O_7$ crystals and approximately N/10 $Na_2S_2O_3$ solution
11	Preparation of standard $K_2Cr_2O_7$ solution & standardization of $Na_2S_2O_3$. Estimation of iodine
	Complexometry titration:

12	Preparation of Standard Zinc sulphate solution and standardisation of E.D.TA. Solution. Estimation of total hardness of the water.
13	Determination of B.O.D. of sewage water
14	Determination of dissolved Oxygen in sewage water

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SECOND SEMESTER

CHEMISTRY PRACTICAL – II. Title: Qualitative Organic Analysis

Practical Duration -03 Hours per week. Examination-03 Hours Total Marks - 30.

Practical Proper-20. Internal Assessment - Record-05+ Class Test-05 = 10

COURSE OBJECTIVES:

- To identify the components present in an organic binary mixture.
- To analyse given organic compound systematically and identify the functional group present in it.

COURSE LEARNING OUTCOME

i) Identification of the components in an organic binary mixture (solid + solid)

ii) Systematic qualitative organic analysis of the following class of organic compounds

CO No.	After the completion of this course the student will be able to	Cognitive level
CO-01	Identify and separate different components present in a given binary mixture	Apply
CO-02	Analyse an organic compound in a systematic way	Analyse
CO-03	To determine the melting point and boiling point of organic compounds	Evaluate

Note-1. Minimum of 12 compounds to be analyzed.

2. The balanced equation of any one of the reaction to identify the functional group should be written.

a. Acids.

b. Alcohols.

c. Aldehydes.

d. Amides.

e. Amines.

f. Halogenated hydrocarbons.

g. Hydrocarbons.

h. Ketones.

i. Nitro compounds.

j. Phenols.

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THIRD SEMESTER

CHEMISTRY PRACTICAL – III Title:Semi-microInorganic Salt Analysis

Practical Duration -03 Hours per week. Examination-03 Hours Total Marks - 30.

Practical Proper-20. Internal Assessment - Record-05+ Class Test-05 = 10

COURSE OBJECTIVES:

- **To develop skills to analyse mixtures of inorganic salt containing two cations and anions systematically.**
- **To expolore new techniques used in the semimicro qualitative analysis of inorganic mixture.**

COURSE LEARNING OUTCOME (CO):

CO No.	After the completion of this course the student will be able to	COGNITIVE LEVEL

CO-01	**Analyse given inorganic salt mixture and identify cations and anions .**	**Analyse**
CO-02	**Use instruments like centrifuge to separate residue and centrifugate.**	**Apply**
CO-03	**Detect the presence of some cations based on flame test**	**apply**

Systematic semi-micro qualitative analysis of inorganic salt mixture containing two cations and two anions, (minimum 16 mixtures to be analyzed)

The constituent ions in the mixture to be restricted to the following.

Anions: HCO_3^- , CO_3^{2-}, Cl^-, Br^- NO_3^-, BO_3^{3-}, SO_4^{2-}, & PO_4^{3-}

Cations: Pb^{+2}, Bi^{+3}, Cd^{+2}, Al^{+3}, Fe^{+2}, Fe^{+3}, $Mn^{+2,}$ Zn^{+2}, Ca^{+2}, Sr^{+2}, Ba^{+2}, Mg^{+2}, K^+, Na^+, and NH_4^+

Note:

1. Mixtures requiring the elimination of phosphate and borate radicals should not be given (avoid cations like Ca^{+2}, Sr^{+2}, Ba^{+2}, and Mn^{+2} when phosphate and borate are given.
2. Combinations like Cl^-& Br^-, NO_3^-& Br^- shall be avoided
3. Salts that yield $SrSO_4$, $BaSO_4$, $CaSO_4$, $PbSO_4$, and $FeSO_4$ on double decomposition shall be avoided.
4. The two cations in the mixture should belong to different groups. However, combinations like Mg^{+2} & NH_4^+ and K^+& NH_4^+ can be given.

Note: The students should be made familiar with writing the ionic equations for the confirming reactions. They also should be given the relevant problems in the analysis to identify the ions.

FOURTH SEMESTER

CHEMISTRY PRACTICAL – IV.

Title: Physical Chemistry- Non - instrumental

Practical Duration -03 Hours per week. Examination-03 Hours Marks - 30.

Practical Proper-20. Internal Assessment - Record-05+ Class Test-05 = 10

COURSE OBJECTIVES:

- To determine physical properties such as density, viscosity , surface tension of different liquidsand molecular weight of given solute .
- To correlate and apply the concepts such as reaction kinetics studied in theory to the experiments.
- To extend the knowledge in improvising the skills required for the experiments and there by able to perform them prisisely.

Course learning outcome (CO):

CO No.	After the completion of this course the student will be able to	Cognitive Level
CO-01	Develop skills to handle various apparatus and apply them in minimizing the possible errors .	Analyse
CO-02	Make use of different methods to determine the concentration of a solution and there by to estimate the amount of substance present in a given solution	Apply
CO-03	To determine the rate constant as well as distribution coefficient of few reactions	Evaluate

1. Determination of density [specific gravity bottle] and viscosity of the given liquid using Ostwald's viscometer.
2. Determination of density [specific gravity bottle] and surface tension of the given liquid using stalagmometer.
3. Determination of molecular weight of a non-volatile solute by Walker-Lumsden's method.
4. Determination of rate constant of the decomposition of hydrogen peroxide catalyzed by $FeCl_3$.
5. Determination of transition temperature of the given salt hydrates ($Na_2S_2O_3$, $SrCl_2$, CH_3COONa)
6. Determination of percentage composition of NaCl solution by determining the miscibility Temperature of phenol-water system.
7. Determine the % composition of a given mixture containing two miscible liquids A & B by Abbe's refractometer.
8. Estimation of the given strong acid using a strong base by thermometric titration method [HCl x NaOH]
9. To study the effect of concentration on the rate of the reaction between $K_2S_2O_8$ and KI,

10. Determination of the distribution coefficient of iodine in water and carbon tetrachloride.

11. Study of kinetics of saponification of ethyl acetate.

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FIFTH SEMESTER

CHEMISTRY PRACTICAL-V

Title: Gravimetric Estimations& Chromatographic separation.

Practical Duration -03 Hours per week Examination-03 Hours Marks - 45

Practical Proper-30 Internal Assessment - Record-05+ Practical Test-10=15

Course Objectives:

1. To understand, apply and analyze the principles of gravimetric analysis.
2. To learn the skills and techniques of gravimetric estimation of $Ba^{2+,}$ Ni^{2+}, Cu^{2+} , Fe^{2+} ions.
3. To learn the Separation of metal ions from their binary mixture.
4. To learn the skills of Separation of o- and p- aniline by TLC method and column chromatography method.
5. To master the skills of Paper chromatographic separation of green leaf pigments.
6. To learn the laboratory skills needed to design, safely conduct and interpret chemical research.

Course Learning Outcome (CO)

CO	After the completion of this course the student will be able to	Cognitive level
CO-1	Apply the techniques of gravimetric analysis to find out the quantity of an ion in a given solution	Apply
CO-2	Apply the techniques of paper chromatography to the separation of metal ions	Apply
CO-3	Separate leaf pigments by paper chromatography	Apply
CO-4	Apply ion exchange and TLC techniques	Apply
CO-5	Understand and develop the laboratory skills needed to design safely conduct and interpret chemical research needed to safely conduct	Create

Gravimetric Estimations:

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of iron as iron (III) oxide.
3. Gravimetric estimation of copper as copper (I) thiocyanate.
4. Gravimetric estimation of nickel as nickel dimethylglyoxime.
5. Gravimetric estimation of magnesium as magnesium -8-hydroxy quinolate.
6. Gravimetric estimation of aluminium as aluminium oxide.
7. Gravimetric estimation of zinc as zinc oxide.

Chromatography

1. Paper chromatographic separation of Fe^{3+} and Ni^{2+} ions.
2. Paper chromatographic separation of green leaf pigments.
3. Separation of p- and o-nitroaniline by TLC method (Solvent extraction).
4. Separation of p- and o-nitroaniline by column chromatography
5. Separation of Zn^{2+}&Mg^{2+} by ion-exchange chromatography**.**

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FIFTH SEMESTER

CHEMISTRY PRACTICAL – VI

Title: Ore & Organic Estimations

Practical Duration -03 Hours per weekExamination-03 Hours Marks - 45

Practical Proper-30 Internal Assessment - Record-05 + Practical Test-10 = 15

Course Objectives

1. To present the results of a practical investigation in a concise manner
2. To gain the knowledge about calculating a limiting reagent, theoretical yield, and percent yield.
3. How to engage in safe laboratory practices handling laboratory glassware, equipment, and chemical reagents
4. Recognise many functional groups and their reactivity,set up glassware and apparatus to conduct experiments in Organic Chemistry
5. To Isolate of Caffeine from tea powder and Castor oil from Castor Seeds

6. To estimate the metal concentrations present in different ore samples. .

Course Learning Objectives (CO):

CO No.	After the completion of this course the student will be able to	Cognitive level
CO-01	Develop good laboratory practice, both conceptually and practically, and consider how to do good scienyist	Apply
CO-02	Critically evaluate data collected to determine the identity, purity, and yield of products.	Evaluate
CO-03	Perform common laboratory techniques, including reflux, distillation, steam distillation, recrystallization, vacuum filtration, aqueous extraction	Apply
CO-04	Predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional group	Anayse

Part-I OreEstimations:

1. Estimation of iron in the given sample of haematite by dichromate method'
2. Estimation of the percentage of calcium in limestone by oxalate method.
3. Estimation of manganese in the given sample of pyrolusite.
4. Estimation of magnesium in the given sample of dolomite ($MgCO_3$. $CaCO_3$) by EDTA method.

Part: I Organic Estimations:

1. Estimation of L- ascorbic acid (vitamin C) by the iodometric method.
2. Determination of iodine value of oil by the Chloramine-T method.
3. Estimation of phenol by bromine- bromide method.
4. Estimation of the ketone by haloform formation.
5. Isolation of Caffeine from tea powder.
6. Isolation of Castor oil from Castor Seeds.
7. Estimation of neutral amino acids by the titrimetric method.
8. Estimation of a carboxylic acid by the titrimetric method.
9. Estimation of $–NH_2$ group by bromination method.
10. Determination of saponification value of oils.

SIXTH SEMESTER

CHEMISTRY PRACTICAL – VII

Title: Physical Chemistry- Instrumental

Practical Duration -03 Hours per week Examination-03 Hours Marks - 45

Practical Proper-30 Internal Assessment - Record-05+ Practical Test-10 = 15

Course Objective

1. To acquire the skills and ability to carry out electric potentiometric titrations and to Determine the equivalence point of titration.
2. To acquire the skills and ability to carry out conductometric titrations and to Determine the equivalence point of titration.
3. To Gain practical skill in colorimetric and determine the colored compounds in solutions by colourimetrically.
4. Measure the pH of various solution using pH meter
5. Determine the rate constant of chemical reaction changes as function of time and concentration.

Course Learning Outcome (CO)

CO	After the completion of this course the student will be able to	Cognitive level
CO-1	Accurately record and analyse the results of the experiments	Apply
CO-2	Calibrate the conductometer and potentiometer	Understanding
CO-3	Apply the techniques of condutometry, potentiometry, pH, colorimetry to solve chemical problems	Apply
CO-4	Determine the strength of the given unknown solution	Analyse

Conductometry:

1. Determination of equivalent conductance of the given electrolyte (strong &weak) by using Meter Bridge.
2. Conductometric titration of i) strong acid with strong base ii) weak acid with strong base iii) mixture of strong& weak acid with a strong base.
3. Determination of K_a [dissociation constant of a weak acid] by Conductometric method.
4. Conductometric titration of a strong acid and strong base and weak acid and strong base.

Potentiometry

5. Potentiometric titration of ferrous ammonium sulphate and potassium dichromate.
6. pH titration of a strong acid and strong base (by observing the change in pH).
7. Determination of pK_a of a weak acid by the Potentiometric method.

Colourimetry

8 Colorimetric estimation of Cu^{+2} ion using NH_4OH as a complexing agent.

9 Colourimetric study of kinetics oxidation of indocarmine by Chloramine-T.

10. Colorimetric estimation of aspirin using $FeCl_3$ kinetics.

11. Determination of E_a for the kinetic oxidation of indigo carmine by CAT.

12. Determination of E_a for the acid catalysedhydrolysis of an ester.

13. To study the effect of temperature on the rate of reaction between $K_2S_2O_8$& KI

SIXTH SEMESTER

CHEMISTRY PRACTICAL – VIII

Title: Organic & Inorganic complex preparation.

Practical Duration -03 Hours per weekExamination-03 Hours Marks - 45

Practical Proper - 30

Internal Assessment – Industrial Visit Report 05 + Record 05+ Practical Test-05=15

Note: - The student should be taken for Industrial Visits [minimum two industries which are relevant to chemistry] and a report to be submitted. The report to be valued for 05 marks and these marks to be considered for internal assessment for practical VIII.

Course objectives:

- To synthesize organic compounds by making use of well known reaction such as acetylation, oxidation nitration etc.
- To calculate theoretical yield of the sample prepared.
- To enhance the practical skills to get accurate experimental yield.

Course Learning outcome (CO):

CO No.	After the completion of this course the student will be able to	Cognitive level

CO-1	Prepare organic compounds by applying different principle.	Apply
CO-2	Calculate theoretical and experimental yield	Apply
CO-3	Develop skills to precipitate, filter, dry the sample and to minimize the personal errors while taking weight of the product.	Evaluate

Part I: **Preparations**:

1. Acetylation: Preparation of acetanilide from aniline.
2. Oxidation: Preparation of benzoic acid from benzaldehyde.
3. Nitration: Preparation of m- dinitrobenzene from nitro benzene.
4. Hydrolysis: Preparation of benzoic acid from ethyl benzoate.
5. Bromination: Preparation of para bromo acetanilide from acetanilide.
6. Diazotization: Preparation of methyl orange.

Part II:Preparation of Inorganic Complexes

1. Preparation of mercurytetrathiocyanatocobaltate(II).
2. Preparation of potassiumtrisoxalatoferrate(III).
3. Preparation of ferrousoxalate.
4. Preparation of potassiumbisoxalatodiaquachromate(III).
5. Preparation of chloropentaminecobalt(III)chloride.
6. Preparation of manganese (III)acetylacetonate.

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Discipline Specific Elective (DSE)

M26Y03 WATER QUALITY AND ITS TREATMENT

CLASS DURATION-02 HOURS PER WEEK 30 HOURS

Marks – Theory – 30 + Internal Assessment –20 = 50

OBJECTIVES:

(i) To familiarize students with basic knowledge about the characteristics of water various methods of analysis and treatments of water.

Course Learning Outcome (CO):

CO No	After thecompletion of this course the student will be able to	Cognitive level
CO-01	determine acidity/ alkalinity of water using a pH meter	evaluate
CO-02	**Know** various methods of treatment and analysis of water	undesrstant
CO-03	perform turbidity and colourtests on a given set of water samples and to examine the results with respect to the water treatment processes	apply

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Unit-1 **10hrs**

1.1 **Introduction:** Characteristics of water turbidity, colour, pH, and alkalinity-hardness,unit of hardness, Total solids, Oxidation transparency, the Silica content

Purification of water for drinking purpose:potability of water clarification coagulation contact &electrochemical coagulation,

Sterilization & disinfection of water precipitation,aeration, ozonisation&Chlorination.

UNIT-2 **10hrs**

2.1 **a. Water softening methods:**Clark's process, limesoda process,modified lime soda process,permutit or zeolite process, Ion exchange process, demineralization of water.

b.Determination of hardness of water: Titration method: acomplexometric method using EDTA -expressing hardness -equivalents of calcium carbonate -problems to determine the temporary& permanent hardness

3.1 **UNIT-3** **10hrs**

Hard water and Industries: Industrial water treatment -

boiler feed water method of softening- prevention of plumbo solvency

-scales in boilers

Analysis of chemical substances indicative of pollution, Determination of pH, acidity,and alkalinity of a water sample,Dissolved oxygen, BOD and COD in sewage water

Books of reference:

1. Water pollution and management -C.K. Varshney -Wiley Eastern Ltd., Chennai -20.
2. Industrial Chemistry (including chemical -engineering) -B.K. Sharma -Goel publishing house, Meerut
3. Principles of Instrumental Analysis, Skoog, D.A. Holler F.J. & Nieman, T.A. Cengage Learning India Ed

M26Y04 ELEMENTS OF PHARMACEUTICAL CHEMISTRY

CLASS DURATION-02 HOURS PER WEEK 30 HOURS

Marks – Theory – 30 + Internal Assessment –20 = 50

OBJECTIVES:

1. To effectively impart knowledge on important pharmaceutical chemicals and their medicinal applications

Course Learning Outcome (CO):

CO No	After thecompletion of this course the student will be	Cognitive level

CO-01	**Made aware of** basic idea of drugs and names of common drugs.	understnad
CO-02	Know BP, Diagnostic Test for sugar, salt,and Cholesterol in serum and urine	undesrstand
CO-03	learn the FIRST AID AND SAFETY skills	apply

Unit-1 **8 hrs**

1.1 **Clinical Health and Biochemical Analysis:** Definition of Health, WHO standard, Sterilization of surgical instruments.
Biochemical analysis of urine and serum,(glucose, salt, cholesterol)
Blood Composition, grouping,and Rh factor.

Unit-2 **6 hrs**

2.1 (i)Definition of the following terms: drug, pharmacophore, pharmacology, pharmacopoeia,
(ii) Bacteria, virus, chemotherapy, and vaccine.
(iii) Symptoms and drug for jaundice, cholera, malaria, and filaria.

Unit-3 **10 hrs**

3.1 **(i)** Causes, detection,and control of anaemia and diabetes. Diagnostic Test for sugar, salt,and Cholesterol in serum and urine.
(ii) Common Drugs: Antibiotics, Antipyretics, Analgesics, Anti-inflammatory agents, Sedatives, Antiseptics, Antihistamines, Tranquilizers, **Hypnotics and Antidepressant drugs:**Definition, Examples, uses and side effects; Preparation of Aspirin and its analysis,Preparation of magnesium bisilicate (Antacid)
(iii) Vital ailments and treatment: Blood pressure- hypertension and hypotension, Diabetes, Cancer, AIDS -Causes, symptoms,and medicines

Unit-4 **6 hrs**

4.1 **FIRST AID AND SAFETY:** Treatment of shock, haemorrhage, cuts,and wounds. Burns -classification and first aid.
Asbestos, silica, lead paints, cement, welding fumes,and gases -
Hazard alert and precautions for safety.

Reference Books:

1. A Text Book of Pharmaceutical Chemistry Jayashree Ghosh S. Chand Company Lt NIT

2. Pharmaceutical Chemistry S. Lakshmi -Sultan Chand.

3. Pharmacology and Pharmacotherapeutics R.S. Satoskar Popular PrakashanVol.I and Vol II.

4. Medicinal Chemistry Asuthosh Kar New Age International Publishers.

5. A Text Book of Synthetic drugs O.D. Tyagi Ammol Publications.

6. Introduction to Biological Chemistry J. Awapara Prentice Hall

7. Essentials of Biological Chemistry James FinleyEast-West Press NIT

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M26Y02 BASICS OF FOOD CHEMISTRY

CLASS DURATION-02 HOURS PER WEEK 30 HOURS

Marks – Theory = 30 + Internal Assessment =20 = 50

OBJECTIVES:

1. To impart knowledge about different foods, their nutritive values of food,food contaminants, adulterants and food poisoning.
2. To learn about food additives, food flavours, food preservatives

Course Learning Outcome (CO):

CO No	After thecompletion of this course the student will be	Cognitive level
CO-01	Difference between food adulteration and food poison	**analyse**
CO-02	**Gain knowledge** food additives and packaging of foods	**understand**
CO-03	detect the common adulterants in milk, tea powder, ghee, chilli powder by performing simple tests	**Evaluate**

1.1	**Unit-1** **Food, Adulterant, Contaminant:** Food and Its Adulteration, Classification of food, functions of food, Food metabolism, sources of food, processing of food, types.	**8hrs**

1.2	**Food Adulteration:** contamination of wheat, rice, milk, butter etc. with clay stones, water,and Toxic Chemicals: Adulteration in some common food items: milk, oils, ghee, coffee, powder, chilli powder and turmeric powder.	
2.1	**Unit-2** **Food Poison:** Diseases due to food stuffs-food poisoning and first aid to food poisoning-causes and remedies for acidity, gastritis, indigestion,and constipation.	**6hrs**
2.2	**Beverages:** Soft drinks –soda –fruit juices –alcoholic beverages examples. Carbonation –addiction to alcohol –cirrhosis of the liver and social problem	
3.1	**Unit-3** **Food Additives and Packaging of Foods:** Food additives- artificial sweeteners –saccharin –cyclamate and aspartate.	**8 hrs**
3.2	**3.2Food flavours:**esters, aldehydes and heterocyclic compound. Food colours –natural and artificial –Emulsifying agents – preservative agents, Baking powder yeast –tastemakers	
3.3	**The packaging of foods:** classification-Materials used for packaging.	
4.1	**Unit-4** **Food Preservation:** Food Preservatives -definition -classification - Food Spoilage -definition -Prevention. Methods of preservation classification, Analysis of preservatives and colouring matter-Low and high temperature -preservatives examples -Dehydration osmotic pressure -food irradiation.	**8 hrs**
4.2	**Determination of Smoking point of cooking oils:** Preparation of dehydrated products from raw materials.	

Books of reference:

Common adulterants –ghee adulterants and their detection

1. Food Science -III Edition -B. Sri Lakshmi New Age International Publisher, 2005

2. Food Chemistry -Lilian Hoagland Meyer CBS Publishers & Distributors,

3. H.K. Chopra, P.S.Panesar, “Food Chemistry”, Narosa Publishing House, 2010.2.

4. Thanlamma Jacob, “Textbook of applied chemistry” for home science and allied Science,MacMillan, 1976

4. Alex V.Ramani, “Food chemistry”, MJP Publishers, Chennai, 2009.

5. Lilian Hoagland Meyer, Food Chemistry -CBS Publishers & Distributors, 2004.

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M26Y01 APPLIED CHEMISTRY OF LEATHER INDUSTRY AND CORROSION

CLASS DURATION-02 HOURS PER WEEK 30 HOURS
Marks – Theory – 30 + Internal Assessment –20 = 50

Objective: To impart the innovative knowledge in the field of the applied chemistry such as leather technology, and corrosion.

Course Learning Outcome (CO):

CO No	After thecompletion of this course the student will	Cognitive level
CO-01	know the basic concepts involved in the manufacture of leather, tannery effluents, and water pollution and prevention	**understand**
CO-02	Understand the basic concepts of electrochemistry	**understand**
CO-03	. Study the concept of corrosion and develop corrosion prevention methods	**apply**

1.1	**UNIT-I** **Leather Chemistry: Introduction**:Constituents of Animal Skin - Preparing skins and hides- Cleaning and soaking -Liming and degreasing -Manufacture of Leather-**,** Leather Tanning-Vegetable Tanning-Chrome Tanning and Mineral Tanning -Dyeing and Fatliquoring Leather finishing- oil tanning- by-product.	**14 hrs**
1.2	**Tannery Effluents:**Tannery Effluents -Pollution and Its Control - Water Pollution And Air Pollution -Waste Management -Primary, Secondary -Tertiary Treatment –Pollution& Prevention	
2.1	**Unit-2Corrosion of Metals and Alloys:** Definition and classification of corrosion. Electrochemical corrosion-General revision of the concept of electrode potential, galvanic cells, electrochemical and galvanic series, causes of corrosion, mechanism of a direct chemical attack, pilling-Bed worth rule, concentration cells	**16 hrs**
2.2	**Differential aeration:** Theory of corrosion, types of corrosion, pitting corrosion, intergranular stress, waterline,and microbial corrosion. Corrosion prevention : (a) Design and material selection, (b) Anodic and Cathodic inhibitors, (c) Cathodic and Anodic protection, (d) Protective coatings -types of surface, coatings and its application	

Books of references

1.The fundamental concept of Applied Chemistry by Jayashree Ghosh, S.Chand& Company Ltd.,

2.Chemical treatment of hides a leather by J. Partridge Noyes, Park Ridge,N.J

3. Applied Chemistry by K.Bagavathi -Sundari, MJP Publishers.

4. Fontana and Green, Corrosion Engineering, Tata McGraw Hill International Book Co. 2nd edition,

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M26Y05 CHEMISTRY IN COSMETICS

CLASS DURATION-02 HOURS PER WEEK 30 HOURS

Marks – Theory – 30 + Internal Assessment –20 = 50

OBJECTIVES: To impart knowledge about the various chemicals used in the everyday life andTrain the students for the preparation of various cosmetics & perfumes

Course Learning Outcome (CO):

CO No	After thecompletion of this course the student will	Cognitive level
CO-01	Able to know various cosmetics & perfumes	**understand**
CO-02	**Able to prepare simple cosmetics and perfumes**	**Create**

1. Able to know various cosmetics & perfumes

2. Ability to prepare Cosmetics & perfumes

1.1	**Unit -1** **A general study including preparation and uses of the following:** Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams).Preparation of talcum powder,shampoo.Enamelsof hair remover.Face cream.Nail polish and nail polish remover.Antiperspirants and deodorants, bath and shower products, colouring materials used in the decorative cosmetics artificial flavours.	**15 hrs**

2.1	**Unit- 2** Essential oils and their importance in cosmetic industries with reference to sandalwood oil, eucalyptus, rose oil, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.Sun damage and sunscreen preparation	**15 hrs**
2.2	Psychology of fragrance and aromatherapy	
2.3	Preservatives in Cosmetics. Regulatory Aspects and Analytical Methods	

Reference Books:

1.E. Stocchi: Industrial Chemistry Vol -I, Ellis Horwood Ltd. The UK.
2.P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
3.Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House,
4.Poucher'sperfumes, cosmetics,and soaps -10 theedition, edited by Hilda Butler

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M26Y06 ELEMENTS OF POLYMER CHEMISTRY

CLASS DURATION-02 HOURS PER WEEK 30 HOURS

Marks – Theory – 30 + Internal Assessment –20 = 50

Course Objectives:

1.To learn the structures, functions, properties and polymerization mechanisms of polymers, preparation of polymers and its uses.

Course Learning Outcome (CO):

CO No	After thecompletion of this course the student will be able to	Cognitive level
CO-01	Understand the classification, structure, function,and importance of polymers	**understand**
CO-02	Acquire the knowledge of nature and physical properties of polymers	**remember**

CO-03	Determine the solubility parameters, thermodynamic properties,and methods to determine the molecular weight of polymers	**apply**

1.1	**Unit-1** **Polymers:** Basic Concept, classification of polymers based onstructures Applications:The distinction among plastics(elastomers, and fibres, Homo and heteropolymers) copolymers, glass transition temp. (Tg) definition, factors affecting Tg, The relationship between Tg and molecular weight.	**8 hrs**
1.2	Identification of Polymer samples, Determination of Density by specific gravity bottle and Viscosity by Viscometer	
2.1	**Unit- 2** Molecular Weight of polymers, Number average, weight average, sedimentation and viscosity average molecular weights, Molecular weights and degree of polymerization. Reactions Hydrolysis, Hydrogenation, addition, substitution, cross-linking vulcanization and cyclisation. Determination of Refractive Index of Polymer – films	**8 hrs**
3.1	**Unit – 3** **Polymerization techniques:** Bulk, solution, suspension & emulsion polymerization melt polycondensation.	**4hrs**
4.1	**Unit – 4** **Chemistry of commercial polymers:**General methods of preparation, properties,and uses of The following Teflon, polyethene, polystyrene, polyesters, polyamides, polycarbonates,and PVC.	**4 hrs**
5.1	**Unit-5** **Advances in polymers:**BioPolymers, polymers in the medical field, High temperature and fire resistant polymers, Determination of water absorption by polymer samples	**6 hrs**

Reference Books:

1. Text Book of Polymer Science, Bill Meyer F.W. Jr. John Wiley & Sons 1984.

2. Polymer Science, Gowarikar. V.R. Viswanathan, N.V. Jayader Sreedhar.

3. Wiley Eastern Ltd., New Delhi, 2005

4. Polymer Chemistry, Sharma.B.K Goel Publishing House, Meerut-1989.

5. Polymer Chemistry. Arora M.G. Vadar M.S.- Anmol publications (p) Ltd.,

6. VishuSha Plastictesting.

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M26Y07 BASICS OF NANO CHEMISTRY

CLASS DURATION-02 HOURS PER WEEK 30 HOURS

Marks – Theory – 30 + Internal Assessment –20 = 50

Course Objective:

Course Learning Outcome (CO):

CO No	After thecompletion of this course the student will be able to	Cognitive level
CO-01	Study the common properties and size-dependent absorption behaviour of nanomaterials, physical and chemical synthetic routes of nanomaterials.	understand
CO-02	Analyze the application of nanomaterials in various fields including catalysis, photonics, and medicine.	apply
CO-03	Students will learn the instrumental techniques used in the characterization of nanomaterials.	**apply**

1.1	**Unit-1** **Basics of Nanochemistry:**Introduction definition**,**length scales the importance of nanoscale and its technology self-assembly of materials self-assembly of molecules porous solids, nanowires, nanomachines and quantum dots.	**6 hrs**
2.1	**Unit-2** **Nano Particles:** Introduction types of nanoparticles,Synthesis of Nanomaterials. Top-down and bottom-up approach, properties and uses of gold, silicon, silver, zinc oxide, iron oxide, alumina and titania nanoparticles.Chemical synthesis of Ag nanoparticles,CdS nanoparticles, and ZnO nanoparticles	**8 hrs**
3.1	**Unit-3** **Synthetic Techniques:** Techniques to synthesize nanoparticles top-down and bottom-up approaches common growth methods characterization of nanoparticles applications and toxic effects of nanomaterials.	**8hrs**

4.1	**Unit-4** **Nano Materials:** Preparation, properties,and applications of carbon nanotubes, nanorods, nanofibre and nanoclay.	**4hrs**
5.1	**Unit-5** **Instrumental Techniques:** Electron microscopes scanning electron microscopes (SEM) transmission electron microscopes (TEM) scanning tunnelling electron microscope (STEM) basic principles only.	**4 hrs**

Reference Books:

1.Nanotechnology, S.Shanmugam, MJP Publishers, Chennai (2010).
2.A Handbook on Nanochemistry, Patrick Salomon, Dominant Publishers and Distributors, NewDelhi.
3.Nanobiotechnology, S. Balaji, MJP Publishers, Chennai (2010).
4.The Chemistry of Nanomaterial: Synthesis, Properties and Applications, Vol. I and II, CNR Rao, Springer (2006).
5.Nanotechnology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press (2005).
6.Nanochemistry, G. B. Sergeev, Elsevier, Science, New York,

BLUEPRINT OF QUESTION PAPER for DSC PAPERS

(question Bank)

FOR- CHEMISTRY PAPER – I, II. III &IV

Time –03 hours Max.Marks-60

PART-A Answer any six questions**[three from each Unit]** 6 x2= 12 marks		
1	Short answers	2 mark
2	Short answers	2 mark
3	Short answers	2 mark
4	Short answers	2 mark
5	Short answers	2 mark
6	Short answers	2 mark
7	Short answers	2 mark
8	Short answers	2 mark
9	Short answers	2 mark

	PART-B (INORGANIC CHEMISTRY) Answer any FOUR questions**[All the questions from unit-1]**	4 x4=16marks
10		
11		
12		
13		
14		
15		
	PART-C (ORGANIC CHEMISTRY) Answer any FOUR questions **[All the questions from unit-2]**	4 x4=16marks
16		
17		
18		
19		
20		
21		
	PART-C (Physical CHEMISTRY) Answer any FOUR questions **[All the questions from unit-3]**	4 x4=16marks
22		
23		
24		
25		
26		
27		

BLUEPRINT OF QUESTION PAPER

FOR V & VI SEMESTERS [CHEMISTRY PAPERS – V, VI, VII, VIII, IX & X]

Time –03 hours Max.Marks-60

PART-A		
Answer all the questions	9 x2= 18 marks	
1	Short answers	2 mark
2	Short answers	2 mark
3	Short answers	2 mark
4	Short answers	2 mark
5	Short answers	2 mark
6	Short answers	2 mark
7	Short answers	2 mark
8	Short answers	2 mark

9	Short answers	2 mark
	PART-B Answer any SIX questions **6x3=18 marks**	6 x3=18marks
10		
11		
12		
13		
14		
15		
16		
17		
	PART-C Answer any SIX questions **6x3=18 marks**	6 x4=24marks
18		
19		
20		
21		
22		
23		
24		
25		

V and VI sem = Project / dissertation

An elective course designed to acquire special/advanced knowledge, such as project work, is introduced. The student will take a course on his own with advisory support by a teacher/faculty member/ industrial instructor and submit the project report as the dissertation.

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BLUEPRINT OF QUESTION PAPER for DSE PAPERS

FOR all the Soft Core papers

Time – 02 Hours Max.Marks-30 Internal Assessment =20

PART-A Answer all the questions 1x6 = 6 marks		
1	a. Short answers	1 mark
	b. Short answers	1 mark
	c. Short answers	1 mark

	d. Short answers	1 mark
	e. Short answers	1 mark
	f. Short answers	1 mark
	PART-B Answer any four questions	4**x6=24 marks**
2	Each question in this part shall contain sub divisions a, b, c or a, b carrying 2+2+,2, **or** 3+3,**or** 4+2 marks	
3		
4		
5		
6		
7		