Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.
Accredited with A$^+$ by NAAC - IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF CHEMISTRY

SYLLABUS FOR UNDERGRADUATE PROGRAMME

TEACHING PLAN

ODD SEMESTER 2024 – 2025

Vision

- Impart quality education, scientific skills, academic excellence, research attitude and skills to face global challenges.

Mission

- To develop intellectual and professional skills of the students
- To provide a firm foundation in chemical concepts, laws and theories
- To sharpen the scientific knowledge
- To enhance critical thinking, problem solving ability, scientific temper and innovation
- To apply chemistry in medicine, biology, industry and environment

Programme Educational Objectives (PEOs)

PEOs	Upon completion of B.A/B.Sc. Degree Programme, the graduates will be able to	Mapping with Mission
PEO 1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	**M1& M2**
PEO 2	use practical knowledge for developing professional empowerment and entrepreneurship and societal services.	**M2, M3, M4 & M5**
PEO 3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	**M3, M4, M5 & M6**

Programme Outcomes (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	**PEO1**
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	**PEO2**
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	**PEO2**
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	**PEO1 & PEO3**
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	**PEO2 & PEO3**
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	**PEO2 & PEO3**
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to improve knowledge and skills.	**PEO1 & PEO3**

Programme Specific Outcomes (PSOs)

PSOs	Upon completion of B.Sc Chemistry programme, the graduates will be able to:	Mapping with POs
PSO - 1	understand the fundamentals, theories and principles of organic, inorganic and physical chemistry.	**PO1**
PSO - 2	analyze physical and chemical properties of chemical compounds and their uses.	**PO1& PO7**
PSO - 3	interpret the mechanism of various chemical reactions.	**PO3 &PO4**
PSO - 4	synthesize organic and inorganic compounds using classical and modern methods.	**PO2**
PSO - 5	design and carry out scientific experiments, record and interpret the results with accuracy	**PO1& PO4**
PSO - 6	use concepts, tools and techniques related to chemistry to other branches of science.	**PO5**
PSO - 7	develop skills in the safe-handling of chemicals and their usage in day today life.	**PO1&PO7**
PSO - 8	develop entrepreneurial skills, empowered to fulfil the professional requirement and become self-dependent.	**PO2& PO6**

Department : Chemistry
Class : I B.Sc Chemistry
Title of the Course : General Chemistry-I
Semester : I
Course Code : CU231CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231CC1	**5**				**5**	**5**	**75**	**25**	**75**	**100**

Learning Objectives

1. To understand various atomic models and atomic structure
2. To realize the wave particle duality of matter
3. To learn periodic table, periodicity in properties and its application in explaining the chemical behaviour
4. To know the nature of chemical bonding, and
5. To understand the fundamental concepts of organic chemistry

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	explain the atomic structure, wave particle duality of matter, periodic properties bonding,and properties of compounds.	PSO – 1	K2(U)
CO - 2	classify the elements in the periodic table, types of bonds, reaction intermediates electroniceffects in organic compounds, types of reagents.	PSO – 2	K1(R)
CO - 3	apply the theories of atomic structure, bonding, to calculate energy of a spectral transition,Δx, Δp electronegativity, percentage ionic character and bond order.	PSO – 3	K3(A)
CO - 4	evaluate the relationship existing between electronic configuration, bonding, geometry ofmolecules and reactions; structure reactivity and electronic effects	PSO – 3	K5(E)
CO - 5	construct MO diagrams, predict trends in periodic properties assess the properties of elements, and	PSO – 3	K3(A)

	explain hybridization in molecules, nature of H – bonding and organic reaction mechanisms.		

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
I	**Atomic structure and Periodic trends**					
	1	History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number,	3	K2(U)	Lecture using models, chalk and talk	Slip test and concept explanations
	2	Atomic Spectra; Black-Body Radiation and Planck's quantum theory	2	K3(A)	Group discussion and problem solving	Problem solving
	3	Bohr's model of atom;The Franck-Hertz Experiment; Interpretation of H- spectrum; Photoelectric effect	3	K1(R)	Lecture using chalk and talk	Short test
	4	Compton effect; Dual nature of Matter- De- Broglie wavelength- Davisson and Germer experiment	2	K2(U)	Lecture using chalk and talk	Slip test and MCQ
	5	Heisenberg's Uncertainty Principle; Electronic Configuration of Atoms and ions	3	K3(A)	Lecture using chalk and talk, group discussion and problem solving	Group discussion and problem solving
	6	Hund's rule, Pauli's exclusion principle and Aufbau principle. Numerical problems involving the core concepts**.**	3	K3(A)	Lecture using models, chalk and talk	Concept explanations and slip test
II	**Introduction to Quantum mechanics**					
	1	Classical mechanics, Wave mechanical model of atom,	2	K2(U)	Lecture using chalk and talk	Short test

		distinction between a Bohr orbit and orbital;				
	2	Postulates of quantum mechanics; probability interpretation of wavefunctions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -	3	K3(A)	Lecture using chalk and talk	Slip test
	3	Probability density and significance of Ψ and Ψ^2. **Modern Periodic Table** **Cause of periodicity**; Features of the periodic table; classification of elements -	2	K1(R))	Lecture using chalk and talk	Short test and MCQ
	4	Periodic trends for atomic size-atomic radii, ionic and covalent radii; ionization energy, electron affinity, electronegativity-	4	K3(A)	Lecture using chalk and talk	Short test and quiz
	5	Electronegativity scales Mulliken and Paulings scales of electronegativity, applications of electronegativity. Problems involving the core concepts	4	K3(A)	Lecture using chalk and talk	Slip test
III	**Structure and bonding – I**					
	1	**Ionic bond** Ionic bond-definition; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies-applications of lattice energy,	3	K1(R)	Lecture using chalk and talk	Concept explanations
	2	Ion polarisation– polarising power and polarizability; Fajans' rules - effects of polarisation on properties of compounds; problems involving the core concepts.	3	K2(U)	Lecture using chalk and talk, Group discussion	Slip test

	3	**Covalent bond** Shapes of orbitals, overlap of orbitals – σ and Π bonds;	3	K3(Ap)	Lecture using powerpoint	Short test
	4	Hybridization-types-sp,sp^2,sp^3-examples. VSEPR theory - shapes of molecules of the type AB_2, AB_3, AB_4, AB_5, AB_6 and AB_7	3	K3(Ap)	Lecture using chalk and talk , Seminar	Slip test and quiz
	5	Partial ionic character of covalent bond-dipole moment, percentage ionic character	3	K2(U)	Lecture using chalk and talk	Concept explanations
IV	**Structure and bonding – II**					
	1	VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – CO_2, NO_2, CO_3^{2-} , NO_3^- limitations of VBT	3	K2(U)	Lecture using powerpoint	Slip test
	2	MO theory - bonding, antibonding and nonbonding orbitals, bond order;	4	K1(R)	Lecture using chalk and talk	Slip test and quiz
	3	MO diagrams of H_2, C_2, O_2, O_2^+, O^{2-} , O^{2-},N_2 , NO, HF, CO; magnetic characteristics, comparison of VB and MO theories.	3	K3(A)	Lecture using chalk and talk	Short test
	4	Coordinate bond: Definition, Formation of BF_3, NH_3 molecules Metallic bond-electron sea model, VB model	2	K2(U)	Lecture using chalk and talk	Group discussion
	5	Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applicationsof semiconductors. numerical problems based on calculation of percentage ionic character.	3	K3(A)	Lecture using chalk and talk, Seminar	Short test
V	**Basic concepts in Organic Chemistry and Electronic effects**					

	1	Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates.	2	K2(U)	Lecture using chalk and talk	Slip test
	2	Types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations, carbenes, arynes and nitrynes. Inductive effect - reactivity of alkyl halides, acidity of halo acids,	2	K2(U)	Lecture using powerpoint,Seminar	Concept explanations
	3	Basicity of amines; inductive and electromeric effects. Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines	3	K2(U)	Lecture using chalk and talk, Group discussion	MCQ
	4	Stability of carbonium ions, carbanions and free radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, steric inhibition to resonance	4	K3(A)	Lecture using chalk and talk	Short test
	5	Hyperconjugation - stability of alkenes, orienting effect of methyl group, dipole moment of aldehydes and nitromethane	2	K3(A)	Lecture using chalk and talk	Short test
	6	Types of organic reactions- addition, substitution, elimination and rearrangements	2	K2(U)	Power point	Long answer test

Course Focussing on Employability/ Entrepreneurship/ Skill Development :
Employability
Activities: Group Discussion, Assignment, Seminar
Assignment :

1. Types of chemical bonding
2. Electronic configuration of first 20 elements.
3. Types of electronic effects

Seminar Topic:

1.Ionic bonding
2. Covalent bonding
3.Types of organic reactions

Sample questions

Part A

1. In Davisson and Germer experiment, the metal used is----------.
2. Photo electric effect supports _____nature of light.

(a) atom (b) particle (c) ion (d) molecule

3. Ionisation energy _____ along a group.
4. The number of electrons in d orbitals is
   (a) 6 (b) 4 (c) 2 (d) 14
5. The energy released when one gram mole of a solid ionic crystal is formed from its gaseous ions is defined as _____ energy.
   (a) lattice (b) ionic (c) Born –Haber (d) thermal
6. Ionic bond is otherwise called as electrovalent bond. Say true or false.
7. The bond order for a nitrogen molecule is_____.
   (a) 2 (b) 3 (c) 1 (d) 0
8. The type of bonding in ammonia is_____.
   (a) ionic (b) covalent (c) coordinate (d) hydrogen
9. Electrophiles are electron _____ centres.
10. The charge of a carbocation is positive. Say true or false.

Part B

1. What is Compton effect? Write its significance.
2. Write notes on (i) Hunds rule (ii) Pauli's exclusion principle
3. Explain the scales of electronegativity.
4. Differentiate between orbit and orbital.
5. List the general characteristics of ionic compounds.
6. Write notes on Fajan's rule.
7. What are bonding, antibonding and non bonding orbitals?
8. Write the postulates of VB Theory.
9. What are electrophilic and nucleophilic reagents? Give examples.
10. What is Inductive effect? Explain the types.

Part C

1. How will you prove the wave nature of electrons proved using Davisson and Germer Experiment?.
2. Write the electronic configuration of first ten elements.
3. Explain the features of the modern periodic table.
4. Explain the periodic variation of ionisation energy, electron affinity and electronegativity.
5. Explain Born – Haber cycle and give its applications.
6. What is ionic bond? Explain the formation of ionic bonding.
7. Explain the conducting property of a conductor and a semi conductor using band theory.
8. Draw the MO diagrams of H_2, HF and CO molecules.
9. Explain the stability of reaction intermediates.
10. What is hyperconjugation? Explain the stability of alkenes using this effect.

Head of the Department **Course Instructor**

Dr. M. Anitha Malbi Dr. L. Deva Vijila

Department : **Chemistry**
Class : **I B.Sc Chemistry**
Title of the Course : **Foundation Course – Basics of Chemistry**
Semester : **I**
Course Code : **CU231FC1**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CU231FC1	2	-	-	2	2	30	25	75	100

Objectives

- To understand the concepts of periodic classification, chemical bonding, nomenclature of organic compound, isomerism and state of matter.
- To acquire knowledge on various spectroscopic techniques.

Course Outcomes (COs)

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO 1	remember the basic concepts of periodic classification, chemical bonding, nomenclature of organic compound, isomerism and state of matter.	PSO 1	K1(R)
CO 2	understand the periodic properties, types of bonding, hybridization, stereo isomerism, properties of matter and spectroscopy.	PSO 1	K2(U)
CO 3	apply the concepts of valence bond theory, hybridization, isomerism IUPAC nomenclature and spectroscopy to chemical compounds.	PSO 2	K3(Ap)
CO 4	analyze the periodic properties of elements, magnetic properties, characteristic of solids and types of spectroscopic techniques.	PSO 6	K4(An)
CO 5	evaluate quantum numbers and their significance and percentage of ionic character of compounds.	PSO 2	K5(E)

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Structure of atom and periodic classification of Elements and properties**					
	1	Atomic structure - fundamental particles - atomic mass - atomic number - isotopes - isobars - isotones - orbitals - quantum number and their significance.	2	K1(R)	Lecture using ppt	Simple definitions and discussion
	2	Shapes of s, p and d orbitals - rules governing electronic configuration in various its atomic orbitals. Periodic table - periodic laws (Mendeleev and Mosley) - classification of elements into s, p, d and f-blocks.	2	K3(Ap)	Lecture using chalk and talk	Slip test and MCQ
	3	Metals - non-metals - periodic properties - concept, variation and factors affecting various periodic properties - inert pair effect.	2	K2(U)	Lecture using chalk and talk	Concept explanation and short test
II	**Chemical Bonding**					
	1	Definition - types of chemical bond - ionic bond - ion polarization - dipole moment and percentage of ionic character.	1	K2(U)	Lecture using ppt	Oral test and discussion
	2	Covalent bond - definition - postulates of valence bond theory and concept of hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2, dsp^2, d^2sp^3).	2	K3(Ap)	Lecture using chalk and talk	Slip test
	3	Magnetic properties - paramagnetic - diamagnetic - ferromagnetic.	1	K4(An)	Lecture using chalk and talk	Short test
	4	Co-ordinate covalent bond - definition - examples - Co-ordination compounds (basic concepts only).	2	K2(U)	Lecture using chalk and talk	Short test and quiz

III	**Nomenclature and Isomerism in Organic compounds**					
	1	Carbon compounds - uniqueness of carbons - classification of hydrocarbons - IUPAC nomenclature of organic compounds.	2	K3(Ap)	Group discussion and problem solving	Problem solving
	2	Structural Isomerism: Chain isomerism, functional isomerism, positional isomerism and meta isomerism.	2	K2(U)	Lecture using ppt	Slip test
	3	Stereoisomerism: Geometrical and optical isomerism - chiral molecule - enantiomers - diastereomers - meso compounds - racemic mixture.	2	K2(U)	Lecture using videos and ppt	Short test and quiz
IV	**States of Matter**					
	1	Gaseous state: Kinetic theory of gases - ideal and non-ideal gases - Ideal gas equation - deviation of ideal gas from ideal behavior - vander Waal's equation and liquification of gases.	2	K2(U)	Lecture using chalk and talk	Concept explanations
	2	Liquids: Intermolecular forces, vapour pressure and boiling point of liquid - surface tension - viscosity - factors affecting surface tension and viscosity.	2	K3(Ap)	Lecture using ppt	Slip test and quiz
	3	Solids: Definition - characteristics of solids- amorphous and crystalline solids - space lattice and unit cells - close packed structure of solids- radius ratio rule.	2	K4(An)	Lecture using videos and ppt	Short test
V	**Introduction to Spectroscopy**					
	1	Electromagnetic radiation - general characteristics of wave - wavelength - frequency - amplitude - wavenumber - electromagnetic spectrum.	1	K2(U)	Lecture using ppt	Discussion
	2	Absorption and emission spectrum - quantization of Energy level - selection rule - intensity of the spectral lines - width of spectral lines.	2	K3(Ap)	Lecture using chalk and talk	Concept explanations

	3	Types of spectroscopy -Microwave spectroscopy, Infrared spectroscopy, UV-Visible spectroscopy, Nuclear Magnetic Resonance spectroscopy, Electron spin resonance spectroscopy	3	K4(An)	Lecture using ppt, chalk and talk	Short test and discussion

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Group discussion and Problem solving

Assignment: (Mention Topic and Type)

IUPAC nomenclature of simple organic compounds - Reflective writing

Sample questions

Part A

1. Who coined the word 'atom'?
   a) Rutherford b) Thomson c) Democritus d) Dalton
2. Identify the isobars from the following elements.
   a) $^{3}He_{2}$ and $^{4}He_{2}$ b) $^{24}Mg_{12}$ and $^{25}Mg_{12}$ c) $^{40}K_{19}$ and $^{40}Ca_{20}$ d) $^{40}K_{19}$ and $^{39}K_{19}$
3. Which of the following molecule have trigonal planar geometry?
   a) IF_3 b) NH_3 c) PCl_3 d) BF_3
4. 2-chloropropane and 1-chloropropane exhibit _____ isomerism.

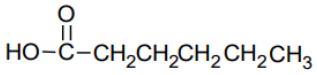
A compound with the same molecular formula exists in two forms one is alcohol and the other is Ether, what type of isomerism does it show?

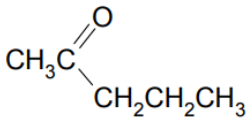
a) Metamerism b) Position isomerism c) Functional isomerism d) Chain isomerism

6. Non-ideal gases approach ideal behaviour under:
   a) high temperature and high pressure b) high temperature and low pressure
   c) low temperature and high pressure d) low temperature and low pressure
7. Which among the following liquids, is the good conductor of heat?
   a) Water b) Mercury c) Ether d) Alcohol
8. The process of changing from solid state to the gaseous state is known as _____.
9. The region of electromagnetic spectrum for nuclear magnetic resonance is _____
10. Identify the UV region.
    a) 200-300 nm b) 200-350 nm c) 300-400 nm d) 200-400 nm

Part - B

1. Differentiate isotopes, isobars and isotones.
2. Explain Mendeleev periodic law.
3. How will you determine the percentage of ionic character?
4. Determine the hybridization and geometry of the following compounds:
   (i) CO_2 (ii) H_2O (iii) NH_3 (iv) BF_3
5. Draw the structural formulas for the following compounds:
   (i) 2-methyl butane (ii) 2-propanol
6. Interpret the IUPAC nomenclature for the following compounds:

(i) 

(ii) 

7. Discuss the kinetic theory of gases.
8. Illustrate radius ratio rule with an example.
9. How will you determine the intensity of spectral lines?
10. Give the principle of electron spin resonance spectroscopy.

Part - C

1. Analyze the factors which affects the periodic properties.
2. Discuss the significance of quantum numbers.
3. Illustrate the postulates of valance bond theory.
4. Differentiate paramagnetic, diamagnetic and ferromagnetic materials.
5. Classify structural isomers with examples.
6. Differentiate enantiomers and diastereomers.
7. Discuss the factors which affects surface tension and viscosity of liquids.
8. Analyze the characteristics of solids.
9. Define the following term:
   (i) Wavelength (ii) Frequency (iii) Amplitude (iv) Wavenumber
10. Explain the principle of UV-Visible and IR spectroscopy.

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr.. L. Deva Vijila

Department : **Chemistry**
Class : **Elective Course I: Botany and Zoology Major**
Title of the Course : **Chemistry for Biological Sciences - I**
Semester : **I**
Course Code : **CU231EC1**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CU231EC1	4	-	-	3	4	60	25	75	100

Objectives

1. To know the significance and shapes of atomic orbitals.
2. To understand the basics of biophysical analysis and industrial chemistry.
3. To recognize the role of drugs, separation and purification techniques.

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	state the theories of chemical bonding and nuclear reactions	PSO - 1	K1(R)
CO - 2	evaluate the efficiencies and uses of various fuels and fertilizers.	PSO - 3	K5(E)
CO - 3	explain the type of hybridization, electronic effect and mechanism involved in theorganic reactions.	PSO - 1	K1(R)
CO - 4	demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics andartificial sugars.	PSO - 6	K3(A)
CO - 5	analyse various methods to identify an appropriate method for the separation of chemical compounds	PSO - 2	K4(An)

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
I	**Atomic Structure**					
	1	Dual nature of electron, de-Broglie equation, Davisson and Germer experiment.	3	K1(R)	Lecture with ppt	Oral test
	2	Heisenberg's uncertainty principle and its significance. Compton effect	3	K2(U)	Lecture using chalk and talk	Slip test
	3	Schrodinger's wave equation and its significance, eigen values and eigen functions, quantum numbers and their significance.	2	K2(U)	Seminar	Short test
	4	Atomic orbitals , significance , shapes , difference between orbit and orbital.	2	K3(Ap)	Lecture using ppt	Oral test and MCQ
	5	Rules for filling up of orbitals , Pauli's exclusion principle , Aufbau principle , Hund's rule. Electronic configuration of elements up to 20.	2	K4(An)	Lecture using chalk and talk	Short test
II	**Industrial Chemistry**					
	1	Fuels, Fuel gases, Natural gas, water gas, semi water gas	3	K2(U)	Lecture using chalk and talk	Oral test
	2	Carbureted water gas, producer gas, CNG, LPG and oil gas	3	K4(An)	Lecture using ppt	Quiz
	3	Silicones, Synthesis, properties and uses of silicones	3	K4(An)	Seminar	Short test and MCQ
	4	Fertilizers, Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate and triple superphosphate.	3	K3(Ap)	Lecture using chalk and talk	Short test and quiz
III	**Biophysical Analysis and Catalysis**					

	1	Osmosis, osmotic pressure and isotonic solutions	3	K1(R)	Lecture using videos	Short test
	2	Determination of molar mass by osmotic pressure measurement	3	K2(U)	Seminar	Oral test
	3	Reverse osmosis, adsorption , types and factors influencing adsorption and applications	3	K3(Ap)	Lecture using chalk and talk	Short test
	4	Catalysis , types , intermediate compound formation theory and adsorption theory	3	K3(Ap)	Lecture using ppt	Slip test and quiz
IV	**Drugs and Speciality Chemicals**					
	1	Definition and uses of antibiotics, Penicillin, chloramphenicol and streptomycin.	3	K2(U)	Lecture using chalk and talk	Slip test
	2	Anaesthetics , chloroform and ether. Antipyretics , aspirin, paracetamol and ibuprofen.	3	K4(An)	Seminar	Group discussion
	3	Artificial Sweeteners , saccharin, aspartame and cyclamate	3	K4(An)	Lecture using videos	Short test
	4	Organic Halogen compounds , freon and teflon	3	K2(U)	Lecture using ppt	Oral test
V	**Analytical Chemistry**					
	1	Introduction qualitative and quantitative analysis. Principles of volumetric analysis	4	K2(U)	Lecture using ppt	Slip test
	2	Separation and purification techniques, extraction, distillation and crystallization.	4	K2(U)	Lecture using chalk and talk	Short test
	3	Chromatography, principle and application of column, paper and thin layer chromatography.	4	K3(Ap)	Group Discussion	MCQ

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Group discussion and Seminar

Assignment: (Mention Topic and Type)

1. Silicones, Synthesis, properties and uses of silicones - Study Assignments

2. Chromatography, principle and application of column chromatography - Study Assignments

Seminar: (Mention Topic)

1. Quantum numbers and their significance.
2. Factors influencing adsorption and applications
3. Separation and purification techniques

Sample questions

Part - A

1. Give the Bragg's equation
   a) $n\lambda = 2d\sin\Theta$ b) $n\infty = 2d\sin\Theta$ c) $n\beta = 2d\sin\Theta$ d) $n\lambda = 2a\sin\Theta$
2. The Heisenberg's uncertainty principle is a proof for the dual nature of electron. Say true or false.
3. What is CNG ?
4. Water gas is ----------
5. Van't Hoff equation is ----------.
   a) P = cRT b) P = cVRT c) P = Crp d) P = cRV
6. The isotonic solutions have same molar concentration. Say true or false.
7. Which is the first antibiotic discovered ?
   a) Penicillin b) Chloramphenicol c)Streptomycin d)Vasopressin
8. Chloramphenicol is used in the treatment of
   a) leprosy b) rheumatoid c)typhoid fever d)cold
9. The method used in the purification of a solid organic compound when the impurities present in it is small in amount is ---------- .
10. The ratio between the distance travelled by solute and the distance travelled by the solvent is known as ----------

Part - B

1. Explain Compton effect .
2. Explain Pauli's exclusion principle and Aufbau principle.
3. Write notes on Natural gas and water gas.
4. Give the preparation of urea and ammonium sulphate.
5. How will you determine the molar mass by osmotic pressure measurement?
6. Discuss the factors influencing adsorption.
7. Write the uses of Penicillin and chloramphenicol.
8. Give the preparation and uses of saccharin and aspartame.
9. Discuss the principles of volumetric analysis.
10. Explain the principle and application of column chromatograghy.

Part - C

1. Explain the quantum numbers and their significances.
2. Explain the shapes of atomic orbitals.
3. Discuss the synthesis, properties and uses of silicones.
4. Write notes on Carburated water gas and producer gas.

5. Discuss the applications of adsorption.
6. Explain the intermediate compound formation theory and adsorption theory.
7. Write the structure and uses of aspirin, paracetamol and ibuprofen.
8. Write notes on freon and teflon.
9. Explain the principle and application of paper chromatography.
10. Discuss the principle and application of thin layer chromatography.

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr. R. Gladis Latha

Department : Chemistry
Title of the Course : NME I : Food Chemistry
Semester : I
Course Code : CU231NM1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231NM1	**2**	**-**	**-**	**-**	**2**	**2**	**30**	**25**	**75**	**100**

Learning Objectives:

1. To know about adulterations used in food and their impact on health.
2. To learn the different types of additives used in food.
3. To gain knowledge on diseases caused by beverages

Course Outcomes

COs	*Upon completion of this course, the students will be able to*:	PSO addressed	Cognitive level
CO - 1	remember and recall the different types of adulterants in food, edible oils used in foods and beverages.	PSO -2	K1(R)
CO - 2	understand the effect of chemicals in common food and their adverse impact on health.	PSO -1	K2(U)
CO - 3	apply various methods to detect various adulterants in food and to determine the values of oils and fats.	PSO -4	K3(A)
CO - 4	analyze the effects of contaminants and additives in food.	PSO -2	K4(An)
CO - 5	remember and recall the different types of adulterants in food, edible oils used in foods and beverages.	PSO -2	K5(E)

Teaching plan
Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Food Adulteration**					
	1	Sources of food, types, advantages and disadvantages.	1	K2(U)	lecture using chalk and talk	Slip test and concept explanations
	2	Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals.	3	K3(A)	Seminar	class test
	3	Common adulterants, Ghee adulterants and their detection.Detection of adulterated foods by simple analytical techniques.	2	K4(An)	lecture using chalk and talk	Short test
II	**Food Poison**					
	1	Food poisons - natural poisons (alkaloids - nephrotoxin).	3	K2(U)	Lecture using videos and ppt	Short summary or overview
	2	Pesticides, (DDT, BHC, Malathion) -Chemical poisons.	1	K2(U)	Lecture using chalk and talk	Slip test and class test
	3	First aid for poison consumed victims	2	K3(A)	Group discussion	Problem solving
III	**Food Additives**					
	1	Food additives - artificial sweeteners-Saccharin-Cyclomate and Aspartate	2	K2(U)	Lecture using ppt	Concept explanations
	2	Food flavours - esters, aldehydes and heterocyclic compounds – Food colours – Emulsifying agents.	2	K4(An)	Seminar	Slip test

	3	Preservatives -leavening agents. Baking powder – yeast – tastemakers – MSG - vinegar.	2	K3(A)	Lecture	Oral test
IV	**Beverages**					
	1	Beverages-soft drinks-soda-fruit juices-alcoholic beverages-examples	3	K2(U)	Lecture using videos and ppt	Concept explanations and short summary
	2	Carbonation-addiction to alcohol– diseases of liver and social problems.	3	K4(An)	Lecture using chalk and talk	Slip test and quiz
V	**Edible Oils**					
	1	Fats and oils - Sources of oils - production of refined vegetable oils - preservation	2	K3(A)	Group discussion	slip test
	2	Saturated and unsaturated fats and oils-examples - iodine value - determination of iodine value, acid value.	2	K2(U)	Lecture using chalk and talk	Short test
	3	RM value, saponification values and their significance-Role of MUFA and PUFA in preventing heart diseases.	2	K5(E)	Group discussion, and Peer tutoring	group discussion and slip test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em/SD): Think-Pair-Share and Seminar

of

Assignment: (Mention Topic and Type)

Disadvantages of Food colours

Seminar: (Mention Topic)

Unit :I

Sources of lipids and proteins

Unit :IV

Disadvantages of alcohol beverages

Sample questions

Part - A

1. Carbohydrates are the polymers of _____-
   a) Sugars b) Fibres c) Amino acids d) Fats
2. Proteins are the polymers of α-amino acids. Say true or false
3. The main source of energy for central nervous system (CNS) is_____
   a) Fats b) Glucose c) Ghee d) Vegetable oil
4. The iodine number of pure ghee is _____
   a) 34.00 b) 36.50 c) 38.10 d) 38.70
5. The most common analytical method of detection of adulterant is_____
   a) NMR b) IR c)HPLC d) ESR

7. The adulterant used in wheat flour is _____.
   a)Talc b)Brick powder c)saccharin d)Tea dust
8. The saponification value of pure ghee is 17. Say true or false.
9. Which of the following adulterant is added in rice?
   a) starch b) mud ball c) dextrine d) glucose

10. Which hormone controls the level in the blood.
    a)Protiens b)Carbohydrates c)Lipids d) Progestrone

Part - B

1. How will you detect the adulterants present in ghee?
2. Explain the action of DDT and BHC against pesticides.
3. Explain the advantages and disadvantages of lipids.
4. Write notes on food poison. Give examples.
5. Discuss the potential hazards of chemical poision
6. Write a note on artificial sweeteners.
7. Define food flavours? Give examples and their uses.
8. Write a notes on
   i) Baking powder ii) taste makers.
9. Explain the methods of carbonation.
10. Discuss the social problems due to alcoholism.

Part- C

1. How will you detect the adulterated foods by simple analytical techniques.
2. Analyse the adulterants present in milk, butter and ghee.
3. Discuss about the first aid for poison consumed victims.
4. Classify beverages with examples.
5. What are preservatives in food. Explain their role in food preservation.
6. Explain emulsifying agent and preservatives

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr.Y.Christabel Shaji

Department : **Chemistry**

Class : **II B.Sc Chemistry**

Title of the Course : **General Chemistry - III**

Semester : **III**

Course Code : **CU233CC1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233CC1	5	-	-	-	5	5	75	25	75	100

Pre-requisite: General Chemistry – I and II

Learning Objectives:

1. To know the properties of applications of chemical compounds
2. To analyse the kinetics of gases, crystal systems, nuclear radioactivity and chemical reactions

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	remember the classification and properties of chemical compounds	**K1**
2.	understand the basic concepts of states of matter, nuclear radioactivity and organic reactions	**K2**
3.	apply the concepts and mechanism in gases, liquids, solids, radioactivity and organic reactions	**K3**
4.	analyze the properties of gases, liquids, solids and mechanisms of chemical reactions	**K4**
5.	evaluate the kinetics of gases, crystal structure, nuclear reactions and properties of organic reactions	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Gaseous state**					
	1	General characteristics of gases - postulates and derivation from the kinetic gas equation	3	K2(U)	Lecture using Chalk and talk	Evaluation through short test
	2	The Maxwell-Boltzmann distribution of speed of molecules - average, root mean square and most	3	K3(A)	Lecture using chalk and talk	Short test

		probable velocity and average kinetic energy				
	3	Collision frequency - collision diameter - mean free path and viscosity of gases	3	K3(A)	Flipped classroom and lecture using chalk and talk	Evaluation through MCQ
	4	Real gases - deviations from ideal gas behaviour compressibility factor - Z and its variation with pressure for different gases	3	K3(A)	Group Discussion	Slip test and MCQ
	5	Equations of states for real gase - Virial equation and van de waal's equation	3	K4(An)	Lecture using chalk and talk	Group discussion and short test
II	**Liquid and Solid State**					
	1	Properties of liquids - surface tension and viscosity. Crystalline and amorphous - isotropy and anisotropy - isomorphism and polymorphism	3	K4(An)	Lecture using videos and ppt	Short summary or overview
	2	Crystals - size and shape - symmetry elements - plane, centre and axis - Miller indices - unit cells and space lattices. Classification of crystal systems - Bravais lattices	3	K2(U)	Lecture using chalk and talk	Slip test and class test
	3	X - ray diffraction and Bragg's equation. Packing in atomic solids - simple cubic - body centered cubic - face centered and hexagonal close packing	3	K2(U)	Group discussion and problem solving	MCQ
	4	Co-ordination number in typical structures - NaCl - CsCl - ZnS and TiO_2.	3	K3(A)	Lecture using chalk and talk	Short test and quiz
	5	Structure and properties of diamond and graphite. Defects in solids - stoichiometric and nonstoichiometric defects.	3	K4(An)	Lecture using chalk and talk	Short summary or overview
III	**Nuclear Chemistry**					
	1	Natural radioactivity - α, β and γ rays - half-life period - Fajan-Soddy group displacement law - Geiger-Nattal rule - isotopes - isobars - isotones - nuclear isomerism	3	K2(U)	Lecture using ppt	Concept explanations

		- radioactive decay series - magic numbers - units				
	2	Curie - Rutherford - Roentgen - nuclear stability - neutron-proton ratio - binding energy - packing fraction and mass defect.	3	K3(A)	Group Discussion &Lecture using chalk and talk	Slip test
	3	Derivation of decay constant - half-life period and radiocarbon dating. Nuclear energy - nuclear fission and fusion - major nuclear reactors in India	3	K4(An)	Lecture using chalk and talk	Short summary or overview
	4	Radiation hazards - disposal of radioactive waste and safety measures.	3	K3(A)	Lecture using chalk and talk	Slip test and quiz
	5	Applications of radioactivity in medicine, agriculture and industry.	3	K3(A)	Seminar	Group discussion
IV	**Halogen Compounds**					
	1	**Aliphatic halogen compounds** General methods of preparation - physical and chemical properties. Mechanism and stereochemistry of aliphatic S_N1 and S_N2 reactions	4	K2(U)	Lecture using videos and ppt	Concept explanations and short summary
	2	Difference between S_N1 and S_N2 mechanism. Factors influencing the rate of aliphatic nucleophilic substitution reaction. Preparation - properties and uses of chloroform - iodoform and carbon tetrachloride	4	K3(A)	Lecture using chalk and talk	Slip test and quiz
	3	Aromatic halogen compounds General methods of preparation - physical and chemical properties. properties of aryl halides	3	K2(U)	Lecture using chalk and talk	Short summary
	4	Mechanism of aromatic S_N1, S_N^{Ar} and benzyne reactions. Preparation - properties and uses of D.D.T and B.H.C	4	K3(A)	Lecture using chalk and talk, mind mapping and	Group discussion and class test

					group discussion	
V	**Alcohols and Phenols**					
	1	General methods of preparation - physical and chemical properties. Ascent and descent series.	2	K2(U)	Introductory session Lecture using videos and ppt	Short test
	2	Preparation - properties and uses of allyl alcohol, ethylene glycol and glycerol. Estimation of number of hydroxyl groups in polyhydroxy alcohols	4	K2(U)	Lecture using chalk and talk	Class test
	3	General methods of preparation - physical and chemical properties. Acidic character of phenol and effect of substituent on the acidity of phenol.	3	K2(U)	Lecture using chalk and talk &Group Discussion	Problem-solving questions
	4	Electrophilic substitution reactions - Reimer-Tiemann - Kolbe-Schmidt - Gatermann synthesis	4	K3(A)	Lecture using chalk and talk	Slip test
	5	Libermann nitroso and phthalein reactions. Preparation, properties and uses of catechol - resorcinol - quinol and pyrogallol	2	K3 (A)	Lecture using chalk and talk	Slip test and quiz

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability and Skill Development

Activities (Em/SD): Demonstration of Miller indices - unit cells and space lattices

Assignment: (Mention Topic and Type)

Chemical properties of alcohols - Reflective writing

PART A

1.What is the compressibility factor (Z) of an ideal gas?

a) 0 b) 1 c) -1 d) 2

2. The most probable velocity of gas molecules is

a) Higher than the average velocity b) Lower than the average velocity

c) Equal to the root mean square velocity d) Dependent on the type of gas only.

3. Bragg's equation is used to determine----------.

a) The density of crystals b) The atomic number of elements

c) The wavelength of X-rays d) The crystal structure

4. The co-ordination number in a body-centered cubic (BCC) structure is----------.

a) 4 b) 6 c) 8 d) 12

5. Which type of defect does not change the stoichiometry of a crystal?
   a) Interstitial defect b) Frenkel defect
   c) Schottky defect d) Substitutional defect
6. Which unit measures the activity of a radioactive substance?
   a) Curie b) Rutherford c) Roentgen d) Becquerel
7. Radiocarbon dating is used to determine the age of
   a) Living plants b) Organic materials
   c) Inorganic minerals d) Water samples.
8. Which of the following statement is correct?
   a) No intermediate is always involved in the S_N^2 mechanism
   b) S_N^2 reactions are a one-step reaction
   c) S_N^2 reaction always follows the second-order kinetics
   d) All of these
9. What is the product formed when chloroform reacts with aqueous sodium hydroxide and iodine?
   a) Chloroform b) Iodoform c) Carbon tetrachloride d) Ethanol
10. Which of the following correctly describes the S_N^{Ar} mechanism in aromatic halogen compounds?
   a) It proceeds through a carbocation intermediate.
   b) It involves the formation of a Meisenheimer complex.
   c) It is a single-step nucleophilic attack.
   d) It involves an elimination-addition mechanism

PART B

1. Explain the concept of the Maxwell-Boltzmann distribution of molecular speeds.
2. Analyze the effect of temperature on the mean free path of gas molecule
3. Compare the packing efficiency of simple cubic, body-centered cubic, and face-centered cubic lattices
4. Compare and contrast the uses of radioactivity in medicine and industry
5. Differentiate S_N^1 and S_N^2 reaction mechanisms
6. Explain the preparation, properties and uses of D.D.T and B.H.C

PART C

1. Calculate the average kinetic energy of a gas molecule at a given temperature
2. Analyze the structural differences between diamond and graphite
3. Describe the process of nuclear fission and its application in nuclear reactors
4. Explain the applications of radioactivity in medicine, agriculture and industry.
5. Compare the preparation and properties of chloroform and iodoform
6. Explain the preparation and properties of aliphatic halogen compounds
7. Analyze the mechanism of aromatic nucleophilic substitution reaction

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr. Y. Christabel Shaji

Department : **Chemistry**

Class : **II B.Sc Chemistry**

Title of the Course : **Applied Chemistry**

Semester : **III**

Course Code : **CU233SE1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233SE1	2	-	-	-	2	2	30	25	75	100

Learning Objectives

1. To transform the acquired theoretical knowledge to industry and vice-versa
2. To familiarize with synthesis of chemicals used in day today life and to develop entrepreneurship skills.

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	remember the synthesis of chemicals used in day today life	PSO-1	K1
CO - 2	understand the effects of adulteration in food and hazards of chemicals	PSO-2	K2
CO - 3	illustrate the different processes of water softening and estimation of hardness of water and uses of chemicals	PSO-3	K3
CO - 4	analyze the action of chemicals and purity of water	PSO-4	K4
CO - 5	evaluate the composition of blood and validate the application of chemicals	PSO-4	K5

Teaching plan

Total Contact hours: 30hrs(Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Soaps and Detergents**					
	1	Soaps: Definition-classification-raw materials used in the manufacture of soap manufacture of toilet soap.	2	K1(R)	Lecture using models, chalk and talk	Slip test and concept explanations

	2	Detergents: Definition -various types with examples	2	K2(U)	Lecture using power point	Group discussion
	3	Advantages of detergents over soaps -cleansing action of soap.	2	K4(An)	Lecture using chalk and talk	Short test
II	**Chemicals of everyday use**					
	1	Preparation and uses of the following articles. Tooth powder, tooth paste, writing inks	2	K2(U)	Lecture using chalk and talk	Short test
	2	Preparation and uses of gum paste, boot polish, talcum powder, chalk crayons	2	K3(A)	Lecture using chalk and talk	Mentimeter
	3	Preparation and uses of agar battis, phenyl and moth balls.	2	K3(A)	Lecture using chalk and talk	Short test and MCQ
III	**Adulteration in Food**					
	1	Adulteration of Food- Simple methods to find adulteration of milk, food, oils (edible and-mineral) and honey -	2	K1(R)	Lecture using chalk and talk	Concept explanation
	2	Food poisoning and its prevention - Antibodies - Food preservation, colouring, flavouring	2	K2(U)	Lecture using chalk and talk, Group discussion	Slip test
	3	Sweetening agents in catering technology - Carcinogens of food materials.	2	K3(A)	Lecture using powerpoint	Short test
IV	**Water Treatment**					
	1	Water treatment: hardness of water temporary and permanent hardness, disadvantages of hard water.	2	K2(U)	Lecture using power point	Slip test

	2	Estimation of hardness by EDTA method. Water purification process – ion exchange, reverse osmosis, activated charcoal treatment	2	K1(R)	Lecture using chalk and talk	Group discussion , slido
	3	Desalination, Disinfection – ozone, UV, chlorination, BIS- specification of drinking water.	2	K5(E)	Lecture using chalk and talk	Short test
V	**Clinical Chemistry**					
	1	Composition of blood - blood grouping - identification of blood groups and matching.	2	K5(E)	Lecture using chalk and talk	Slip test
	2	Determination of glucose in serum, estimation of glucose in urine.	2	K5(E)	Lecture using powerpoint, Seminar	Concept explanation
	3	Tests for salts in serum and urine. Estimation of cholesterol in serum.	2	K2(U)	Lecture using chalk and talk, Group discussion	Short test

Course Focussing on Employability/ Entrepreneurship/ Skill Development :
Entrepreneurship and Skill Development
Activities: Group Discussion, Assignment, Seminar
Assignment :

4. Methods to find food adulteration
5. Hardness of water
6. Composition of blood

Seminar Topic:

1. Types of soaps
2. Estimation of hardness of water

Sample questions

Part A

1.What are soaps?
2.How will you prepare gum paste?
3.What is adulteration of food?
4.Define hard water.
5.What is blood grouping?

Part B

1. Differentiate between soaps and detergents.
2. Give the preparation and uses of tooth powder and moth balls.
3. What is food poisoning? How will you prevent it?
4. Explain the different types of hardness of water.
5. How will you determine glucose in serum?

Part C

1. Explain the cleansing action of soap.
2. Write the preparation and uses of a) tooth paste b) phenyl and c) chalk crayons
3. What are the various methods adopted to find the adulteration in food?
4. How will you estimate the hardness of water?
5. Explain the composition of blood.

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr. Y. Christabel Shaji

Department : **Chemistry**

Class : **II B.Sc Physics**

Title of the Course : **Chemistry for Physical Sciences – I**

Semester : **III**

Course Code : **CU233EC1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233EC1	**4**	**-**	**-**	**-**	**3**	**4**	**60**	**25**	**75**	**100**

Prerequisites: Higher secondary chemistry

Learning Objectives

1. To know the basics of atomic orbitals, chemical bonds and hybridization
2. To understand the concepts of thermodynamics, phase rule, nuclear chemistry and its applications.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	remember the classification and properties of chemical compounds	**K1**
2.	understand the basic concepts of states of matter, nuclear radioactivity and organic reactions	**K2**
3.	apply the concepts and mechanism in gases, liquids, solids, radioactivity and organic reactions	**K3**
4.	analyze the properties of gases, liquids, solids and mechanisms of chemical reactions	**K4**
5.	evaluate the kinetics of gases, crystal structure, nuclear reactions and properties of organic reactions	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Chemical Bonding and Nuclear Chemistry**					
	1	Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals.	2	K2(U)	Lecture using Chalk and talk	Concept explanations
	2	Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.	3	K3(A)	Lecture using chalk and talk	Slip test

	3	Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers	3	K3(U)	Flipped classroom and lecture using chalk and talk	Evaluation through MCQ
	4	Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations.	2	K3(A)	Group Discussion	Slip test
	5	Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes – carbon dating, rock dating and medicinal applications.	2	K4(An)	Group discussion and Peer Teaching	Short test
II	**Industrial Chemistry**					
	1	Fuels: Fuel gases: Natural gas, water gas, semi water gas,	2	K2(U)	Lecture using videos and ppt	Short summary
	2	carbureted water gas, producer gas, CNG, LPG and oil gas	2	K2(U)	Lecture using chalk and talk	Class test
	3	Silicones: Synthesis, properties and uses of silicones.	3	K3(A)	Group discussion and problem solving	MCQ
	4	Fertilizers: Urea, ammonium sulphate, potassium nitrate,	3	K3(A)	Lecture using chalk and talk	Short test and quiz
	5	NPK fertilizer, superphosphate, triple superphosphate.	2	K4(An)	Lecture using ppt	Short summary or overview
III	**Fundamental Concepts in Organic Chemistry**					
	1	Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6.	2	K4(An)	Lecture using models	Concept explanations
	2	Electronic effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric- examples.	3	K3(A)	Lecture using chalk and talk	Slip test

	3	Reaction mechanisms: Types of reactions–aromaticity (Huckel's rule)	2	K2(U)	Lecture using chalk and talk	Short summary or overview
	4	Aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation.	3	K3(A)	Lecture using chalk and talk	Slip test and quiz
	5	Heterocyclic compounds: Preparation, properties of pyrrole and pyridine	2	K3(A)	Seminar	Group discussion
IV	**Thermodynamics and Phase Equilibria**					
	1	Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes.	3	K2(U)	Lecture using videos and ppt	Concept explanations and short summary
	2	Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine.	2	K3(A)	Lecture using chalk and talk	Slip test and quiz
	3	Entropy and its significance. Free energy change and its importance. Conditions for spontaneity in terms of entropy and Gibbs free energy.	3	K2(U)	Lecture using chalk and talk	Short summary
	4	Relationship between Gibbs free energy and entropy. Phase Equilibria: Phase rule - definition of terms in it	2	K3(A)	Lecture using chalk and talk, mind mapping and group discussion	Group discussion and class test
	5	Applications of phase rule to water system. Two component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag).	2	K3(A)	Lecture using chalk and talk	Slip test and quiz
V	**Analytical Chemistry**					
	1	Introduction to qualitative and quantitative analysis. Principles of volumetric analysis.	3	K2(U)	Introductory session Lecture using videos and ppt	Solving problems and slip test

	2	Separation and purification techniques – extraction, distillation and crystallization.	2	K4(An)	Lecture using chalk and talk	Simple Definitions & MCQ
	3	Chromatography: principle and application of column chromatography	3	K3(A)	Lecture using chalk and talk &Group Discussion	Problem-solving questions
	4	Principle and application of paper chromatography.	2	K3(A)	Lecture using chalk and talk	Slip test
	5	Principle and application of thin layer chromatography.	2	K3 (A)	Lecture using chalk and talk	Class test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability and Skill Development
Activities (Em/SD): Demonstration of chromatographic techniques

Assignment: (Mention Topic and Type)
Applications of radioisotopes - Preparing Album

PART - A

1. What is the compressibility factor (Z) of an ideal gas?
   a) 0 b) 1 c) -1 d) 2
2. The most probable velocity of gas molecules is
   a) Higher than the average velocity b) Lower than the average velocity
   c) Equal to the root mean square velocity d) Dependent on the type of gas only.
3. Bragg's equation is used to determine
   a) The density of crystals b) The atomic number of elements
   c) The wavelength of X-rays. d) The crystal structure
4. The coordination number in a body-centered cubic (BCC) structure is
   a) 4 b) 6 c) 8 d) 12
5. Which type of defect does not change the stoichiometry of a crystal?
   a) Interstitial defect b) Frenkel defect c) Schottky defect d) Substitutional defect
6. Which unit measures the activity of a radioactive substance?
   a) Curie b) Rutherford c) Roentgen d) Becquerel
7. Radiocarbon dating is used to determine the age of
   a) Living plants b) Organic materials c) Inorganic minerals d) Water samples.

PART - B

1. Explain the concept of the Maxwell-Boltzmann distribution of molecular speeds.
2. Differences between chemical reactions and nuclear reactions .
3. Differentiate nuclear fission and nuclear fusion reaction.
4. Classify the types and uses of fuels.

5. Explain the synthesis and applications of silicones.
6. Compare thermal and photochemical reactions.
7. Draw and explain the structure of CH_4.
8. Explain the preparation and properties of pyrrole.

PART - C

1. Draw the MO diagram of nitrogen molecule and calculate its bond order.
2. Explain the applications of radioisotopes medicinal industry.
3. Analyse the mechanisms of aromatic electrophilic substitution reactions
4. Explain the preparation urea, ammonium sulphate and NPK fertilizers.
5. Explain Carnot's cycle and efficiency of heat engine.

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr. M. Anitha Malbi

Department : **Chemistry**
Class : **III B.Sc Chemistry**
Title of the Course : **Core V: Organic Chemistry - I**
Semester : **V**
Course Code : **CC2051**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2051	5	-	-	5	5	75	30	70	100

Objectives

- To understand symmetry elements, stereo isomerism and conformational analysis of organic compounds.
- To know the methods of synthesis and the reactions of carbonyl, nitrogen containing and heterocyclic compounds.

Course Outcomes (COs)

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	understand the concept of optical activity, stereoisomerism and stereo isomers	PSO - 1	K2(U)
CO - 2	remember the preparation and synthesis of carbonyl, nitrogen containing and heterocyclic compounds	PSO - 4	K1(R)
CO - 3	apply the synthetic methods to synthesize new compounds	PSO - 4	K3(Ap)
CO - 4	analyze the synthetic importance of different organic compounds	PSO - 2	K4(An)
CO - 5	create alternate routes to prepare new compounds	PSO - 5	K6(C)

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/Evaluation
I	**Stereochemistry**					
	1	Optical activity-elements of symmetry, optical activity of compounds containing asymmetric carbon atoms - lactic and tartaric acids. Chirality-achiral carbon molecules - (+), (-) and D, L notations.	3	K2(U)	Lecture using models, chalk and talk	Slip test and concept explanations
	2	Projection formulae-Newmann, Fischer, Flying wedge, Sawhorse and projection formulae notation for optical isomers, Cahn - Ingold and Prelog rules, R-S notation.	2	K3(Ap)	Group discussion and problem solving	Problem solving
	3	Enantiomers and diastereomers, racemic and mesoforms. Racemisation-resolution of racemic mixtures. Walden inversion and asymmetric synthesis.	2	K4(An)	Lecture using chalk and talk	Short test
	4	Optical activity of compounds without asymmetric carbon atoms-biphenyl, allenes and spiranes.	2	K2(U)	Lecture using chalk and talk	Slip test and MCQ
	5	Geometrical isomerism: Maleic and fumaric acid- aldoximes and ketoximes. Methods of distinguishing geometrical isomers, determination of configuration of ketoximes - Beckmann rearrangement, E-Z notation.	3	K3(Ap)	Lecture using chalk and talk, group discussion and problem solving	Group discussion and problem solving
	6	Conformational Analysis: Introduction of terms-configuration and conformation, dihedral angle, torsional strain, conformational analysis of ethane, n-butane, 1,2-dichloro ethane and cyclohexane.	3	K3(Ap)	Lecture using models, chalk and talk	Concept explanations and slip test
II	**Carbonyl Compounds - I (Aldehydes and Ketones)**					
	1	Synthesis of aldehydes from acid chlorides, Stephen's reduction -	2	K2(U)	Lecture using chalk and talk	Short test

		Gattermann-Koch and Etard reactions.				
	2	Synthesis of ketones from nitriles, dialkylcadmium, alkyl lithium and lithium dialkylcuprate and Friedel-Crafts and Hoesch reactions.	3	K3(Ap)	Lecture using chalk and talk	Slip test
	3	Mechanism of nucleophilic additions to carbonyl group -addition of HCN, alcohols, thiols, sodium bisulfite, Grignard reagents -condensation with ammonia and its derivatives	2	K4(An)	Lecture using chalk and talk	Short test and MCQ
	4	Aldol, Perkin, Benzoin and Knoevenagel condensations, Wittig reaction, Mannich reaction, Reformatsky reaction and Cannizaro reaction.	4	K3(Ap)	Lecture using chalk and talk	Short test and quiz
	5	Oxidation by Tollen's reagent, $KMnO^4$, hypohalite, SeO_2 and peracids. Reduction by H_2/Ni, H_2-Pd-C, $NaBH_4$, $LiAlH_4$, MPV, Clemmenson and Wolff-Kishner reductions, α, β unsaturated aldehydes and ketones – preparation and reactions.	4	K3(Ap)	Lecture using chalk and talk	Slip test
III	**Carbonyl Compounds – II (Carboxylic acids and their derivatives)**					
	1	Preparation of carboxylic acids, acidity of carboxylic acids, effects of substituents on acid strength, acidity of aliphatic and aromatic acids.	3	K1(R)	Lecture using chalk and talk	Concept explanations
	2	Reactions of carboxylic acids - Hell-Volhard-Zelinsky reaction, Synthesis of acidchlorides, esters and amides, Reduction of carboxylic acids, methods and mechanism of decarboxylation.	3	K2(U)	Lecture using chalk and talk	Slip test
	3	Methods of preparation and chemical reactions of halo acids - Hydroxy acids - malic, tartaric and citric acids - unsaturated monocarboxylic acids - dicarboxylic acids.	3	K3(Ap)	Lecture using chalk and talk	Short test

	4	Preparation and reactivity of carboxylic acid derivatives - acid chlorides, esters, amides and anhydrides - Mechanisms of esterification and hydrolysis – acid catalysed reactions.	3	K3(Ap)	Lecture using chalk and talk	Slip test and quiz
	5	Relative stability of acyl derivatives - interconversion of acid derivatives by nucleophilic acyl substitution.	3	K2(U)	Lecture using chalk and talk	Concept explanations
IV	**Nitrogen Containing Compounds**					
	1	Preparation of nitroalkanes and nitroarenes - Chemical reactions of nitroalkanes and nitroarenes - reduction in acidic, neutral and alkaline media.	3	K2(U)	Lecture using chalk and talk	Slip test
	2	Methods of preparation of alkyl and aryl amines – Ritter reaction, Hofmann ammonolysis – Hofmann degradation – Schmidt, Curtius reaction - Leuckart reaction- Ullmann reaction - Gabriel phthalimide reaction and Hofmann reaction.	4	K3(Ap)	Lecture using chalk and talk	Slip test and quiz
	3	Separation of a mixture of primary, secondary and tertiary amines - Hinsberg's and Hofmann's method	3	K4(An)	Lecture using chalk and talk	Short test
	4	Basicity of amines - basicity of aliphatic and aromatic amines - reactions of amines.	2	K4(An)	Lecture using chalk and talk	Group discussion
	5	Aryl diazonium salts – benzene diazonium chloride -preparation, reactions and synthetic transformations.	3	K3(Ap)	Lecture using chalk and talk	Short test
V	**Heterocyclic Compounds**					
	1	Aromatic characteristics of pyrrole, furan, thiophene and pyridine.	2	K2(U)	Lecture using chalk and talk	Slip test
	2	Comparison of the basicity of pyridine, piperidine and pyrrole.	2	K4(An)	Lecture using chalk and talk	Concept explanations
	3	Methods of synthesis and chemical reactions with special emphasis on the mechanism of electrophilic substitution and mechanism of	3	K4(An)	Lecture using chalk and talk	MCQ

		nucleophilic substitution reaction in pyridine derivatives.				
	4	Preparation and reactions of indole, quinoline and isoquinoline - Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis.	4	K3(Ap)	Lecture using chalk and talk	Short test
	5	Reactions and mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.	4	K3(Ap)	Lecture using chalk and talk	Short test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Group discussion and Problem solving on R,S and E,Z nomenclature

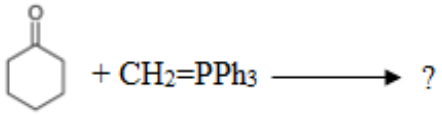
Assignment: (Mention Topic and Type)

3. Interpretation of R,S and E,Z nomenclature of stereoisomers - Reflective writing
4. Methods of preparation of alkyl and aryl amines - Study assignment

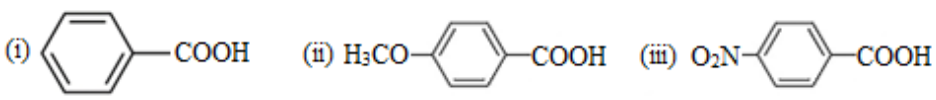
Sample questions

Part A

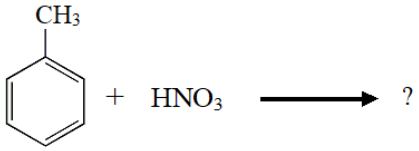
1. Which of the following group has the highest priority according to the Cahn-Ingold-Prelog sequence rules?
   a) CH_3 b) CH_2Cl c) CH_2OH d) CHO
2. Arrange the conformers of cyclohexane in the increasing order of stability.
   a) Chair < Boat < Twist boat < Half-chair b) Half-chair < Boat < Twist boat < Chair
   c) Chair < Twist boat < Half-chair <Boat d) Chair < Twist boat < Boat < Half-chair
3. Choose the incorrect statement:
   a) Carbonyl carbon is sp^2hybridised
   b) Aldehydes on reaction with HCN givecyanohydrins
   c) Ketones can be oxidised by Tollen's reagent
   d) Grignard reagent provides nucleophile
4. Identify the product of the following reaction:



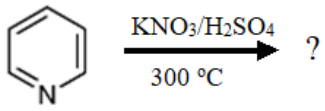
5. Arrange the following acids in the increasing order of acidity:



6. Assertion (A): Malic acid on reduction with HI gives succinic acid
   Reason (R) : Malic acid having two chiral carbon atoms
   a) Both A and R are true b) A is true but R is false
   c) R is true but A is false d) Both A and R are false
7. Complete the following reaction:

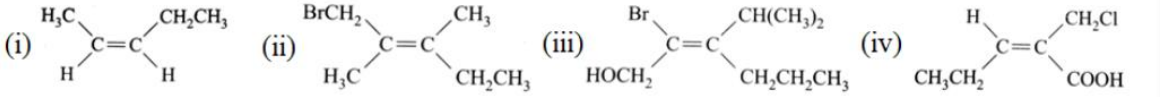


8. Which one of the following is least basic?
   a) Cyclohexamine b) Triethylamine
   c) Dimethylamine d) Triphenylamine
9. Identify the catalyst involved in Fischer Indole synthesis.
   a) $SnCl_2$ b) HCl c) NaCl d) $ZnCl_2$
10. Predict the product of the following reaction:



Part - B

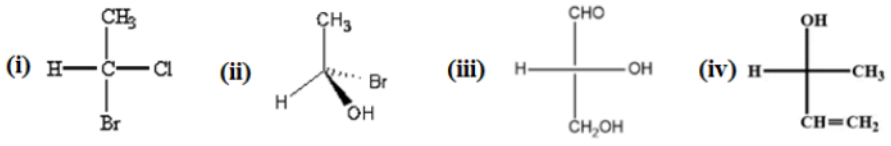
1. Assign E or Z configuration for the following compounds:

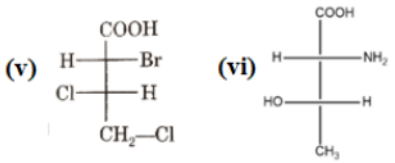


2. How will you determine the configuration of ketoxime using Beckmann rearrangement?
3. Design the mechanism for the synthesis of 4-methylbenzaldehyde using Gattermann-Koch synthesis.
4. Predict the mechanism for the conversion of benzaldehyde to cinnamic acid.
5. Compare the relative stability of acyl derivatives.
6. Interpret the mechanism of esterification with an example.
7. Discuss Gabriel phthalimide reaction.
8. How will you separate mixture of amines by Hofmann's method?
9. Explain the mechanism of electrophilic substitution reaction with an example.
10. Discuss the aromatic features of pyrrole and furan.

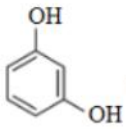
Part - C

1. Assign R or S configuration for the following compounds:





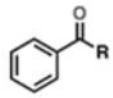
2. Illustrate the optical activity of allenes with examples.
3. Complete the following reactions:

(i)  + HCN + HCl $\xrightarrow[H_2O/H^+]{ZnCl_2}$?

(ii) $C_6H_5CHO + C_6H_5MgBr \xrightarrow{THF}$?

(iii) $CH_3CHO + NaHSO_3 \longrightarrow$?

(iv) $C_6H_5\text{-}CH{=}CH\text{-}CHO \xrightarrow{LiAlH_4}$?

(v)  + $NH_2\text{-}NH_2 \xrightarrow{KOH}$?

(vi) $CH_3CHO + 2Ag(NH_3)_2^+OH^- \longrightarrow$?

4. Illustrate the mechanism of Knoevenagel and Reformatsky reactions.
5. Explain the chemical reactions of tartaric and citric acids.
6. Discuss any four reactions of carboxylic acid.
7. Deduce the mechanism of Ritter reaction and Hoffmann degradation.
8. Compare the basicity of amines.
9. Analyse themechanism for the synthesis of quinoline and isoquinoline
10. Compare the basicity of pyridine, piperidine and pyrrole.

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr. Sheeba Daniel

Department : **Chemistry**
Class : **III B.Sc Chemistry**
Title of the Course : **Inorganic Chemistry**
Semester : **V**
Course Code : **CC2052**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2052	4	1	-	5	5	75	30	70	100

Objectives

- To understand the chemistry of transition, inner transition elements and organometallic compounds
- To know the nomenclature and isomerism in co-ordination compounds
- To learn the principles of analytical chemistry

Course Outcome

CO - No.	Upon completion of the course students will be able to	PSO	CL
CO - 1	acquire knowledge on transition and inner transition elements	PSO – 1	K2(U)
CO - 2	name the co-ordination compounds	PSO – 5	K3(A)
CO – 3	analyse the nature of bonding in co-ordination and organometallic compounds	PSO – 2	K4(An)
CO – 4	predict the geometry and colour and spin of co-ordination compounds	PSO – 4	K5(E)
CO – 5	minimize the errors in chemical analysis	PSO – 2	K4(An)

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**d and f-block elements**					
	1	General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties and ability to form complexes	3	K2(U)	Lecture using models, chalk and talk	Slip test and concept explanations
	2	Difference between the first, second and third transition series. Extraction, properties and uses of Ti, V,Mo and W.Toxicity of Cd and Hg – oxides, mixed oxides, halides, and oxohalides of transition metals	2	K3(A)	Group discussion and problem solving	Problem solving
	3	Synthesis, reactivity and uses of vanadates, chromates, dichromate, molybdates, tungstates, tungsten bronzes, manganate, permanganate, ferrocyanide, ferricyanide,platinum(IV)chloride, chloroplatinic acid and Purple of Cassius	2	K3(A)	Lecture using chalk and talk	Short test
	4	Interstitial compounds – nitrides, carbides, hydrides, borides of Ti, V, Cr, W and their industrial uses.	2	K2(U)	Lecture using chalk and talk	Slip test and MCQ
	5	Electronic configuration, oxidation states, colour, spectral and magnetic properties. Causes and consequences o lanthanide contraction - uses of lanthanides.	3	K3(A)	Lecture using chalk and talk, group discussion and problem solving	Group discussion and problem solving
	6	Comparison between lanthanides and actinides. Extraction, properties and uses of thorium and uranium,compounds of uranium-zinc uranyl acetate and uranium hexa fluoride.	3	K3(A)	Lecture using models, chalk and talk	Concept explanations and slip test
II	**Co-ordination chemistry – I**					

	1	Double salts and co-ordination compounds-differences- types of ligands. Nomenclature, and isomerism- structural isomerism – ionization, hydrate, co-ordination, linkage and co-ordination position isomerism.	3	K2(U)	Lecture using chalk and talk	Short test
	2	Stereoisomerism – geometrical isomerism in tetrahedral and octahedral complexes - optical isomerism in octahedral complexes.Theories of co-ordination compounds	3	K3(A)	Lecture using chalk and talk	Slip test
	3	Werner's theory- postulates – verification of Werner's theory-cobalt ammine complexes. EAN rule	2	K2(U)	Lecture using chalk and talk	Short test and MCQ
	4	Calculation of EAN in metal complexes and carbonyls. Pauling's theory (VBT) – postulates	4	K3(A)	Lecture using chalk and talk	Short test and quiz
	5	Application of VBT to square planar and tetrahedral complexes, inner and outer complexes – merits and demerits of VBT.	4	K3(A)	Lecture using chalk and talk	Slip test
III	**Co-ordination chemistry – II**					
	1	Shapes of d-orbitals. Crystal field theory – Crystal field splitting of tetrahedral, square planar and octahedral complexes.. Factors affecting crystal field stabilisation energy CFSE–crystal field splitting energy values and stability of complexes.	3	K2(U)	Lecture using chalk and talk	Concept explanations
	2	Weak and strong field ligands – spectrochemical series.Distortion from perfect symmetry – Jahn-Tellar theorem and its effect.	3	K2(U)	Lecture using chalk and talk, Group discussion	Slip test
	3	Molecular Orbital Theory (MOT)– MO diagrams of ML_6 type complexes. Stability of metal complexes	3	K3(A)	Lecture using powerpoint	Short test

	4	Relation between stability constant and dissociation constant – factors affecting the stability of metal complexes from thermodynamic data.	3	K4(An)	Lecture using chalk and talk , Seminar	Slip test and quiz
	5	Irving William series – stabilization of unstable oxidation state. Substitution reactions of square planar complexes – trans effect.	3	K2(U)	Lecture using chalk and talk	Concept explanations
IV	**IV Analytical Chemistry**					
	1	Types of errors- determinate and indeterminate errors- minimization of errors. Precision and accuracy- ways of expressing precision.	3	K2(U)	Lecture using powerpoint	Slip test
	2	Standard deviation- mean deviation – relative mean deviation and coefficient of variance.	4	K2(U)	Lecture using chalk and talk	Slip test and quiz
	3	Accuracy- absolute error- relative error- confidence limit- Rejection of a doubtful value – Q Test and related problems.	3	K3(A)	Lecture using chalk and talk	Short test
	4	Principles and requirements of gravimetric analysis- mechanism of precipitation – digestion, filtration, washing, drying and ignition.	2	K2(U)	Lecture using chalk and talk	Group discussion
	5	Factors affecting solubility of precipitate - co-precipitation and post precipitation – prevention and difference between co-precipitation and post precipitation, precipitation from homogenous solution.	3	K3(A)	Lecture using chalk and talk, Seminar	Short test
V	**Organometallic Chemistry**					
	1	Introduction - structure and application of metal carbonyls -mono and poly nuclear carbonyls of Ni, Fe, Cr, Co and Mn -synthesis and structure -nitrosyl compounds	2	K2(U)	Lecture using chalk and talk	Slip test

	2	Classification, preparation and properties -structure of nitrosyl chloride and sodium nitroprusside.	2	K4(An)	Lecture using powerpoint,Seminar	Concept explanations
	3	Nomenclature of organometallic compounds, 16- and 18- electron rule. Structure and bonding in transition metal carbonyls-polynuclear carbonyls.	3	K4(An)	Lecture using chalk and talk, Group discussion	MCQ
	4	Bridging and terminal carbonyls, transition metal alkyls, carbenes, and carbynes, and metallocenes..	3	K2(U)	Lecture using chalk and talk	Short test
	5	Photochemistry of organometallic compounds Wilkinson's catalyst and alkene hydrogenation, hydroformylation,	3	K2(U)	Lecture using chalk and talk	Short test
	6	Monsanto acetic acid process, Ziegler – Natta catalyst and polymerization of olefins.	2	K2(U)	Power point	Long answer test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability
Activities (Em): Assignment, Endowment Lecture, Group discussion and Seminar

Assignment :

1.Characteristics of d-block elements.
2.General Characteristics of f-block elements.
3.Metal Carbonyls and their types
4. Types of Errors and aways to minimise errors
5.Theory of co-ordination complexes.

Seminar Topic:

1.Lanthanide Contraction
2.Colour and catalytic properties of d-block elements
3.Polynuclear metal carbonyls.

Sample questions

Part A

1. Rutile is the ore of _____.
   a)tungsten b)titanium c) uranium d)copper
2. Potassium permanganate is used as an oxidizing agent. Say true or false.
3. Which one of the following complexes is anionic?
   a) $[Cu(NH_3)_4]SO_4$ b) $K_4[Fe(CN)_6]$ c) $[Cr(NH_3)_3Cl_3]$ d) $[Ag(NH_3)_2]Cl$
4. In the complex $[Co(NH_3)_6]Cl_3$ the ammine ligands are monodentate. Say true or false.
5. A coordination complex contains 2 unpaired electrons. Its magnetic moment is _____.
6. According to Crystal Field Theory the bond between metal and ligand is purely ionic. State true or false.
7. If precipitation occurs due to the impurities in the mother liquor then the process is called_____.

8.The test used to reject a doubtful experimental value is_____

a) Q-test (b) T-test (c) F-Test (d) P-Test

9. The shape of Ni $(CO)_4$ is _____.

10. The central metal atom in Wilkinson's catalyst is _____.

a) Cd b) Rh c) Cr d) Co

Part - B

1. Give the magnetic and catalytic properties of d-block elements.
2. What are the causes and consequences of lanthanide contraction?
3. Write the IUPAC names of the following complexes:
   i) $[CoCO_3(NH_3)_5]Cl$
   ii) $[Co(NH_3)_6]^{3+}$
   iii) $Li[AlH_4]$
   iv) $[(NH_3)_5Co\text{-}NH_2\text{-}Co(NH_3)_5](NO_3)_5$
4. Apply EAN rule and predict the stability of the following complexes
   i) $[Zn(NH_3)_4]^{2+}$ ii)$[Co(NH_3)_6]^{2+}$ iii) $[Ni(CO)_4]$ iv) $[Fe(CN)_6]^{3-}$
5. Write the postulates of Crystal Field theory
6. Explain Jahn-Teller Theorem.
7. Give the differences between co-precipitation and post precipitation.
8. Write the differences between precision and accuracy.
9. Write the preparation and properties of sodium nitro prusside.
10. Write a note on Wilkinson's catalyst.

Part - C

1. How is tungsten extracted from its ore? Name its ores.
2. List out the ores of Uranium. How is it extracted from its ore?
3. Co-ordination complexes show different structural isomerism. Justify this statement by giving appropriate examples.
4. Apply Valence Bond theory and predict the geometries of $[Ni(CN)_4]^{2-}$, $[PtCl_4]^{2-}$ and $[Cu(NH_3)_4]^{2+}$
5. Explain Crystal Field theory. Apply it for octahedral and tetrahedral complexes.
6. Apply Molecular Orbital theory to ML_6 type of complexes.
7. What are the requirements of gravimetric analysis? Explain the various Steps.
8. What are the different types of errors? How will you minimise them?
9. Draw the structures of poly nuclear carbonyls of Ni, Fe, Cr, Co and Mn.
10. Explain the structure and bonding in carbynes and metallocenes.

Head of the Department
Dr. M. Anitha Malbi

Course Instructor
Dr. R. Gladis Latha

Department : **Chemistry**
Class : **III B.Sc Chemistry**
Title of the Course : **Core VII: Physical Chemistry**
Semester : **V**
Course Code : **CC2053**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2053	5	-	-	5	6	75	30	70	100

Objectives

- To know the concepts of conductance , strong and weak electrolytes
- To understand the working of electro chemical cells, EMF measurement and their applications
- To learn the basic principles and applications of spectroscopy

Course Outcomes (COs)

CO - No.	Upon completion of the course, students will be able to	PSO	CL
CO - 1	understand the basic principles of electrochemistry	PSO - 1	K2(U)
CO - 2	apply EMF measurements in different fields of chemistry	PSO - 2	K3(Ap)
CO - 3	analyzethe working of electrical appliances in day to day life	PSO - 5	K4(An)
CO - 4	remember the principle and applications of the different spectral techniques	PSO - 7	K1(R)
CO - 5	interpret the IR,NMR and ESR spectra of simple molecules	PSO - 3	K5(E)

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Electrochemistry – I**					
	1	Definition of conductance, specific conductance, equivalent conductance and molar conductance and factors affecting conductance of a solution.	3	K2(U)	Lecture using models, chalk and talk	Slip test
	2	Strong and weak electrolytes , variation of equivalent conductance with dilution. Debye-Huckel theory of strong electrolytes and Debye-Huckel– Onsagar equation.	2	K3(Ap)	Group discussion and problem solving	Problem solving
	3	Kohlrausch's law and its applications, Applications of conductance measurements, Determination of λ_∞ of weak acid and weak base-degree of dissociation of weak electrolytes, solubility and solubility products of sparingly soluble salts and conductometric titrations.	2	K4(An)	Lecture using chalk and talk	Short test
	4	Transport number , determination of transport number by Hittorff's method and moving boundary method.	2	K2(U)	Lecture using chalk and talk	Slip test and MCQ
	5	Hydrolysis, hydrolysis constant,degree of hydrolysis of salts of weak acids and strong bases, weak bases and strong acids	3	K3(Ap)	Lecture using chalk and talk, group discussion and problem solving	Group discussion and problem solving
	6	Determination of degree of hydrolysis by conduction and distribution methods.	3	K3(Ap)	Lecture using models, chalk and talk	Slip test
II	**Electrochemistry – II**					

	1	Electrochemical cells , reversible and irreversible cells , EMF of cells , determination , cell representation.	2	K2(U)	Lecture using chalk and talk	Short test
	2	Single electrode potential, types of electrodes , metal- metal ion electrodes, amalgam electrodes, gas electrodes, metal –insoluble metal salt electrodes and oxidation - reduction electrodes . Standard hydrogen electrode (SHE) and calomel electrode.	3	K3(Ap)	Lecture using chalk and talk	Group discussion
	3	Nernst equation for electrode potential , Nernst equation for emf of cells , standard electrode potential and its determination.	2	K4(An)	Lecture using chalk and talk	Short test and MCQ
	4	Electro chemical series, thermodynamics of galvanic cells ΔG, ΔH, ΔS and equilibrium constant (K).	2	K3(Ap)	Lecture using chalk and talk	Short test and quiz
	5	Concentration cells with transference and without transference and liquid junction potential and its elimination.	2	K3(Ap)	Lecture using chalk and talk	Slip test
	6	Applications of EMF measurements , determination of transport number, valency of an ion, pH of a solution using hydrogen, quinhydrone and glass electrode.	2	K3(Ap)	Lecture using ppt	Short test and MCQ
	7	Potentiometric titrations , acid-base, oxidation reduction and precipitation titrations. Decomposition potential and overvoltage	2	K2(U)	Lecture using using videos	Short test and quiz
III	**Applied Electro Chemistry**					
	1	Application of electrochemical principle in inorganic chemistry , manufacture of NaOH and H_2O_2.	3	K1(R)	Lecture using videos	Concept explanations
	2	Electroplating , principle , electro plating of copper, nickel and cadmium	3	K2(U)	Lecture using chalk and talk	Slip test
	3	Types of coating , protection of pipelines , protection of ships in sea.	3	K3(Ap)	Lecture using videos	Short test

	4	Power sources , primary cells , Lechlanche cell, principle , selection of anode and cathode and alkaline MnO_2 cells	3	K3(Ap)	Lecture using ppt	Slip test and quiz
	5	Secondary cells , characteristics , lead storage ,lithium and nickel-cadmium battery. Fuel cells , principle , hydrogen - oxygen fuel cells and alkaline fuel cells.	3	K2(U)	Lecture using chalk and talk	Oral test
IV	**Spectroscopy –I**					
	1	Electromagnetic radiation, electromagnetic spectrum , general spectroscopic methods , Born-Oppenheimer approximation and types of molecular spectra.	3	K2(U)	Lecture using videos	Slip test
	2	Microwave spectra, principle, intensity, selection rule and applications and determination of bond distances in diatomic molecules.	4	K3(Ap)	Lecture using ppt	Slip test and quiz
	3	Infra Red spectra , principle , harmonic oscillator , unharmonicity , selection rules , intensity , modes of vibrations and types ,force constant and its determination	3	K4(An)	Lecture using chalk and talk	Short test
	4	Applications of IR, important functional groups and elucidation of structure , hydrogen bonding, Fermi resonance , overtones and combination bands.	2	K4(An)	Lecture using chalk and talk	Group discussion
	5	Electronic spectra , selection rules , Frank Condon Principle , types of transitions and its applications.	3	K3(Ap)	Lecture using ppt	Solving problems
V	**Spectroscopy –II**					
	1	NMR, introduction , conditions , principle , types , origin , Larmor procession and signals	2	K2(U)	Lecture using ppt	Slip test
	2	Chemical shift, screening constant , spin-spin coupling .Applications of NMR, elucidation of molecular structure, hydrogen bonding, and tautomerism	2	K4(An)	Lecture using chalk and talk	Solving problems

	3	Study of water of crystallization in solids and Nuclear magnetic resonance imaging	3	K4(An)	Lecture using chalk and talk	MCQ
	4	ESR spectroscopy , principle , hyperfine structure , application of ESR to hydrogen and methyl radicals. Raman Spectra , introduction - Rayleigh scattering and quantum theory	4	K3(Ap)	Lecture using videos	Group discussion
	5	Raman effect , Raman scattering , conditions for Raman spectra , selection rule , mutual exclusion principle , Raman spectra of CO_2 and HCN and differences between Raman and IR spectra.	4	K3(Ap)	Lecture using chalk and talk	Short test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Group discussion on IR and ESR spectroscopy

Problem solving on electronic and NMR spectroscopy

Assignment: (Mention Topic and Type)

1. Applications of conductance measurements - Reflective writing
2. Primary and Secondary cells - Study assignment

Sample questions

PART A

1. The unit of molar conductance is _____
   a) 10^{-4} Sm^2 mol^{-1} b)10^{-2} Sm^2 mol^{-1} c) 10^{-3} Sm^2 mol^{-1} d) 10^{-1} Sm^2 mol^{-1}
2. Give an example for strong electrolyte.
3. Calomel electrode is represented as _____
4. The value of specific conductance of water at 25°C is _____
   a) 5.1 x 10^{-8} mho cm^{-1} b) 5.2 x 10^{-8} mho cm^{-1}
   c) 5.5 x 10^{-8} mho cm^{-1} d) 5.6 x 10^{-8} mho cm^{-1}
5. Which is used as an electrolyte in Lechlanche cell ?
6. The nickel-cadmium battery is a secondary cell. Say true or false.
7. A vibrational transition occurs on absorption of quantized energy .Say true or false.
8. The energy of IR radiation is weaker than that of visible and ultraviolet radiation. Say true or false.
9. Zero point energy of a diatomic SHO is ----------
   a) hν b) ½ hν c) ¼ hν d) 0
10. The ESR spectrum of deuterium consists of ---------- lines
    a) 2 b) 3 c) 6 d) 8

Part - B

1. State Hittorf's law. How will you determine the transport number of ions by Hittorf's method ?
2. How will you calculate the λc value and degree of dissociation of weak electrolytes using Kohlraush'slaw ?
3. Explain liquid junction potential .How can it be eliminated ?
4. Write a note on the following potentiometric titrations.
   a. Acid -base ii) Oxidation -reduction
5. Explain the manufacture of NaOH and H_2O_2.
6. Explain Kolbe's synthesis and adiponitrile synthesis.
7. Explain the types of molecular spectra.
8. Explain the principle and applications of microwave spectra.
9. How are hydrogen bonding and tautomerism studied using NMR spectroscopy ?
10. Illustrate the hyper fine structure of Hydrogen radical.

Part- C

1. Discuss the applications of conductance measurements.
2. i)How does equivalent conductance vary with dilution?
   ii)Explain Debye-Huckel theory of strong electrolytes.
3. (i) Derive Nernst equation for electrode potential.
   ii) Write notes on hydrogen and calomel electrodes.
4. Discuss the applications of EMF measurements
5. Explain the principle of electroplating. How is copper and nickel electro plated ?
6. i)Explain the principle and working of Lechlanche cell.
   ii) Discuss the principle and working of hydrogen - oxygen fuel cell.
7. Explain the applications of IR spectroscopy.
8. i) Explain Frank Condon Principle.
   ii) Write the applications of electronic spectroscopy .
9. Discuss the quantum theory of Raman spectroscopy and show how stokes and anti- stokes lines appear in the Raman spectrum of a molecule?
10. Discuss the applications of NMR spectroscopy.

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr. S.Ajith Sinthuja

Department : **Chemistry**
Class : **III B.Sc Chemistry**
Title of the Course : **Elective III: Bio Chemistry**
Semester : **V**
Course Code : **CC2054**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2051	4	-	-	3	4	60	30	70	100

Objectives

- To understand the biological action of carbohydrates
- To know the functions of lipids, amino acids, proteins and nucleic acids

Course Outcomes (COs)

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	understand the function and metabolism of biomolecules	PSO - 1	K2(U)
CO - 2	recall the importance of biomolecules	PSO - 2	K1(R)
CO - 3	compare DNA and RNA	PSO - 5	K4(An)
CO - 4	elucidate the structure of different biomolecules	PSO - 2	K3(Ap)
CO - 5	illustrate the industrial and medical applications of enzymes	PSO - 8	K2(U)

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Carbohydrates**					
	1	Carbohydrates -definition and classification. Glycosides physiological significance. Amino sugars - importance	3	K1(R)	Lecture with ppt	Quiz
	2	Chemistry of poly saccharides - starch, glycogen, cellulose, inuline, hemi-celluloses, chitin, pectin and lignin	3	K2(U)	Seminar	Slip test

	3	Glycosaminoglycans - hyaluronic acid, chondroitin sulphate, keratin sulphate, heparin and dermatan sulphate	3	K2(U)	Lecture using chalk and talk	Short test
	4	Blood group substances. Carbohydrate metabolism - Embden - Meyerhof pathway- TCA cycle	3	K3(Ap)	Lecture using chalk and talk	Oral test and MCQ
II	**Lipids**					
	1	Lipids - definition and classification. Types of fatty acids - saturated, unsaturated, unusual and essential fatty acids	2	K2(U)	Lecture using chalk and talk	Short test
	2	Triacylglycerols - chemistry. Characterization - saponification number, iodine number, acid number, RM value and acetyl value	4	K4(An)	Seminar	Quiz
	3	Chemistry and functions of phospholipids - lecithin and cephalin. Sphingolipids - sphingomycin.	3	K4(An)	Lecture using ppt	Short test and MCQ
	4	Glycolipids - cerebroside, ganglioside Cholesterol - spot tests and structure. Biochemical functions of cholesterol	3	K3(Ap)	Lecture using chalk and talk	Short test and quiz
III	**Amino Acids and Proteins**					
	1	Amino acids and proteins - structure, classification and biochemical importance - one method each to identify ‘C’ terminal and N terminal amino acids	3	K1(R)	Seminar	Short test
	2	Secondary, tertiary and quaternary structures	3	K2(U)	Lecture using videos	Oral test
	3	Abbreviated names - structure and importance of simple peptide - glutathione, carnosine, anserine, vasopressin and oxytocin	3	K3(Ap)	Lecture using chalk and talk	Short test
	4	Peptide antibiotics - Geramicidin, bacitracin and actinomycin. Transamination - deamination - urea cycle	3	K3(Ap)	Lecture using chalk and talk	Slip test and quiz

IV	**Nucleic Acids**					
	1	Components of nucleic acid - organic nitrogeneous bases - Purines - pyrimidines - sugars - deoxyribose - ribose	3	K2(U)	Lecture using chalk and talk	Slip test
	2	Nucelosides - ribonucleoside deoxyribonucleoside. Nucleotides ribonucleotide -deoxyribonucleotide - cyclic nucleotides	3	K4(An)	Seminar	Group discussion
	3	DNA - Structure and functions - RNA - types (m-RNA, t-RNA and rRNA). Nucleases - Endonucleases - DNase - RNase- Exonucleases	3	K4(An)	Lecture using videos	Short test
	4	Cyclic nucleotides - functions of cyclic AMP - and cyclic GMP - Nucleoproteins - nucleohistones - nucleoprotamines	3	K2(U)	Lecture using ppt	Oral test
V	**Enzymes**					
	1	Enzymes - characteristics - classification, enzyme specificity. Factors affecting enzyme reaction	4	K2(U)	Lecture using ppt	Slip test
	2	Michaelis-Menten equation - derivation - inhibition of enzyme action - competitive, non - competitive and uncompetitive coenzymes	4	K2(U)	Lecture using chalk and talk	Short test
	3	Mechanism of NAD+ and PLP. Immobilisation of enzymes - industrial and medical application of enzymes	4	K3(Ap)	Seminar	MCQ

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability

Activities (Em): Group discussion and Seminar

Assignment: (Mention Topic and Type)

3. Chemistry and functions of phospholipids - lecithin and cephalin. Sphingolipids - sphingomycin. Study Assignments
4. Enzymes - characteristics - classification, enzyme specificity. Factors affecting enzyme reaction. Study Assignments

Seminar: (Mention Topic)

11. Chemistry of poly saccharides - starch, glycogen, cellulose, inuline, hemi-celluloses, chitin, pectin and lignin

12. Triacylglycerols - chemistry. Characterization - saponification number, iodine number, acid number, RM value and acetyl value
13. Amino acids and proteins - structure, classification and biochemical importance - identify 'C' terminal and N terminal amino acids
14. Nucelosides - ribonucleoside deoxyribonucleoside. Nucleotides ribonucleotide - deoxyribonucleotide - cyclic nucleotides
15. Mechanism of NAD^+ and PLP. Immobilisation of enzymes - industrial and medical application of enzymes

Sample questions

Part - A

1. The metabolism of glucose is controlled by ----------
   a) Insulin b) Glycogen c) Pepsin d) Adrenalin
2. Identify the disaccharide present in milk.
   a) Sucrose b) Lactose c) Maltose d) Cellobiose
3. Which of the following alcohol is present in sphingolipids?
   a) Glycerol b) Sphingosine c) Ethanol d) Inositol
4. Cholesterol is a ----------
   b) Simple lipid b) Complex lipid c) Neutral lipid d) Derived lipid
5. The helical structure of proteins is stabilized by ----------
   a) Peptide bonds b) Hydrogen bonds c) Sulphide bonds d) double bonds
6. Match the following:

Peptide		**Structure**
a) Glutathione	-	(i) Dipeptide
b) Gramicidin	-	(ii) Nonapeptide
c) Vasopressin	-	(iii) Tripeptide
d) Carnosine	-	(iv) Cyclic peptide

7. Ribosomal RNA constitutes about 20-25 % of total RNA of the cell. State True or False
8. Which of the following unusual base is present in cocoa beans?
   a) Xanthine b) Theophylline c) Theobromine d) Theotramine
9. Assertion (A): The activity of an enzyme is minimum at the optimum temperature
   Reason (R) :The optimum temperature of human enzyme is 37ºC
   a) Both A and R are true
   b) A is true but R is false
   c) R is true but A is false
   d) Both A and R are false
10. Identify the coenzyme of Niacin.
    a) FAD b) NAD c) PLP d) NADP

Part - B

1. Explain the major classes of glycosides. Give its physiological significances.
2. Discuss the importance of amino sugars.
3. Classify fatty acids on the basis of composition and physical properties.
4. Point out the biochemical functions of cholesterol.
5. Categorize amino acids based on their structure and biological importance.
6. Draw the structures of glutathione and carnosine.
7. Differentiate DNA and RNA.
8. Describe the functions of cyclic AMP.
9. Analyze the influence of temperature and pH on enzyme activity.

10. Compare the characteristics of non-competitive and uncompetitive enzyme inhibitions.

Part - C

1. Apply Embden-Meyerhof-Parnas pathway for the conversion of glucose to pyruvate.
2. Illustrate the reactions and significance of TCA cycle.
3. Discuss the classification of lipids.
4. Explain the chemistry and functions of lecithin and cephalin.
5. Outline the primary and secondary structures of proteins.
6. Infer the structure and biomedical applications of bacitracin and actinomycin.
7. Correlate the structures of DNA and RNA.
8. Differentiate ribonucleosides and ribonucleotides with examples.
9. Derive Michaelis-Menten equation.
10. Generalize the industrial and medical applications of enzymes.

Head of the Department: Dr. M. Anitha Malbi **Course Instructor:** Dr. Sheeba Daniel