



(For Candidates admitted from the academic year 2022-23)  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI-620002**  
**SCHOOL OF PHYSICAL SCIENCES**  
**PG AND RESEARCH DEPARTMENT OF CHEMISTRY**  
**LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK (LOCF)**

**Programme Outcomes**

<b>PO 1</b>	Demonstrate ability and attitude to acquire knowledge and skills in the advancing global scenario to apply them effectively and ethically for professional and social development.
<b>PO 2</b>	Involve in research and innovative endeavors and share their findings for the wellbeing of the society
<b>PO 3</b>	Work effectively in teams and take up leadership in multi-cultural milieu.
<b>PO 4</b>	Act with moral, ethical and social values in any situation.
<b>PO 5</b>	Excel as empowered woman to empower women.
<b>PO 6</b>	Participate in activities towards environmental sustainability goals as responsible citizens.
<b>PO7</b>	Pursue higher studies in the related fields of science, humanities and management.
<b>PO8</b>	Analyse and record the results obtained using experimental and analytical techniques in physical, chemical and biomedical laboratories
<b>PO9</b>	Develop a range of generic skills related to self-employment and entrepreneurship in areas related to Physical Sciences.

**Programme Specific Outcomes (PSOs)**

<b>PSO1</b>	Synthesize, separate and characterize compounds using theoretical and practical knowledge in chemistry
<b>PSO2</b>	Design, analyze and interpret green chemistry research for sustainable development.
<b>PSO3</b>	Apply the expertise in chemistry to various multidisciplinary domains of academics, analytical, pharmaceuticals, food, nano and agricultural fields.

(For Candidates admitted from June 2021- 22)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2**  
**School of Physical Sciences**  
**PG AND RESEARCH DEPARTMENT OF CHEMISTRY**  
**UG-COURSE PATTERN**  
**B.Sc. CHEMISTRY**

Sem ester	Part	Course	Title of the Course	Course Code	Hrs. /wk.	Credits	Marks
<b>I</b>	I	Language	General Tamil I/ General Hindi I/ General French I	<b>U21TL1TAM01/ U21HN1HIN01/ U21FR1FRE01</b>	3	3	100
	II	English	General English I	<b>U21EL1GEN01</b>	3	3	100
	III	Major Core – 1	Fundamental concepts of chemistry	<b>U21CH1MCT01</b>	5	4	100
		Major Core – 2	Volumetric Analysis (Lab cum theory)	<b>U21CH1MCP02</b>	4	3	100
		Major Core -3	Analytical Chemistry	<b>U21CH1MCT03</b>	4	4	100
		Allied – 1	Differential Calculus and Trigonometry/ Biomolecular Chemistry	<b>U21MA1ALT02/ U21BC1ALT01</b>	4	2	100
		Allied – 2	Algebra and Integral Calculus/ Practical	<b>U21MA1ALT07/ U21BC1ALP02</b>	4	2	100
	IV	Environmental Studies	Environmental Studies	<b>U21RE1EST01</b>	2	1	100
		Value Education	Ethics-I/ Bible Studies-I/ Catechism-I	<b>U21VE2LVE01/ U21VE2LVB01/ U21VE2LVC01</b>	1	-	-
			<b>Service oriented course</b>			-	-
		<b>Internship / Field Work / Field Project 30 Hours - Extra Credit</b>		<b>U21SP1ECC01</b>		2(E.C)	
		<b>Total</b>			<b>30</b>	<b>22</b>	<b>800</b>
	I	Language	General Tamil II/ General Hindi II/ General French II	<b>U21TL2TAM02/ U21HN2HIN02/ U21FR2FRE02</b>	3	3	100
	II	English	English Paper II	<b>U21EL2GEN02</b>	3	3	100
		Major Core –4	Organic and Physical Chemistry	<b>U21CH2MCT04</b>	5	5	100

<b>II</b>	III	Major Core –5	Semi micro Analysis (Lab cum Theory)	<b>U21CH2MCP05</b>	4	3	100
		Major Elective - 1			5	3	100
		Allied – 3	Analytical geometry of three dimensions, vector calculus and differential equations / Enzymes and Enzyme Technology	<b>U21MA2ALT09/ U21BC2ALT03</b>	4	2	100
	IV	Skill-based Course– 1	Soft Skill Development	<b>U21SS2SBC01</b>	2	1	100
		Skill-based Elective – 2	Rural Enrichment and Sustainable Development	<b>U21RE2SBC02</b>	2	1	100
			Industrial Chemistry	<b>U21CH2IRT01</b>	1	1	
		Value Education	Ethics I/ Bible Studies I/ Catechism I	<b>U21VE2LVE01/ U21VE2LVB01/ U21VE2LVC01</b>	1	1	100
		<b>Service Oriented Course</b>			-	-	-
		<b>Internship / Field Work / Field Project 30 Hours - Extra Credit</b>		<b>U21SP2ECC02</b>		2(E C)	<b>100</b>
		<b>Total</b>			<b>30</b>	<b>23</b>	<b>900</b>
<b>Seme ster</b>	<b>Part</b>	<b>Course</b>	<b>Title of the Course</b>	<b>Course Code</b>	<b>Hrs. /wk</b>	<b>Credit s</b>	<b>Mark s</b>
<b>III</b>	I	Language	General Tamil III/ General Hindi III/ General French III	<b>U21TL3TAM03/ U21HN3HIN03/ U21FR3FRE03</b>	3	3	100
	II	English	English Paper III	<b>U21EL3GEN03</b>	3	3	100
	III	Major Core –6	Inorganic and Organic Chemistry	<b>U21CH3MCT06</b>	5	4	100
		Major Core –7	Physical Experiments and Computer Aided Molecular Calculations	<b>U21CH3MCP07</b>	4	3	100
		Major Elective - 2	Nutraceuticals and Health care/ Renewable Energy Resources	<b>U21CH3MET03/ U21CH3MET04</b>	4	3	100

		Allied – 4	Basic Physics I	<b>U21PH3ALT05</b>	4	2	100
	IV	Major Skill-based Elective–1	Biological Techniques for Chemistry/ Basic Skills in Biological Science	<b>U21BO3SBP03/ U21ZO3SBP02</b>	2	1	100
		Non Major elective - 1			3	3	100
		Value Education	Ethics-II/ Bible Studies-II/ Catechism -II	<b>U21VE4LVE02/ U21VE4LVB02/ U21VE4LVC02</b>	1	-	-
		Gender studies	Gender studies	U21WS3GST01	1	1	100
		<b>Service Oriented Course</b>					
		<b>Internship / Field Work / Field Project 30 Hours - Extra Credit</b>		<b>U21SP3ECC03</b>		2(EC)	100
		<b>Total</b>			<b>30</b>	<b>23</b>	<b>900</b>
IV	I	Language	General Tamil IV/ General Hindi IV/ General French IV	<b>U21TL4TAM04/ U21HN4HIN04/ U21FR4FRE04</b>	3	3	100
		II	English	English Paper – IV	<b>U21EL4GEN04</b>	3	3
	III	Major Core –8	Inorganic and Physical Chemistry	<b>U21CH4MCT08</b>	5	4	100
		Major Core -9	Applied Chemistry Practical	<b>U21CH4MCP09</b>	3	3	100
		Major Elective - 3	Phytochemistry/Chemistry for Biologist- Lab cum theory (For Biotech)	<b>U21CH4MEP05/ U21CH4MEP06</b>	4	3	100
		Allied – 5	Basic Physics II	<b>U21PH3ALT06</b>	4	2	100
		Allied – 6	Basic Physics Practicals	<b>U21PH3ALP07</b>	4	2	100
		Non Major Elective - 2			3	3	100
	IV	Value Education	Ethics II/ Bible Studies II/ Catechism II	<b>U21VE4LVE02/ U21VE4LVB02/ U21VE4LVC02</b>	1	1	100

		<b>Service Oriented Course</b>				2(EC)	
		<b>Internship / Field Work / Field Project 30 Hours - Extra Credit</b>		<b>U21SP4ECC04</b>		2(E.C)	100
		<b>Total</b>			<b>30</b>	<b>24</b>	<b>900</b>
<b>Seme ster</b>	<b>Part</b>	<b>Course</b>	<b>Title of the Course</b>		<b>Hrs. /wk.</b>	<b>Credit s</b>	<b>Mark s</b>
<b>V</b>	<b>III</b>	Major Core – 10	Inorganic Chemistry - I	<b>U21CH5MCT10</b>	4	4	100
		Major Core – 11	Organic Chemistry - I	<b>U21CH5MCT11</b>	4	3	100
		Major Core -12	Physical Chemistry -I	<b>U21CH5MCT12</b>	4	4	100
		Major Core -13	Gravimetric analysis and preparation of inorganic complexes	<b>U21CH5MCP13</b>	4	3	100
		Major Core -14	Physical Chemistry Practical - I	<b>U21CH5MCP14</b>	4	3	100
		Major Elective - 4	Food Chemistry/ Smart Waste Management for Environmental Sustainability	<b>U21CH5MET07/ U21CH5MET08</b>	4	3	100
		Major Skill based Elective – 2	Cosmetology/ Micro Enterprises [For Chemistry students]	<b>U21CH5SBT03/ U21CH5SBT04</b>	2	1	100
	<b>IV</b>	Non Major Elective – 3			3	3	100
		Value Education	Ethics III/ Bible Studies III/ Catechism III	<b>U21VE6LVE03/ U21VE6LVB03/ U21VE6LVC03</b>	1	-	-
		<b>Internship / Field Work / Field Project 30 Hours - Extra Credit</b>		<b>U21SP5ECC05</b>		2(E C)	100
		<b>Total</b>			<b>30</b>	<b>24</b>	<b>800</b>
<b>VI</b>	<b>III</b>	Major Core – 15	Inorganic Chemistry - II	<b>U21CH6MCT15</b>	4	3	100
		Major Core – 16	Organic Chemistry II	<b>U21CH6MCT16</b>	4	4	100
		Major Core – 17	Physical Chemistry– II	<b>U21CH6MCT17</b>	4	4	100

		Major Core – 18	Organic analysis and Organic Preparation	<b>U21CH6MCP18</b>	4	3	100
		Major Core – 19	Physical Chemistry Practical - II	<b>U21CH6MCP19</b>	4	3	100
		Major Core- for Physics	Spectroscopy	<b>U21CH6MCT20</b>	4	3	100
IV		Non Major Elective - 4	Cosmetology	<b>U21CH6NMT04</b>	3	3	100
		SBC – 3	Research Methodology	<b>U21DS6SBC03</b>	2	1	100
		Value Education	Ethics III/ Bible Studies III/ Catechism III	<b>U21VE6LVE03/ U21VE6LVB03/ U21VE6LVC03</b>	1	-	-
	<b>Internship / Field Work / Field Project 30 Hours - Extra Credit</b>			<b>U21SP6ECC06</b>		2(E C)	100
	<b>Online Course</b>			<b>U21OC5ECT01</b>		2(E C)	
	RESCAPES					4(E C)	
		<b>Total</b>			<b>30</b>	<b>24</b>	<b>800</b>
		<b>Grant Total</b>			<b>180</b>	<b>140</b>	<b>5100</b>
<b>Grant Total – 140+ 20(EC) = 160</b>							

**List of Allied/NME/Elective courses offered to other Department students**

Sem ester	Part	Course	Title of the Course	Course Code	Hrs. /wk.	Credits	Marks
I	III	Allied – 1	Chemistry Paper I (For Botany/Zoology)	<b>U21CH1ALT01</b>	4	2	100
		Allied – 2	Chemistry Paper II (For Botany/ Zoology)	<b>U21CH1AL P02</b>	4	2	100
II		Major Elective - 1	Nano technology and Crystal growth techniques/ Chemistry of materials(For Physics)	<b>U21CH2MET01/ U21CH2MET02</b>	5	3	100
		Allied – 3	Chemistry Paper III (For Bot/ Zoology)	<b>U21CH2ALT03</b>	4	2	100
			Industrial Chemistry	<b>U21CH2IRT01</b>			
III	III	Major Elective - 2	Nutraceuticals and Health care/	<b>U21CH3MET03/ U21CH3MET04</b>	4	3	100

			Renewable Energy Resources				
		Allied – 4	Chemistry Paper-I (For Biochemistry Physics)	<b>U21CH3ALT04/ U21CH3ALT05</b>	4	2	100
	IV	Major Skill-based Elective–1	Dairy Entrepreneurship	<b>U21CH3MSBT01</b>	2	1	100
		Non Major elective - 1	Food and Nutrition	<b>U21CH3NMT01</b>	3	3	100
IV	III	Major Elective - 3	Phytochemistry/Chemistry for Biologist- Lab cum theory (For Biotech)	<b>U21CH4MEP05/ U21CH4MEP06</b>	4	3	100
		Allied – 5	Chemistry paper –II (For Biochemistry Physics)	<b>U21CH4ALT06/ U21CH4ALT07</b>	4	2	100
		Allied – 6	Chemistry paper III (For Biochemistry/ Physics)	<b>U21CH4ALP08/ U21CH4ALP09</b>	4	2	100
	IV	Non Major Elective - 2	Home Care	<b>U21CH4NMT02</b>	3	3	100
V	III	Major Elective - 4	Food Chemistry/ Solid Waste Management	<b>U21CH5MET07/ U21CH5MET08</b>	4	3	100
	IV	Non Major Elective – 3	Beauty care	<b>U21CH5NMT03</b>	3	3	100
VI	IV	Non Major Elective - 4	Cosmetology	<b>U21CH6NMT04</b>	3	3	100

<b>Course Title</b>	<b>Major Core 1 – FUNDAMENTAL CONCEPTS OF CHEMISTRY</b>
<b>Code</b>	<b>U21CH1MCT01</b>
<b>Course type</b>	<b>Theory</b>
<b>Semester</b>	<b>I</b>
<b>Hours/Week</b>	<b>5</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

## CONSPECTUS

To make the students understand the fundamentals of quantum chemistry, periodic table and variation in periodic properties, chemical bonding, first law of thermodynamics, thermochemistry and basic concepts in organic chemistry.

## COURSE OBJECTIVES:

1. To illustrate the fundamental principles of atomic theory and to understand the postulates of Quantum mechanics.
2. To compare and contrast the properties of the elements in the modern periodic table.
3. To categorize the types of chemical bonding and to interpret the shapes of the molecules using VSEPR, VB & MO theories.
4. To develop abroad knowledge on the principles of thermodynamics and thermochemistry.
5. To enumerate the basic concepts of organic chemistry.

## UNIT 1- FUNDAMENTALS OF QUANTUM CHEMISTRY

**12Hrs**

- 1.1. Atomic structure - Rutherford's nuclear model of atom. Planck's Quantum theory of radiation. Photoelectric effect and quantum theory.
- 1.2. Bohr's model of an atom. Bohr's theory and the origin of hydrogen spectrum. Somerfield's extension of Bohr's theory.
- 1.3. Particle and wave character. de Broglie's equation. Heisenberg's uncertainty principle.
- 1.4. Compton effect. Postulates of Quantum mechanics. Schrodinger wave equation. Significance of  $\psi$  and  $\psi^2$ , Radial and angular functions. Quantum Numbers – wave picture of electron. Concept of atomic orbitals – shapes of s, p & d orbitals, nodal planes and nodal points in atomic orbitals.

**Extra reading/Keywords:** *Problems in particle in 1D and cubical box.*

## UNIT -II PERIODICITY

**12Hrs**



- 2.1 Periodic variation of properties of elements – effective nuclear charge, screening effect, Slater's rule. Periodicity of properties of s, p, d and f block elements with respect to atomic radii, ionic radii, ionisation energy, electronegativity, electron affinity, flame colouration, reducing properties, hydration of ions, oxidation of ions and oxidation potential.
- 2.2 Chemistry of s- block elements – Discussion of alkali metal group with respect to their oxides, halides and hydroxides.
- 2.3 Comparison of Li with other elements, diagonal relationship between Li and Mg
- 2.4 Alkaline earth metals – Discussion of alkaline earth metals with respect to their oxides, halides and hydroxides. Comparison of Be with other elements, diagonal relationship between Be and Al. Importance of Cryptands and crown ethers,  $\text{CaC}_2$ ,  $\text{CaCN}_2$ , Plaster of Paris, Epsom salt

**Extra reading/Keywords:** *Comparative study of periodic properties*

### UNIT -III CHEMICAL BONDING

**12Hrs**

- 3.1 Ionic bond -Properties of ionic compounds – Factors favouring the formation of ionic compounds (ionization energy, Electron affinity, Electro negativity and Lattice energy) – Lattice energy – definition, Born Lande equation (Derivation not required) factors affecting lattice energy – Born Haber cycle – Illustration and calculation for NaCl
- 3.2 Covalent bond – Covalent character in ionic bond, polarisation of ions and Fajan's rules with illustrations, percentage ionic character of a polar covalent bond.
- 3.3 Prediction of the molecular shapes – Valence Bond theory – Hybridization and geometry of molecules. VSEPR theory – Structures of  $\text{CH}_4$ ,  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{SF}_4$ ,  $\text{XeF}_2$ ,  $\text{XeF}_6$ .
- 3.4 MO theory - LCAO method, criteria of orbital overlap, types of molecular orbitals (sigma and pi). Qualitative MO energy level diagram of homo and hetero diatomic molecules  $\text{H}_2$ ,  $\text{He}_2$ ,  $\text{N}_2$ ,  $\text{O}_2$ , and CO, bond order and stability of molecules.

**Extra reading/Keywords:** *MO configuration of  $\text{Li}_2$ ,  $\text{Be}_2$ ,  $\text{F}_2$  and NO*

### UNIT- IV FIRST LAW OF THERMODYNAMICS AND THERMOCHEMISTRY

**12Hrs**

- 4.1 Importance and Limitations of Thermodynamics. Terms and definitions – system, macroscopic properties, state variables, thermodynamic equilibrium, extensive and intensive properties, processes and their types, exact and inexact differentials, concept of heat and work.
- 4.2 First Law of Thermodynamics: Statement, the energy content, work, heat and energy changes, thermodynamic reversibility, work of expansion against constant external pressure, isothermal reversible work of expansion. Heat changes at constant volume and constant pressure, heat content, relationship between  $C_p$  and  $C_v$ , reversible adiabatic expansion and compression.
- 4.3 Thermochemistry - Joule-Thomson experiment, Joule-Thomson coefficient – derivation, derivation of inversion temperature in terms of Vanderwaal's constants.
- 4.4 Heat of reaction, relationship between heat of reaction at constant pressure and at constant volume, types of heat of reactions – . Effect of temperature on heat of reaction – Kirchoff's equation, Thermochemical laws, Bond energies.

**Extra reading/Keywords:** *Zeroth law of thermodynamics, thermodynamic irreversibility, Applications of Joule-Thomson effect.*

## UNIT V - INTRODUCTION TO ORGANIC CHEMISTRY

12Hrs

- 5.1 IUPAC Nomenclature of Organic Compounds. Isomerism-Types and examples Types of covalent bonds –  $\sigma, \pi$  bond, Polarity of covalent bonds. Hybridization –  $sp, sp^2, sp^3$ .
- 5.2 Nature of Bond Fission – Homolytic and Heterolytic Cleavages. Types of Reagents – Electrophiles and Nucleophiles. Types of Organic Reaction: Substitution, Addition, Elimination and Rearrangement Reactions (Definition with an example)
- 5.3 Reactive Intermediates: Carbocations, Carb anions and Free Radicals - Formation, Stability and Structure, their Reactions with Examples.
- 5.4 Electron Displacement Effects - Inductive, Electromeric, Mesomeric, Resonance, Hyper-Conjugation and Steric Effect.

**Extra reading/Keywords:** *Applications of Organic compounds in day today life.*

### TEXT BOOKS

1. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Physical Chemistry* 35<sup>th</sup>edn)., New Delhi:Shoban Lal Nagin chand and Co, 2013.
2. Soni P.L. and Chawla H.M, *Text Book of Organic Chemistry*, 26<sup>th</sup>edn., New Delhi: Sultan Chand and sons, 2014.
3. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Inorganic Chemistry* 35<sup>th</sup>edn., New Delhi:Shoban Lal Nagin chand and Co, 2013.
4. Samuel Glasstone, *Thermodynamics for Chemists* 3<sup>rd</sup> printing., East-West edn.,1974.
5. Lee, J.D., *Concise Inorganic Chemistry*, 5th edn., Blackwell Science, 1996.
6. Jain M.K. *Organic Chemsitry*, 12<sup>th</sup>edn.,, New Delhi: Shoban Lal Nagin Chand and Co, 2003.

### SUGGESTED READINGS

1. Raj K. Bansal, *A Text Book of Organic Chemistry*, 5<sup>th</sup>edn., New Age, 2007.
2. Bahl B.S, Arun Bahl, *A Textbook of Organic Chemistry*. New Delhi: Sultan Chand and sons, 2010.
3. Soni P.L. and Mohankatyal ,*Text book of Inorganic Chemistry*, 20<sup>th</sup> revised edn., New Delhi: Sultan Chand and sons, 2013.
4. Bahl B.S, Arun Bahl and Tuli G.D., *Essentials of Physical Chemistry*, New Delhi: SultanChand and sons, 2012.

### WEB REFERENCES

1. <https://www.webelements.com/>
2. <https://chem.libretexts.org/>

3. <https://chem.libretexts.org/>
4. <https://www.emedicalprep.com/>
5. [https://seo-manager.s3.amazonaws.com/prod/content-files-downloadable-modified/59d74047e4b0b990ba5c9fc8\\_5e9a092ba8446510cc99fb5a\\_1615282586341.pdf](https://seo-manager.s3.amazonaws.com/prod/content-files-downloadable-modified/59d74047e4b0b990ba5c9fc8_5e9a092ba8446510cc99fb5a_1615282586341.pdf)
6. [https://chem.libretexts.org/Bookshelves/Organic\\_Chemistry/Supplemental\\_Modules\\_\(Organic\\_Chemistry\)/Fundamentals/Nomenclature](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Fundamentals/Nomenclature)
7. <https://youtu.be/xkNw2f3sNpI>

## COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive Level
CO1	Fundamental concepts in atomic structure, MOT, VSEPR and VBT, define the terms and know the laws in thermodynamics and thermochemistry, describe the rules of electronic configuration, nature and types of bonding, Fajan's rule, Isomerism, hybridization and electronic effects. Formation of ionic and covalent bonds, polarization of bonds	K1
CO 2	discuss the formation, stability and structure of intermediates, bond fission reactions, IUPAC Nomenclature, hybridization of molecules using MOT, VSEPR and VBT, general concept of thermodynamics, atomic structure, electronic effects identify the quantum numbers, Classify Isomers and Organic Reagents, compare the properties of elements, diagonal relationship between elements and importance of specific inorganic compounds. Factors affecting lattice energy and the formation of ionic bond, Born lande equation,	K2
CO-3	Calculation of momentum, uncertainty parameters, Bohr radius and spectral lines, sketch the structures of homo and hetero diatomic molecules using VSEPR, VBT & MOT, compare and contrast thermodynamic properties and the processes, calculate heat capacities of ideal gas and lattice energy. Apply Slater's rule for screening constant and effective nuclear charge. Use the IUPAC system to name the organic compounds. Identify Organic Reactions and Electronic effects, Organic reagents and types of intermediate involved in various organic reactions, Compare the stability and structure of the intermediates. Apply the Joule Thomson effect to solve problems, illustrate the relationship between heat capacities and various thermodynamic variables. Apply the Born -Haber cycle to calculate the Lattice energy of a molecule.	K3
CO-4	Prediction of radial nodes, angular nodes and quantum number values for the given orbital, explain and compare the periodic properties of group I and II, types of physical and organic reactions. Calculate the work done in reversible isothermal expansion and adiabatic processes. Predict the isomerism and the number of isomers for a given molecular formula, structural formula of organic compounds using IUPAC rule Illustrate the acidity of halogenated acids and basicity of amines using inductive effect, Infer the percentage Ionic character using Fajan's Rule.	K4

**PO-CO Mapping**

<b>CO/PO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>
<b>CO-1</b>	<b>H</b>	<b>M</b>	<b>L</b>	<b>M</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
<b>CO-2</b>	<b>H</b>	<b>M</b>	<b>L</b>	<b>M</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>L</b>
<b>CO-3</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>
<b>CO-4</b>	<b>H</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>

**PSO-CO Mapping**

<b>CO/ PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	<b>H</b>	<b>M</b>	<b>H</b>
<b>CO2</b>	<b>H</b>	<b>M</b>	<b>H</b>
<b>CO3</b>	<b>H</b>	<b>M</b>	<b>H</b>
<b>CO4</b>	<b>H</b>	<b>M</b>	<b>H</b>

<b>Course Title</b>	<b>Major Core – 2: VOLUMETRIC ANALYSIS – Lab cum Theory</b>
<b>Code</b>	<b>U21CH1MCP02</b>
<b>Course type</b>	<b>Lab cum Theory</b>
<b>Semester</b>	<b>I</b>

<b>Hours/Week</b>	<b>4</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

## CONSPECTUS

To expose the students to the various concepts in volumetric analysis and to make them gain skill in the preparation of standard solution and finding out the strength of unknown solutions in different types of volumetric analysis.

### COURSE OBJECTIVES:

1. To understand the terminologies and principles involved in volumetric analysis
2. To identify primary standard secondary standard solution and determine the equivalence point
3. To describe the concentration of solution in various units and prepare standard solutions
4. To determine the strength of the given solution from different types of titrations like acid base, redox, and precipitation titration with the appropriate use of indicators.
5. To solve volumetric problems using formula method

### UNIT: I - VOLUMETRIC ANALYSIS

- 1.1 Terminology, Basic requirement of a titration, standard solution – primary standard, preservation of standard solution, expressing concentration of standard solution, simple correlation for quick and convenient volumetric calculation, p-functions.
- 1.2 Volumetric Titrations: Acid base titration – acid base titration and use of indicators, titration of a strong acid against a strong base, titration of a weak acid with a strong base, titration of a weak base with strong acid, titration of  $\text{Na}_2\text{CO}_3$  with HCl, the theory of acid base indicators, action of phenolphthalein and methyl orange.
- 1.3 Redox titration – theory – titration of Mohr salt against  $\text{KMnO}_4$ , oxalic acid against  $\text{KMnO}_4$ ,  $\text{FeSO}_4$  against  $\text{K}_2\text{Cr}_2\text{O}_7$ , internal indicator, external indicator, starch, iodimetry and iodometry. Precipitation titrations – conditions for precipitation titration and indicators.
- 1.4 Complexometric titration:- EDTA titrations, indicators of EDTA titrations, complexometric titration curves, EDTA – titration methods – masking of ions, precautions to avoid errors in titrimetric analysis, corrections for unavoidable errors.

**Extra reading/Keywords :** *Determine the total hardness present in the given water sample*

### VOLUMETRIC ANALYSIS:

1. Acidimetry  
Estimation of Oxalic acid.
2. Permanganometry:  
i. Estimation of  $\text{FeSO}_4$ .  
ii. Estimation of Calcium. (Direct Method).
3. Iodimetry & Iodometry:  
i. Estimation of copper.  
ii. Estimation of Arsenious oxide.

4. Dichrometry:  
Estimation of Ferrous ion.
5. EDTA Titrations:
  - i. Estimation of Magnesium.
  - ii. Estimation of Zinc.

#### TEXT BOOKS:

1. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Inorganic Chemistry* 35<sup>th</sup>edn., New Delhi:Shoban Lal Nagin chand and Co, 2013.
2. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 2<sup>nd</sup>edn, Sultan Chand & Sons, 1997.
3. Gopalan R, Subramanian PS and Rengarajan K '*Elements of Analytical Chemistry*' Second revised edition, Sultan chand, 1993

#### SUGGESTED READINGS:

1. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Text Book of Qualitative Analysis*, US: 6<sup>th</sup>edn., Pearson Education, 2006.
2. Soni P.L. and Mohankatyal, *Text book of Inorganic Chemistry*, 20<sup>th</sup> revised edn., New Delhi: Sultan Chand and sons, 2013.

#### WEB REFERENCES

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#### COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	describe the fundamental concepts and theories in quantitative analysis	K1
CO-2	interpret the basic competency of analyzing chemical compounds quantitatively and the theories of volumetric titrations with respect to the indicators.	K2
CO-3	apply laboratory skills needed to conduct, interpret chemical research in multi-disciplinary domains	K3

<b>CO-4</b>	find the risks and hazards in the lab and adopt techniques for lab safety and sustainable development	K4
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### PO-CO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	H	H	M	H	-	H	H	H	H
CO-2	H	H	H	H	-	H	H	H	M
CO-3	H	H	H	H	H	H	H	H	H
CO-4	H	H	H	H	H	H	H	H	H

### PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	H	H	H

<b>Course Title</b>	<b>Major Core 3:ANALYTICAL CHEMISTRY</b>
<b>Code</b>	<b>U21CH1MCT03</b>
<b>Course Type</b>	<b>Theory</b>
<b>Semester</b>	<b>I</b>
<b>Hours/Week</b>	<b>4</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

### **CONSPECTUS:**

Analytical chemistry is an interdisciplinary subject merging the areas of Inorganic chemistry and Data analysis. The various segment of the course deals with the risk assessment in performing chemical experiment, interpretation and validation of data, laboratory operations, separation and purification techniques, alternative analytical methods for quality assurance and theoretical principles of chromatography.

### **COURSE OBJECTIVES:**

1. To describe the various chemicals and laboratory safety measures
2. To identify the different types of errors in qualitative analysis
3. To discover the uses of apparatus in the chemical laboratory
4. To examine the chemical methods of purification and test of purity
5. To explain the procedure and typical applications of chromatographic techniques.



## **UNIT I - LABORATORY, HYGIENE AND SAFETY**

**12Hrs**

- 1.1 Storage and Handling of chemicals – carcinogenic chemicals – Handling of Ethers – Toxic and Poisonous chemicals – safe limits of vapour concentrations.
- 1.2 Waste disposal – disposal of expired chemicals – Fume disposal - precautions for avoiding accidents, Material safety data sheet (MSDS)
- 1.3 First Aid techniques, precautions to avoid poisoning, treatment for specific poisons, laboratory safety measures.

**Extra reading/Key words:** *Hazardous waste management.*

## **UNIT II - DATA ANALYSIS**

**12Hrs**

- 2.1 The mean, The median, significant numbers, confidence limits, data ethics, precision and accuracy.  
Methods of expressing precision: mean, median, deviation, average deviation and coefficient of variation
- 2.2 Errors – Types of errors, correction of determinate errors. Methods for improving accuracy .
- 2.3 Statistical tests of data -the F test, the t test, Q test for bad data, the method of least squares. Presentation of tabulated data – Scatter diagram –, S.I. UNITS.

**Extra reading/Key words:** *Problems.*

## **UNIT III-LABORATORY OPERATIONS**

**12Hrs**

- 3.1 Single pan analytical balance: (operation and theory of the balance, construction details, errors in weighing, care of an analytical balance).
- 3.2 Description and use of common laboratory apparatus: Volumetric flasks, burettes, pipettes, meniscus readers, weighing bottles, different types of funnels chromatographic columns, chromatographic jars, desiccators, drying ovens, filter crucibles, rubber policeman, Calibration and use of volumetric glass ware. .
- 3.3 pH meter: components of pH meter, use of pH Meter, maintenance of pH meter, application of data

**Extra reading/Key words:** *Principle and working of colorimeter*

## **UNIT IV- SEPARATION AND PURIFICATION TECHNIQUES**

**12Hrs**

- 4.1 General purification techniques - purification of solid organic compounds, recrystallisation, use of miscible solvents, use of drying agents and their properties, sublimation.
- 4.2 Purification of liquids - experimental techniques of distillation, fractional distillation, distillation under reduced pressure. Extraction, use of immiscible solvents, solvent extraction. Chemical methods of purification and test of purity.

- 4.3 Solubility and solubility products, expressions for solubility products. Determination of solubility from solubility products

**Extra reading/Key words:** *Concept of ionic products, precipitation*

## UNIT V–CHROMATOGRAPHY

**12Hrs**

- 5.1 Column chromatography – principle, types of adsorbents, preparation of column, elution- Ion exchange chromatography – cation and anion exchangers – applications.
- 5.2 Paper chromatography – principle, R<sub>f</sub> value and its significance, factors affecting R<sub>f</sub> value, selection of solvents, development of chromatogram, applications. Paper electrophoresis – principle, electrophoretic mobility, factors affecting electrophoretic mobility, advantages and disadvantages.
- 5.3 Thin layer chromatography–principle, choice of adsorbent, preparation of plates, development and applications.

**Extra reading/Key words:** *GC- MS chromatography*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

## TEXT BOOKS

1. Gopalan R, Subramanian PS and Rengarajan K ‘*Elements of Analytical Chemistry*’ Second revised edition, Sultan chand.1993
2. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*: New Delhi. Sultan Chand. 1989.
3. Gurdeep R Chatwal, Sham K. Anand ‘*Instrumental Methods of Chemical Analysis*’, Himalaya publishing house.2005

## SUGGESTED READINGS

1. Puri B.R., Sharma, L.R and Madan S. Pathania , *Principles of Physical Chemistry*New Delhi: 35<sup>th</sup>edn, Shoban Lal Nagin Chand and Co.2008
2. Willard H H, MerrittL. L., and Dean J. A., *Instrumental Methods of analysis*,Delhi, 6th edn, CBS Publishers & Distributors, Shahdara 1986.
3. Gary D. Christian, *Analytical Chemistry*, John Wiley & Sons, 6th edition, 2007.
4. BobbittJ. M, Roy Gritter, *Introduction to chromatography*, Holden Day; 2nd edition.1985
5. Soni P.L., Chawla H.M., *Text Book of Organic Chemistry*, 6<sup>th</sup> Reprint, New Delhi: Sultan Chand & sons, 2006.
6. Douglas A. Skoog, Donald M. West and F. J. Holler, ‘*Fundamentals of Analytical Chemistry*’, 7thedition, Harcourt College Publishers. 1997
7. Mendham J., Denny R. C., Barnes J.D., Thomas M., ‘*Vogel’s Test book of Quantitative Chemical analysis*’ 6th edition, Pearson education.1999

8. Sharma, B. K., 'Instrumental Methods of Chemical Analysis', Goel Publishing House, Merrut .1997

### WEB REFERENCES

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2. <https://studiousguy.com/list-of-chemistry-laboratory-apparatus-and-their-uses/>
3. [https://www.chem.purdue.edu/gchelp/howtosolveit/Equilibrium/Solubility\\_Products.htm](https://www.chem.purdue.edu/gchelp/howtosolveit/Equilibrium/Solubility_Products.htm)
4. [https://chem.libretexts.org/Ancillary\\_Materials/Demos\\_Techniques\\_and\\_Experiments/General\\_Lab\\_Techniques/Thin\\_Layer\\_Chromatography](https://chem.libretexts.org/Ancillary_Materials/Demos_Techniques_and_Experiments/General_Lab_Techniques/Thin_Layer_Chromatography)

### COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive level
CO1	recall the laboratory safety measures, types of errors, instruments, separation techniques and know the principles of different chromatographic techniques required for quality control sectors.	K1
CO2	identify the first aid techniques, waste and fume disposal, the laboratory apparatus, purification and separation techniques and interpret the analytical data with theoretical results in the field of research, experimental methods of different chromatographic techniques.	K2
CO3	adapt safety procedure in laboratory, methods for improving accuracy of results, calibration techniques, separation techniques, minimal usage of chemicals, applications of chromatography and apply green chemistry approach for sustainable environment.	K3
CO4	categorize the hazards in the laboratory, types of statistical tests, laboratory operations, test the purity of samples and separate components using various chromatographic techniques needed for research and development unit.	K4

### PO-CO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	H	H	M	H	M	H	H	H	H
CO-2	H	H	M	H	M	M	H	H	H
CO-3	H	H	M	H	M	H	H	H	H
CO-4	H	H	M	H	M	H	H	H	H

### PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	H	M	H
CO3	H	H	H

<b>CO4</b>	<b>H</b>	<b>H</b>	<b>H</b>
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<b>Course Title</b>	<b>Allied – 1: CHEMISTRY PAPER I [For Bioinformatics, Botany and Zoology]</b>
<b>Code</b>	<b>U21CH1ALT01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Semester</b>	<b>I</b>
<b>Hours/Week</b>	<b>4</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

### CONSPECTUS

To make the students to understand the basic concepts of quantum numbers and periodic properties, organic reactions, carbohydrates, amino acids and proteins, water chemistry, chromatography and osmosis.

### COURSE OBJECTIVES:

1. To recognize and understand the quantum numbers, periodic table and periodic properties.
2. To categorize and discuss the different types of organic reactions, reaction intermediates, organic reagents, electronic effects and hybridization.
3. To recall, classify and identify the different types of carbohydrates, amino acids and proteins.
4. To understand, apply and determine the water quality parameters.
5. To understand and apply the concept of chromatography and osmosis in everyday life.

### UNIT 1 - PERIODIC TABLE

**12Hrs**

- 1.1 Quantum numbers: - Principal, Azimuthal, Magnetic and Spin quantum numbers. Electronic configuration of elements – Aufbau principle, Hund's rule and Pauli's exclusion principle.
- 1.2 Long form of periodic table, division of elements into s, p, d and f blocks, cause of Periodicity.
- 1.3 Periodic properties – Atomic radius, Ionic radius, Ionization energy, Electron affinity and Electronegativity – definition and variation along a group and a period.

**Extra Reading/Keywords:** *Applications of metals and nonmetals in day today life.*

### UNIT 2 - FUNDAMENTAL CONCEPTS OF ORGANIC CHEMISTRY

**12Hrs**

- 2.1 Types of organic reactions – substitution (one example each of nucleophilic and electrophilic), addition (preparation of 1,2-Dibromoethane), elimination (Dehydration of ethanol), rearrangement (pinacol pinacolone rearrangement) and Polymerization reactions (PVC).
- 2.2 Types of reaction intermediates- carbanion, carbocation and free radicals, types of reagents –

- Electrophiles and nucleophiles: definition and examples
- 2.3 Electron Displacement Effects - Inductive, Resonance, Hyper-Conjugation and Steric Effect – an elementary idea. States of hybridization of carbon.

**Extra Reading/Keywords:** *Stability and feasibility of organic reactions*

### **UNIT 3 – CARBOHYDRATES, AMINO ACIDS AND PROTEINS**

**12Hrs**

- 3.1. Carbohydrates – classification, glucose, fructose and sucrose – structure only, properties, Mutarotation, Test to identify carbohydrates- elementary idea of Starch and Cellulose.
- 3.2. Amino acids - classifications, preparation and properties of  $\alpha$ - amino acids. Test for amino acids. Peptides – peptide linkage.
- 3.3. Proteins – definition, classification based on physical properties and biological function, primary and secondary structures (elementary treatment). Test for proteins.

**Extra Reading/Keywords:** *Elementary idea of DNA, RNA and their biological role*

### **UNIT 4 - CHEMISTRY OF WATER**

**12Hrs**

- 4.1. Hard and Soft water- types of hardness, temporary and permanent hardness – Disadvantages of hard water, boiler feed water- scale and sludge formation, caustic embrittlement, boiler corrosion, priming and foaming.
- 4.2. Internal and external treatment of hard water – Zeolite process, Ion exchange process, desalination of water.
- 4.3. DO, BOD and COD – definition and determination (any one method), preparation of potable water and deionized water.

**Extra Reading/Keywords:** *Industrial applications of water.*

### **UNIT 5- CHROMATOGRAPHY AND OSMOSIS**

**12Hrs**

- 5.1 Chromatography- Introduction, principle, instrumentation and sampling techniques.
- 5.2 Types of chromatography - Column Chromatography, Thin layer Chromatography and Paper Chromatography.
- 5.3 Electrophoresis, Osmosis – Osmotic pressure and its determination.

**Extra Reading/Keywords:** *Applications in Chromatographic techniques*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

#### **TEXT BOOKS:**

1. Soni P.L. and Chawla H.M, *Text Book of Organic Chemistry*(26<sup>th</sup>edn). New Delhi: Sultan Chand and sons., 2014.
2. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Physical Chemistry* (35<sup>th</sup>edn) New Delhi: Shoban Lal Nagin chand and Co, 2013.
3. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Inorganic Chemistry*, (35<sup>th</sup>edn). New Delhi:Shoban Lal Nagin chand and Co., 2013.

## SUGGESTED READINGS

:

1. Soni P.L. and Mohankatyal, *Text book of Inorganic Chemistry*, 20<sup>th</sup> revised edition, sultan chand,. 1992.
2. Bahl B.S, Arun Bahl and Tuli G.D, *Essentials of Physical Chemistry*, New Delhi: Sultan Chand and sons, 2012.
3. [Robert Thornton Morrison](#), [Robert Neilson Boyd](#) , [SaibalKanti Bhattacharjee](#), *Organic Chemistry* ( 7<sup>th</sup> Edition), Chennai: Pearson Education India, 2011.
4. Jain M.K, Sharma S.C, *Modern Organic Chemistry*, Vishal Publishing Co, 2007

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2. [https://www.researchgate.net/publication/317617161\\_A\\_Handbook\\_of\\_Chromatography](https://www.researchgate.net/publication/317617161_A_Handbook_of_Chromatography)
3. <https://pubchem.ncbi.nlm.nih.gov/periodic-table/https://www.suezwatertechnologies.com/handbook/chapter-01-water-sources-impurities-and-chemistry>

## COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive level
CO1	describe the concepts of quantum numbers, electronic configuration, periodic table, periodic properties, carbohydrates, amino acids, proteins, types of water, hardness of water, water quality parameters, boiler feed water, chromatographic techniques, osmosis, organic reactions, reaction intermediates, reagents, electronic effects and hybridization, electrophoresis and osmotic pressure.	K1
CO2	identify the trend of periodic properties and the types of quantum numbers, periodic elements, organic reaction, reaction intermediates, reagents, electron displacement effects, hybridization, describe the types of carbohydrates, amino acids, proteins and their structures, internal and external treatment of hard water, disadvantages of hard water, chromatographic techniques and the principle of osmotic pressure.	K2
CO3	apply the concept of quantum numbers, electronic configuration and periodicity to illustrate the properties of elements, identify organic reactions, organic reagents and types of intermediate involved in various organic reactions, compare the stability and structure of the intermediates, explain the type of electronic effects and hybridization in organic molecules, chemical properties of carbohydrates, amino acids and proteins, boiler feed water, calculation of water quality parameters and use the principle of osmosis in osmotic pressure.	K3
CO4	examine the location of electrons in orbitals using quantum numbers, periodic trends, amino acids by chromatographic techniques. Predict	K4

	the reactivity and stability of reaction intermediates, organic reactions, electronic effects and analyze the states of hybridization of carbon , carbohydrates, amino acids, proteins, preparation of potable water and deionized water, desalination of water, electrophoresis and determine osmotic pressure.	
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### PO-CO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	H	M	M	M	M	M	H	H	M
CO-2	H	H	M	M	H	M	H	H	M
CO-3	H	H	M	H	M	H	H	H	M
CO-4	H	H	M	H	M		M	H	-

### PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	M	M	H
CO2	M	L	M
CO3	L	M	L
CO4	M	L	L

<b>Course Title</b>	<b>Allied 2: CHEMISTRY PAPER II (For Bioinformatics, Botany and Zoology)</b>
<b>Code</b>	<b>U21CH1ALP02</b>
<b>Course Type</b>	<b>Lab cum Theory</b>
<b>Semester</b>	<b>I</b>
<b>Hours/Week</b>	<b>4</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

### CONSPECTUS

To expose the students to various concepts in volumetric analysis and to gain skill in the preparation of different concentrated solutions and calculation of strength of the given unknown solution.

#### Course Objective:

1. To understand the terminologies and principle involved in volumetric analysis
2. To define primary standard, secondary standard and determine the equivalence point
3. To determine the concentration of solution in various units and prepare standard solution and dilute solution
4. To explain the different types of titrations like acid-base, redox and precipitation

5. To solve volumetric problems using principle of volumetric analysis

**UNIT 1 - VOLUMETRIC ANALYSIS:**

**12 Hrs**

- 1.1 Definitions:- Titration, Back Titration, End point, Equivalence point, Indicator, Normality, Molality, Molarity, Mole Fraction, Equivalent weights of acid, base, salt, oxidizing and reducing agents.
- 1.2 Standard solution, requirements of a primary standard, preparation of standard solution, secondary standard, principle of volumetric analysis.
- 1.3 Acid-Base titrations – HCl with NaOH, CH<sub>3</sub>COOH against NaOH, Na<sub>2</sub>CO<sub>3</sub> with HCl. Acid-Base indicators – Ostwald's theory and quinonoid theory.
- 1.4 Redox titrations – Mohr salt against KMnO<sub>4</sub>, Oxalic acid with KMnO<sub>4</sub>, FeSO<sub>4</sub> against K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. Redox indicator – Diphenyl amine, Iodometry - Estimation of copper sulphate

**Extra reading/Keywords:** EDTA Titrations

**VOLUMETRIC ANALYSIS (DOUBLE TITRATION WITH WEIGHING):**

(3 hrs. External)

I Acidimetry and Alkalimetry:

1. Estimation of sodium hydroxide.
2. Estimation of hydrochloric acid.

II Permanganometry:

3. Estimation of Mohr's Salt.
4. Estimation of Oxalic acid.

III Iodometry:

5. Estimation of copper sulphate

IV Dichrometry:

6. Estimation of iron (internal indicator)

**TEXT BOOKS:**

1. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.
2. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 2<sup>nd</sup>edn, Sultan Chand & Sons, 1997.

**SUGGESTED READINGS:**

1. Svehla G. *Vogel's Qualitative Inorganic Analysis*. US: 7<sup>th</sup> Edition, Prentice Hall, 1996.
2. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Prescribed Book of Qualitative Chemical Analysis*, US: 6<sup>th</sup> Edition, Prentice Hall, 2000.
3. Henry William Schimpf, *A Textbook of Volumetric Analysis*, ISBN: 978-1-332-43299-8.
4. Peter AC McPherson, *Practical Volumetric Analysis*, 1<sup>st</sup> Edition, ISBN: 1849739145

**WEB REFERENCES**

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2. <https://www.merriam-webster.com/dictionary/volumetric>
3. <https://www.goodreads.com/book/show/30861279-a-text-book-of-volumetric-analysis-with-special-reference-to-the-volume>

## COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	define and recall the terms of volumetric analysis	K1
CO-2	explain and describe the knowledge of different concentration units and theory of indicators	K2
CO-3	apply laboratory skills needed to conduct, interpret chemical research in multi-disciplinary domains	K3
CO-4	analyze and adapt green chemistry principles for lab safety and ecofriendly atmosphere	K4

## PO-CO Mapping

CO/PO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	M	M	L	-	-	M	L	L	L
CO-2	M	L	-	M	L	-	M	M	M
CO-3	M	-	L	-	L	M	-	-	H
CO-4	M	L	M	M	L	H	L	M	M

## PSO-CO Mapping

CO/PSO	PSO1	PSO2	PSO3
CO-1	L	M	M
CO-2	M	M	M
CO-3	L	M	L
CO-4	M	H	H

Course Title	Major Core 4- ORGANIC AND PHYSICAL CHEMISTRY
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<b>Code</b>	<b>U21CH2MCT04</b>
<b>Semester</b>	<b>II</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

## CONSPECTUS

To understand the reactions of aliphatic hydrocarbons and learn about the second and third law of thermodynamics

## COURSE OBJECTIVES:

1. To understand the preparation and properties of alkanes, cycloalkanes and explain the stability of cycloalkanes
2. To classify dienes and understand its stability, explain the elimination reactions and properties of alkynes
3. To learn the concept and behavior of gases.
4. To understand the second law of thermodynamics and apply to physical and chemical system.
5. To illustrate the importance of third law of thermodynamics and significance of chemical potential.

## Unit I: ALKANES AND CYCLOALKANES

18

### Hrs

- 1.1. Alkanes - General methods of preparation and properties- Sulphonation, nitration, pyrolysis and oxidation. Mechanism of free radical substitution of halogenation.
- 1.2. Petroleum - Petroleum refining, Cracking, Rating of Fuels-Octane number, Cetane number, Flash point – definitions. Synthetic Petroleum- Fischer-Tropsch process. Anti-knocking properties. Petroleum as a source of aromatics.
- 1.3. Cycloalkanes - preparation – Freund’s method, Dieckmann condensation, Catalytic reduction, Simmons- Smith reaction and Thrope – Ziegler reaction. Properties –Substitution, Addition, Catalytic reduction and Oxidation reactions.
- 1.4. Cycloalkanes - Stability - Baeyer’s strain theory, Sachse- Mohr theory, Coulson and Moffitt’s concept, orbital picture of angle strain.

**Extra reading/Keywords:** *Conformational analysis of Substituted cyclohexane.*

## Unit II: ALKENES AND ALKYNES

### 18Hrs

- 2.1. Alkenes - General methods of preparation by dehydrogenation, dehydrohalogenation, dehydration, Hoffmann and Saytzeff rules, cis and trans eliminations.
- 2.2. Reactions of Alkenes: Mechanism of electrophilic and free radical addition, addition of hydrogen, halogen, hydrogen halide (Markownikoff’s rule), hydrogen bromide (peroxide

- effect), sulphuric acid, water, hydroboration, ozonolysis, dihydroxylation with  $\text{KMnO}_4$ , allylic bromination by NBS.
- 2.3. Dienes - Types, Stability of dienes (conjugated, isolated and cumulative dienes). General methods of preparation and Reactions- Mechanism of 1, 2- and 1,4-additions, Diels- Alder reactions. Addition polymerization reactions, mechanism of Ziegler Natta polymerization.
  - 2.4. Alkynes - Preparation- Mechanism of dehydrohalogenation and dehalogenation. Reactions: acidity of alkynes, formation of acetylides, Electrophilic and Nucleophilic additions, reduction and oxidation.

**Extra reading/Keywords:** *Problems related to alkynes and alkenes*

### **UNIT III- THE GASEOUS STATE**

**18Hrs**

- 3.1 General Characteristics of gases, Parameters of a gas- The Kinetic Molecular theory of gases- Derivation of Kinetic gas equation, Derivation of gas laws from Kinetic equation, Maxwell's law of distribution of molecular velocities, Different types of molecular velocities.
- 3.2. Collision Parameters - Collision number, collision cross section, collision frequency, collision diameter and mean free path. Transport phenomenon in gases, Degrees of Freedom- Principle of Equipartition of energy.
- 3.3. Real gases and ideal gases - Deviation of real gases from ideal behavior, Derivation of Vander Waals equation for real gases, Vander Waals constants.
- 3.4. Critical phenomenon - critical constants of a gas, critical temperature, critical pressure, critical volume, PV isotherms for real gases, calculation of critical constants (simple problems using Vander Waals equation).

**Extra reading/Keywords:** *Law of corresponding states and reduced equation of states.*

### **UNIT IV - SECOND LAW OF THERMODYNAMICS**

**18Hrs**

- 4.1 The second Law of thermodynamics - Need for the second law of thermodynamics, spontaneous or irreversible processes, Statements of the II law, Conversion of heat into work – the Carnot's theorem, the Carnot cycle, maximum efficiency of heat engine, refrigeration engine, thermodynamic scale of temperature.
- 4.2 Entropy – concept of entropy, entropy as a state function, physical significance of entropy, entropy change in isothermal expansion of an ideal gas and its applications to simple systems, entropy changes in reversible and irreversible processes
- 4.3 Entropy change accompanying change of phase, entropy of mixing of ideal gas and its applications to simple problems, Variation of entropy with temperature, Maxwell's relations, the thermodynamic equations of state.
- 4.4 Free energy, work function, variation of  $\Delta A$  and  $\Delta G$  with temperature and pressure, Isothermal change in Free energy, Gibb's Helmholtz equation.

**Extra reading/Keywords:** Application of Gibb's Helmholtz equation.

**UNIT V - CHEMICAL POTENTIAL AND THIRD LAW OF THERMODYNAMICS**  
**18Hrs**

- 5.1 Chemical potential – partial molar properties, physical significance of partial molar property, partial molar free energy – Gibb’s Duhem equation, variation of chemical potential with temperature and pressure.
- 5.2 Chemical potential in a mixture of ideal gases, Clausius-Clapeyron equation and its applications.
- 5.3 Fugacity and Activity -Concept of fugacity, Determination of fugacity of real gas, activity and activity co-efficient concept.
- 5.4 The Third law of thermodynamics – Nernst heat theorem, third law of thermodynamics, determination of absolute entropies of solids liquids and gases, exceptions to III law.

**Extra reading/Keywords:** *Calculation of partial molar properties from experimental data, activity coefficients of non-electrolytes*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**COURSE OUTCOMES**

CO No.	COURSE OUTCOMES	Cognitive Level
CO1	Describe general methods of preparation and properties of Alkanes, Alkenes, Alkynes, Cycloalkanes and Dienes. Explains molecular velocities, second and third law of thermodynamics	K1
CO 2	Discuss Fischer- Tropsch process of Synthesis of petrol, Octane number, Cetane number, Illustrate the Mechanism of various organic reactions of aliphatic hydrocarbons. General Characteristics of gases, derivation of gas laws, collision parameters, transport phenomena in gases, carnot’s theorem and entropy of gases.	K2
CO-3	Identify the stability of cycloalkanes and the product of addition reactions using Markonikov’s rule and Peroxide effect, calculation of critical constants, molecular velocities, collision parameters and fugacity.	K3
CO-4	Deduce the mechanism of organic reactions of alkanes, alkenes, Alkynes, cycloalkanes and Dienes, analyze the P-V isotherms for real gases, Variation of entropy with temperature , variation of chemical potential with temperature and pressure, variation of $\Delta A$ and $\Delta G$ with temperature and pressure.	K4

**RBT Levels**

**K1 – Remember, K2- Understand, K3 – Apply, K4- Analyse, K5 – Evaluate, K6 - Create**

**TEXTBOOKS**

1. Soni P.L. and Chawla H.M. *Text Book of Organic Chemistry*, 26th edn., New Delhi: Sultan Chand and sons, 2014.
2. Puri B.R., Sharma. L.R. and Madan S. Pathania, *Principles of Physical Chemistry*, (46 th edition), New Delhi, Vishal Publishing Co, 2012.
3. Bahl B.S., Arun Bahl and Tuli, *Essentials of Physical Chemistry*, New Delhi, Sultan chand and sons,2007.
4. Jain M.K, Sharma S.C, *Modern Organic Chemistry* , Vishal Publishing Co,. 2007
5. Samuel Glasstone. *Thermodynamics for Chemists* ( 3rd printing) East-WestEdn., 2007.
6. Rajaram. J & Kuriacose. J.C., *Chemical Thermodynamics*, New Delhi, Pearson Education, 2013.

### SUGGESTED READINGS

1. Peter Atkins and Julio De Paula, *Atkin's Physical Chemistry*, (2006), Oxford University Press, New Delhi.
2. Castellan G.W., *Physical Chemistry*, Third Edition, New Delhi, Orient Longmann (1987).
3. Robert Thornton Morrison, Robert Neilson Boyd ,SaibalKanti Bhattacharjee, *Organic Chemistry*, 7th edn., Chennai: Pearson Education India, 2011.
4. Raj K. Bansal, *A Text Book of Organic Chemistry*, 5th edn., New Age, 2007.

### WEB REFERENCES

1. <https://nptel.ac.in/courses/104/103/104103071/>
2. <https://www.khanacademy.org/science/organic-chemistry/bond-line-structures-alkanes-cycloalkanes>
3. <https://nptel.ac.in/courses/103/101/103101004/>
4. <https://nptel.ac.in/courses/112/108/112108148/>
5. <https://slideplayer.com/slide/8415870/>

### PO-CO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	H	H	L	M	M	M	H	L	L
CO-2	H	M	L	M	M	M	M	M	L
CO-3	H	H	M	M	M	M	M	M	M
CO-4	H	M	H	M	M	M	M	M	M

### PSO-CO Mapping

<b>CO/ PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	<b>H</b>	<b>M</b>	<b>H</b>
<b>CO2</b>	<b>H</b>	<b>M</b>	<b>H</b>
<b>CO3</b>	<b>H</b>	<b>M</b>	<b>H</b>
<b>CO4</b>	<b>H</b>	<b>M</b>	<b>H</b>

**\*Correlation H=High, M= Medium, L=Low**

<b>Course Title</b>	<b>Major Core 5- SEMI-MICRO QUALITATIVE ANALYSIS</b>
<b>Code</b>	<b>U21CH2MCP05</b>
<b>Semester</b>	<b>II</b>
<b>Total Hours</b>	<b>45</b>
<b>Hours/Week</b>	<b>3</b>
<b>Course type</b>	<b>Practical</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

## CONSPECTUS

To expose the students to various concepts in semi-micro analysis and to make them systematically identify elements and ions in the salt mixture and develop analytical skills in inorganic qualitative analysis based on green chemistry techniques.

## COURSE OBJECTIVES:

6. To understand the basic principles and concepts involved in semi-micro analysis
7. To identify the acid and base radicals in the given salt mixture systematically.
8. To analyze the interfering radicals and separate the cations into individual groups.
9. To examine the cations using confirmatory tests.
10. To report the acid and basic radicals in the given mixture by writing the systematic procedure of semi-micro qualitative analysis.

## ANALYSIS OF INORGANIC SALT MIXTURE

1. Analysis of the Acid Radicals: Carbonate, Sulphate, Sulphide, Nitrate, Chloride, Bromide, Fluoride, Oxalate, Phosphate, Arsenite, Arsenate, Chromate and Borate
2. Elimination of Interfering Radicals – Fluoride, Oxalate, Phosphate, arsenate and Borate
3. Analysis of the Basic Radicals and its Group Separations. Lead, Copper, Bismuth, Cadmium, Antimony, Iron, Chromium, Aluminum, Cobalt, Nickel, Manganese, Zinc, Barium, Strontium, Calcium, Ammonium and Magnesium.

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	describe the basic principles and the tests for acid and basic radicals in semi-micro qualitative analysis.	K1
CO-2	relate the theories, identify the acid and basic radicals through systematic tests and recognize the interfering radicals.	K2
CO-3	apply the concepts of qualitative analysis in confirmatory tests and separation of the cations into groups.	K3
CO-4	analyze the given inorganic salt mixture by adopting green techniques for lab safety and sustainable development	K4

#### RBT Levels

**K1 – Remember, K2- Understand, K3 – Apply, K4- Analyse, K5 – Evaluate, K6 - Create**

#### TEXT BOOKS:

1. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Inorganic Chemistry* 35<sup>th</sup> edn., New

Delhi:Shoban Lal Nagin chand and Co, 2013.

2. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*.

New Delhi: 2<sup>nd</sup> edn, Sultan Chand & Sons, 1997.

#### SUGGESTED READINGS:

2. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Text Book of Qualitative Analysis*, US: 6<sup>th</sup> edn., Pearson Education, 2006.

2. Soni P.L. and Mohankatyal, *Text book of Inorganic Chemistry*, 20<sup>th</sup> revised edn., New Delhi: Sultan Chand and sons, 2013.

#### WEB REFERENCES

1. <https://youtu.be/wDkCDlq8YL8>
2. <https://youtu.be/kjyKK5a0Ulk>
3. <https://youtu.be/qPjGbrd4nJw>
4. <https://youtu.be/jGgwZx7tyI8>
5. <https://youtu.be/yMChYvgTfkQ>



### CO-PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	H	H	M	H	-	H	H	H	M
CO-2	H	H	M	H	-	H	H	H	M
CO-3	H	H	H	H	H	H	H	H	H
CO-4	H	H	H	H	H	H	H	H	H

### CO-PSO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	H	H	H

\*Correlation H=High, M= Medium, L=Low

<b>Course Title</b>	<b>Major Core 6 – BASICS OF ANALYTICAL AND PHYSICAL METHODS</b>
<b>Code</b>	<b>U21CH2MCT06</b>
<b>Semester</b>	<b>II</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5</b>
<b>Course type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

### CONSPECTUS

To make the students understand the fundamentals of basics of practical chemistry such as qualitative analysis of inorganic salts and volumetric analysis, theory of solutions, phase equilibria and phase rule.

### COURSE OBJECTIVES:

1. To develop skills necessary for qualitative analysis of acid and basic radicals in inorganic salts mixtures
2. To illustrate the terminologies and principles involved in volumetric analysis
3. To categorize the different types solutions
4. To illustrate various colligative properties
5. To enumerate the basic concepts of phase equilibria and phase rule

## **UNIT I: PRINCIPLES OF INORGANIC QUALITATIVE ANALYSIS**

**15Hrs.**

- 1.1 Dry Tests -Physical Examination of Mixture, Dry Heating Test, Flame Test, Borax–Bead Test, Charcoal Cavity Test, Cobalt Nitrate Test and Caustic Soda Test.
- 1.2 Wet Tests for Acid Radicals (Confirmatory Test for Anions), Sodium Carbonate Extract, Dilute Acid Test, Elimination of Interfering Radicals – Fluoride, Oxalate, Phosphate, arsenate and Borate.
- 1.3 Basic principles of Chemical analysis - Solubility product, Common ion effect, complexation, oxidation and reduction. Wet Tests for Basic Radicals- Analysis of Basic Radicals, Preparation of Original Solution.
- 1.4 Group Separations, Analysis of Individual Groups of Cations - Lead, Copper, Bismuth, Cadmium, Antimony, Iron, Chromium, Aluminum, Cobalt, Nickel, Manganese, Zinc, Barium, Strontium, Calcium, Ammonium and Magnesium.

**Extra reading/Keywords:** *Analysis of lanthanides*

## **UNIT II- VOLUMETRIC ANALYSIS**

**15Hrs.**

- 2.1 Principles involved in Volumetric Analysis, Requirement of Titrimetric Reactions, Expression of Concentration of Solutions - Mass or weight (w) percent, Volume percent, Strength, Molarity, Molality, Normality, Mole Fraction, Mole Percent. Preparation of Standard solution. Primary and secondary standards. Equivalent Masses for Various Reactions.
- 2.2 Volumetric Titrations: Acid base titration – acid base titration and use of indicators, theory of acid base indicators, action of phenolphthalein and methyl orange. Titration of a strong acid against a strong base, titration of a weak acid with a strong base, titration of a weak base with strong acid, titration of  $\text{Na}_2\text{CO}_3$  with HCl.
- 2.3 Redox titration – theory – titration of Mohr salt against  $\text{KMnO}_4$ , oxalic acid against  $\text{KMnO}_4$ ,  $\text{FeSO}_4$  against  $\text{K}_2\text{Cr}_2\text{O}_7$ , internal indicator, external indicator, starch, iodimetry and iodometry. Precipitation titrations – conditions for precipitation titration and indicators.
- 2.4 Complexometric titration: - EDTA titrations, indicators of EDTA titrations, complexometric titration curves, EDTA – titration methods – masking of ions, precautions to avoid errors in titrimetric analysis, corrections for unavoidable errors.

**Extra reading/Keywords:** *Principles of potentiometric titrations*

## **UNIT III: SOLUTIONS**

**15Hrs.**

- 3.1 Concentration of a solution, ways of expressing concentration, solutions of gases in gases - characteristic properties of gaseous solutions, Henry's law.

- 3.2 Solubility of partially miscible binary liquid systems: phenol and water –triethylamine and water – nicotine and water – lower and upper CST's.
- 3.3 Solutions of liquids in liquids – ideal and non-ideal solutions, Raoult's law, criteria for ideal solutions, non-ideal solutions - Type I, Type II and Type III solutions.
- 3.4 Theory of fractional distillation, vapour pressure of mixtures of non-miscible liquids, Steam distillation.

**Extra reading/ Keywords:** Excess thermodynamic functions

#### **UNIT IV: THEORY OF DILUTE SOLUTIONS**

**15Hrs.**

- 4.1 Colligative properties – Lowering of vapour pressure by a non-volatile solute, Determination of molecular mass from vapour pressure lowering, Measurement of vapour pressure lowering by Ostwald-Walker method.
- 4.2 Elevation of boiling point - Relation between elevation of boiling point and lowering of vapour pressure, Measurement of boiling point elevation - Cottrell's method.
- 4.3 Freezing point depression - Relation between depression of freezing point and lowering of vapour pressure, measurement of freezing point depression - Beckmann's method, Abnormal molecular weights – Van't Hoff factor, association and dissociation. Nernst distribution law & its applications.
- 4.4 Osmosis and osmotic pressure – Measurement of osmotic pressure by Berkeley – Hartley method, Isotonic solutions, Reverse osmosis, Laws of osmotic pressure, calculation of osmotic pressure.

**Extra Reading / key words:** Application of colligative properties and distribution law

#### **UNIT V: PHASE EQUILIBRIA AND PHASE RULE**

**15Hrs.**

- 5.1 Meaning of the terms – phase, component and degree of freedom. Criteria of phase equilibrium, Gibb's phase rule.
- 5.2 Phase equilibria in one component systems – phase diagrams of water, carbon di-oxide and Sulphur system.
- 5.3 Simple eutectic system – Lead-Silver system and Potassium iodide-Water system.
- 5.4 Systems giving rise to compounds with congruent melting point – Zinc-Magnesium system. Systems giving rise to compounds with incongruent melting point – Sodium-Potassium system.

**Extra Reading / key words:** Three component system

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	Describes the basic principles and the methods to identify acid and basic radicals in semi-micro qualitative analysis, principles of volumetric analysis, Derives Raoult's law, explains colligative properties, phase rule.	K1
CO-2	.Explains the testing of acid and basic radicals, types of titrations, experimental determination of colligative properties, one and two component systems	K2
CO-3	Classify simple and eliminating acid radicals, calculate the strengths and equivalent weights, identify the solutions based on Raoult's Law and demonstrates the distillation processes and phase equilibria.	K3
CO-4	Analyze the acid and basic radicals, compares iodometric and iodimetric titrations, the colligative properties and determine the molecular mass from the colligative properties, Outline the phase rule and analyze the Phase equilibria.	K4

#### RBT Levels

**K1 – Remember, K2- Understand, K3 – Apply, K4- Analyse, K5 – Evaluate, K6 - Create**

#### TEXT BOOKS:

1. Jeffery, G. H., Mendham, J., Denney, R. C., & Bassett, J. (2009). *Text book of Quantitative Chemical Analysis*, (6<sup>th</sup> edn). Pearson Education.
2. Puri B.R., Sharma L.R. and Madan S. Pathania, (2013). *Principles of Physical Chemistry* (35<sup>th</sup> edn).New Delhi: Shoban Lal Nagin chand and Co.
3. Bahl B.S, Arun Bahl and Tuli G.D. (2012), *Essentials of Physical Chemistry*, New Delhi:Sultan Chand and sons.
4. Venkateswaran V., Veeraswamy R., Kulandaivelu A.R., (1997), '*Basic Principles of Practical Chemistry*', (2<sup>nd</sup> Edn). Sultan Chand & Sons.
5. Walter J Moore '*Physical Chemistry*', (5<sup>th</sup> Edn)., Prentice-Hall, 1999

#### SUGGESTED READINGS:

5. P. W. Atkins, (2009) "*Physical Chemistry*", (7<sup>th</sup> Edn). Oxford University Press,
6. Castellan G.W., *Physical Chemistry*, Third Edition, New Delhi, Orient Longmann (1987).
7. Donald A. McQuarrie, John D. Simon,( 2005),*Physical Chemistry: A Molecular Approach*, University Science books,.

## WEB REFERENCES

1. <https://nptel.ac.in/courses/112104248>
2. [https://uomustansiriyah.edu.iq/media/lectures/6/6\\_2020\\_10\\_09!12\\_07\\_57\\_AM.pdf](https://uomustansiriyah.edu.iq/media/lectures/6/6_2020_10_09!12_07_57_AM.pdf)
3. <https://vlab.amrita.edu/index.php?sub=2&brch=190&sim=1545&cnt=1>
4. <https://www.eng.uc.edu/~beaucag/Classes/Properties/Collig.pdf>
5. [https://archive.nptel.ac.in/content/storage2/courses/downloads\\_new/112104248/noc18\\_mm\\_20\\_Assignment5.pdf](https://archive.nptel.ac.in/content/storage2/courses/downloads_new/112104248/noc18_mm_20_Assignment5.pdf)

## CO-PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	H	H	M	H	H	H	H	H	M
CO-2	H	H	M	H	H	H	H	H	M
CO-3	H	H	M	H	-	H	H	H	M
CO-4	H	H	M	H	-	H	H	H	M

## CO-PSO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	H	H	H

\*Correlation H=High, M= Medium, L=Low

<b>Course Title</b>	<b>Allied – 3: CHEMISTRY PAPER III [For Botany/ Zoology]</b>
<b>Code</b>	<b>U21CH2ALT03</b>
<b>Semester</b>	<b>II</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

## CONSPECTUS

To make the students to understand and apply the basic concepts of co-ordination chemistry, chemicals in pharmacy, photochemistry, electrochemistry and applications of chemistry in industries.

## COURSE OBJECTIVES:

1. To recognize, understand the terms and apply the theories of co-ordination chemistry to the co-ordination complexes.
2. To classify and identify the therapeutic applications of drugs and the role of metal ions in biological systems.
3. To recognize and relate the different photochemical laws and photochemical processes.
4. To understand and apply the basic concepts of conductance in the determination of pH Kohlrausch law and the conductometric titrations.
5. To analyze the industrial applications of different chemical compounds in industries.

## UNIT 1 -CO-ORDINATION CHEMISTRY

**12Hrs**

- 1.1 Double salts, co-ordination compounds, complex ions, co-ordination number, classification of ligands, Nomenclature of mono nuclear complexes-Theories of coordination compounds – Werner, Sidgwick and Pauling theories.
- 1.2 Chelation and its industrial importance with reference to EDTA, hardness of water. Biological role of hemoglobin, myoglobin and chlorophyll.
- 1.3 Importance and applications of co-ordination compounds- In analytical chemistry, metallurgy, purification of metals, biological systems, industry and medicinal field.

**Extra reading/Keywords:** *Industrial applications of Coordination compounds.*

## UNIT 2- CHEMICALS IN PHARMACY

**12Hrs**

- 2.1. Definition and therapeutic uses – Antiseptics: Alum, boric acid- mouth washes: hydrogen peroxide- Antacids: Aluminum hydroxide- Analgesics: Aspirin, Paracetamol.
- 2.2. Antibiotics - Penicillin, Tetracyclines- Hematinic: Ferrous Fumarate, Ferrous glucomate  
Laxatives: Epsom salt, milk of magnesia- Sedatives: Diazepam.

- 2.3 Metal ions in Biology- Essential and trace elements in biological system – biological importance and toxicity of elements such as Fe, Cu, Zn, Co, Mo, W, V, Mn and Cr in biological system and their vital role in the active site.

**Extra reading/Keywords:** *Advancements in medicinal applications of chemicals.*

### **UNIT 3- PHOTOCHEMISTRY**

**12Hrs**

- 3.1 Photochemistry – Photochemical reactions – differences between thermal and photochemical reaction- Lambert's law, Beer's law, Grothus-Draper law and Stark Einstein's law of photochemical equivalence, Jablonski diagram for photophysical process
- 3.2 Quantum yield- Definition, classification of photochemical reactions based on quantum yield, reasons for high and low quantum yield – formation of HCl reaction, decomposition of HI, Dimerization of anthracene, Kinetics of HCl formation and decomposition of HI
- 3.3 Photosensitized reactions, Photochemical processes – fluorescence, phosphorescence and chemiluminescence. Applications of fluorescence and phosphorescence

**Extra reading/Keywords:** *Biological applications of chemiluminescence*

### **UNIT 4 - ELECTROCHEMISTRY**

**12Hrs**

- 4.1 Electrical conductance –specific conductance, equivalent conductance, relationship between specific and equivalent conductance, Ohm's law, molar conductance, Strong and weak electrolytes, variation of molar conductance with dilution.
- 4.2 Kohlrausch law and its application to determine  $\Lambda_0$  of a weak electrolyte, Conductometric titrations – HCl Vs NaOH, KCl Vs AgNO<sub>3</sub>, CH<sub>3</sub>COOH Vs NaOH.
- 4.3 pH, Determination of pH by conductivity method and colorimetric method. Buffer solutions- buffer action, buffer solutions in biological systems.

**Extra reading/Keywords:** *Determination of acid strength using conductometric titration*

### **UNIT 5 - APPLICATIONS OF CHEMISTRY IN INDUSTRIES**

**12Hrs**

- 5.1 Fuel gases – Requisites of a good fuel, types of fuel, advantages of gaseous fuel. Water gas, semi water gas, carbureted water gas, producer gas, LPG, Gobar gas and Natural gas
- 5.2 Fertilizers – Requisites of a good fertilizer, micronutrients, macro nutrients and NPK fertilizers. Ammonium sulphate, urea, superphosphate of lime, triple super phosphate and potassium nitrate,
- 5.3 Cleansing agents – Soaps and Detergents, types of soaps, advantages and disadvantages of using soap as cleansing agent, classification and uses of detergents.

**Extra reading/Keywords:** *Industrially important compounds*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

## TEXTBOOKS

1. Soni P.L. and Chawla H.M, *Text Book of Organic Chemistry*(26<sup>th</sup> edn). New Delhi: Sultan Chand and sons., 2014.
2. Textbook Of Pharmaceutical Chemistry, by Jayashree Ghosh (Author),S Chand & Company Pvt Ltd (Publisher)
3. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Physical Chemistry* (35<sup>th</sup> edn).New Delhi:Shoban Lal Nagin chand and Co.,2013.
4. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Physical Chemistry* (35<sup>th</sup> edn).New Delhi:Shoban Lal Nagin chand and Co.,2013.
5. Industrial Chemistry – B.K. Sharma( Goel Publishing House, Meerut)

## SUGGESTED READINGS

1. Jain M.K, Sharma S.C, *Modern Organic Chemistry*, Vishal Publishing Co.,m 2007.
2. Soni P.L. and Mohankatyal ,*Text book of Inorganic Chemistry*, 20<sup>th</sup> revised edition, sultan chand., 1992.
3. Bahl B.S, Arun Bahl and Tuli G.D ,*Essentials of Physical Chemistry*, New Delhi:Sultan Chand and sons., 2012.

## WEB REFERENCES:

1. <https://www.verywellhealth.com/importance-of-hemoglobin-2249107>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7866148/>
3. <https://www.vedantu.com/physics/fluorescence-and-phosphorescence>
4. <https://www.vedantu.com/chemistry/conductometric-titration>
5. <https://byjus.com/chemistry/soaps-and-detergents/>

## COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive level
CO1	Define and describe the terms in co-ordination chemistry, chemicals in pharmacy, laws of photochemistry, electrochemistry, fuel gases, fertilizers and cleansing agents.	K1
CO2	Identify and recognize the theories of coordination compounds and their role in biological system, therapeutic uses of pharma chemicals, explain photochemical reactions, quantum yield, electrical conductance, conductometric titrations and determination of pH, discuss the types, composition and uses of fuel gases, fertilizers and cleansing agents.	K2
CO3	Apply Pauling's theory to determine the hybridization, magnetic behavior of coordination complexes, chemicals in pharmacy, illustrate the photochemical processes, Kohlrausch law in determination of $\Lambda_0$ , calculation of quantum yield and pH of buffer solutions	K3
CO4	Analyze the stability of complexes using EAN, hybridization and magnetic behavior of coordination complexes, role of metal ions in the active site of biological systems, photochemical reactions based on quantum yield,	K4



	relationship between specific and equivalent conductance, advantages of gaseous fuel, role of micronutrients, macro nutrients and cleansing action of soaps and detergents.	
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### RBT Levels

**K1 – Remember, K2- Understand, K3 – Apply, K4- Analyse, K5 – Evaluate, K6 - Create**

### PO-CO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	M	H	M	M	M	H	H	H	L
CO-2	H	H	M	M	H	H	H	M	M
CO-3	M	H	M	H	H	M	H	M	M
CO-4	H	H	H	H	H	M	H	M	H

### PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	M	M	M
CO2	M	M	H
CO3	H	H	H
CO4	H	H	H

\*Correlation H=High, M= Medium, L=Low

<b>Course Title</b>	<b>SBC-2 - INDUSTRIAL CHEMISTRY</b>
<b>Code</b>	<b>U21CH2IRT01</b>
<b>Semester</b>	<b>II</b>
<b>Total Hours</b>	<b>15</b>
<b>Hours/Week</b>	<b>1</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>1</b>
<b>Marks</b>	<b>50</b>

### CONSPECTUS

To make the students to gain knowledge on fuels and energy storage devices, manufacture of sugar, cement, glass and paper, preparation of dyes and various effluent treatment processes.

### COURSE OBJECTIVES:

1. To illustrate the manufacture of synthetic petrol and construction of different types of batteries.

2. To describe the manufacturing process of sugar and cement.
3. To classify different types of dyes based on structure and application
4. To discuss the manufacture of glass and paper.
5. To elaborate the treatment and disposal of industrial waste.

#### **UNIT I - FUELS AND BATTERIES**

**3hrs**

- 1.1 Petroleum – manufacture of synthetic petrol (Bergius process) – knocking – octane number – diesel oil – cetane number – natural gas – compressed natural gas (CNG) – liquefied petroleum gases (LPG) – producer gas – water gas. Power alcohol and bio diesel.
- 1.2 Batteries and fuel cells – Types of batteries – alkaline battery – lead storage battery – nickel cadmium battery – lithium battery – fuel cells -  $H_2-O_2$  fuel cell.

#### **UNIT II - SUGAR AND CEMENT INDUSTRY**

**3hrs**

- 2.1 Sugar industry – Manufacture – clarification, concentration, separation of crystals refining and recovery
- 2.2 Portland cement – raw materials, Manufacture, setting of cement, concrete.

#### **UNIT III - DYES AND PIGMENTS**

**3hrs**

- 3.1 Classification of dyes according to application and structure. Malachite green, Methyl orange, Bismarck brown. Phenolphthalein, Fluorescein, alizarin, Indigo – preparation and uses.
- 3.2 Raw materials for manufacture of paints

#### **UNIT IV - GLASS AND PAPER INDUSTRY**

**3hrs**

- 4.1 Glass Industry – Raw materials. Manufacture Annealing, varieties of glass.
- 4.2 Paper industry – raw materials used, Manufacture, Filling and sizing, calendaring.

#### **UNIT V - INDUSTRIAL WASTES AND TREATMENT PROCESSES**

**3hrs**

- 5.1 Industrial wastes – types – process waste – chemical waste – effects of industrial wastes.
- 5.2 Treatment and disposal of industrial wastes – paper and pulp industry, soaps and detergents, chemical industries – treatment of municipal wastewater.

#### **TEXT BOOKS**

1. Jain M.K., Sharma S.C., (2012), Modern organic chemistry, Fourth edition, Vishal Publishing Co., Jalandhar.
2. Soni P.L., Mohan Katyal., (1996), Text book of 'Inorganic Chemistry', Sultan Chand and Sons, New Delhi.
3. Sharma B.K., Kaur. K.H, (1995), Environmental Chemistry, Goel Publishing House, Meerut, U.P.

## SUGGESTED READINGS

1. Gopalan R., 2009, 'Inorganic Chemistry', First Edition, Universities Press India Ltd, Chennai.
2. Soni P.L., Chawla H.M., (2006), 'Text Book of Organic Chemistry', 6<sup>th</sup> Reprint, Sultan Chand & sons, New Delhi.
3. De.A.K., (2007), 'Environmental Chemistry, Seventh Edition, New age international publishers Private Limited, New Delhi.

## WEB REFERENCES

1. <http://www.bajajhindusthan.com/bio-compost.php>
2. <https://www.cmaindia.org/blogs/the-cement-manufacturing-process>
3. <https://www.mixerdirect.com/blogs/mixer-direct-blog/how-paint-is-made>
4. <https://www.envicaresystems.com/effluent-treatment-plants-pune>.

## COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive level
CO1	Recall the composition of natural and synthetic gaseous fuels, types of batteries, raw materials for the manufacture of sugar, cement, paints, glass, paper and types of industrial wastes.	K1
CO2	Describe the octane and cetane number, cell reactions of different batteries, setting of cement, concrete, classification and preparation of dyes, glasses and the effects of industrial wastes.	K2
CO3	Adapt the usage of eco-friendly fuels, storage devices, illustrate the manufacturing process of sugar, cement, glass, paint and paper, sketch the various steps involved in waste treatment process.	K3
CO4	Compare the efficiency of different gaseous fuels, batteries, explain the steps involved in the production of sugar, cement, paint, glass and paper, analyse the treatment and disposal of various industrial wastes and municipal wastes.	K4

### RBT Levels

**K1 – Remember, K2- Understand, K3 – Apply, K4- Analyse, K5 – Evaluate, K6 - Create**

### PO-CO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO-1	H	M	H	H	H	M	H	M	H
CO-2	H	M	H	H	H	H	H	H	H
CO-3	H	H	H	H	H	H	H	M	H
CO-4	H	H	H	H	H	H	H	M	H

### PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	H	H	H

\*Correlation H=High, M= Medium, L=Low

(For Candidates admitted from the academic year 2020-21 onwards)

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**SCHOOL OF PHYSICAL SCIENCES**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>MAJOR CORE : 6 - INORGANIC AND ORGANIC CHEMISTRY</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5 Hrs /Wk</b>
<b>Code</b>	<b>U20CH3MCT06</b>
<b>Course Type</b>	<b>THEORY</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE**

To make the students to learn about the various concepts in metallurgy, metallic bond and hydrogen bond and make them to know about acids and bases, Aromaticity, Organic Halogen compounds, Alcohols and Phenols.

**COURSE OBJECTIVES**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the properties of metals and Hydrogen Bonding.
CO-2	understand the concepts and theories of Acids and Bases.
CO-3	summarise the theories and reactions of Aromatic Hydrocarbons.
CO-4	explain the preparation, properties and applications of Organic Halogen Compounds
CO-5	understand the Preparation, Properties and uses of Alcohols and Phenols.

**UNIT – I: METALLURGY, METALLIC BOND AND HYDROGEN BONDING 15hrs**

- 1.1 Metallurgy - Occurrence of metals – concentration of ores – froth flotation, magnetic separation, calcination, roasting, smelting, flux, aluminothermic process, purification of metals – electrolysis, zone refining, Van Arkel de-Boer process.

- 1.2 Metallic bond – Properties of metals, free electron theory, band theory explaining the properties of metals, crystal structure of metals-*ccp*, *hcp*, semiconductors and insulators-stoichiometric and non-stoichiometric defects and their applications.
- 1.3 Alloys-mixture, interstitial and substitutional solid solutions, Hume-Rothery rules, interstitial compounds.
- 1.4 Non covalent interactions - Hydrogen bonding-intra- and intermolecular hydrogen bonding, influence on the physical properties of molecules, comparison of hydrogen bond strength and properties of hydrogen bonded N, O and F compounds, associated molecules-ethanol and acetic acid, hydrogen bonding in protein and DNA, crystalline hydrates and clathrates, Vander Waals forces, ion dipole-dipole interactions.

*Extra reading, keywords: Applications of Ellingham Diagram*

## **UNIT -II: ACIDS AND BASES**

**15hrs**

- 2.1 Acid -base concept- Arrhenius, Bronsted – Lowry, Lux - Flood, Usanovich, Lewis, Solvent system, Relative strength of acids and bases.
- 2.2 Hard and soft acids and bases -Pearson's concept – Bonding in hard – hard and soft-soft combinations -symbiosis. HSAB principle and its applications.
- 2.3 Non – aqueous solvents – classifications of solvents, characteristic properties of solvents – Liquid  $\text{NH}_3$  as a solvent – chemical reactions in liquid  $\text{NH}_3$ .
- 2.4 Anhydrous hydrogen fluoride as a solvent – chemical reactions in anhydrous hydrogen fluoride. Liquid  $\text{SO}_2$  as a solvent – chemical reactions in liq. $\text{SO}_2$ .

*Extra reading, keywords: Cady – Esley Concept*

## **UNIT – III: AROMATIC HYDROCARBONS AND AROMATICITY**

**15hrs**

- 3.1 Aromaticity- Huckel theory, examples of aromatic, non-benzenoid aromatic compounds and antiaromatic compounds, resonance theory, molecular orbital theory. Structure and stability of benzene ring.
- 3.2 Electrophilic substitution reactions of benzene- mechanism of halogenations, nitration, sulphonation, Friedel –Crafts alkylation and Friedel –Crafts acylation. Orientation effect of substituents- activating and deactivation groups, Hammett equation (derivation not needed)

- 3.3 Aromatic Nucleophilic substitution - reactions of nitro compounds and aryl halides, bimolecular displacement and benzyne intermediate mechanisms. Arenes- preparation (Wurtz-Fitting reaction, reduction of acylbenzenes), Reactions in benzene ring and in the side chain, oxidation and hydrogenation reactions.
- 3.4 Aromatic polynuclear hydrocarbons- synthesis, properties and uses of Naphthalene, Anthracene and Phenanthrene.

*Extra reading, keywords: Aromaticity in annulenes*

#### **UNIT – IV: ORGANIC HALOGEN COMPOUNDS**

**15hrs**

- 4.1 Alkyl halides – classification, vicinal and geminal dihalides. General methods preparation, physical and chemical properties of alkyl halides. Preparation and uses of poly halogenated alkanes (chloroform, carbon tetrachloride). Grignard reagent – reactions of Grignard reagent (synthetic applications)
- 4.2 Mechanism of aliphatic nucleophilic substitution reactions in alkyl halides- SN1, SN2, SNi, factors influencing rates of nucleophilic substitution reactions, E1 and E2 mechanism.
- 4.3 Vinyl halides and allyl halides – preparation, properties and uses. Preparation and uses of fluorocarbons and chlorofluoro hydrocarbons.
- 4.4 Aryl halide – Preparation, physical and chemical properties. Reactivity of aryl and vinyl halides. Formation of DDT and its uses.

*Extra reading, keywords: Impact of fluorocarbons on environment*

#### **UNIT – V: ALCOHOLS, PHENOLS AND ETHERS**

**15hrs**

- 5.1 Alcohols – classification, general methods of preparation, Distinction between primary, secondary and tertiary alcohols. Reactions involving cleavage of O-H and C-OH bonds.
- 5.2 Allyl alcohol – preparation, properties and uses. Di and tri hydric alcohols- preparation, properties and uses of ethylene glycol and glycerol.
- 5.3 Phenols – Nomenclature, isomerism, acid strength, preparation and chemical properties. Preparation, properties and uses of picric acid, catechol, resorcinol, quinols and naphthols.
- 5.4 Ethers – Preparation – Williamson ether synthesis, physical and chemical properties of ethers – crown ethers.

*Extra reading, keywords: Synthesis and chemical properties of Naphthols.*

## COURSE OUTCOMES(CO):

### The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	explain the extraction and properties of Metals	PSO2	U
CO-2	recognise the various concepts of acids and bases and discuss the chemistry of non-aqueous solvents	PSO3	Ap
CO-3	discuss the mechanism of aromatic electrophilic substitution reaction	PSO4	U
CO-4	list out the preparation, properties of halogen compounds, alcohols and phenols	PSO3	R, Ap
CO-5	explain the mechanism of nucleophilic substitution in alkyl halides.	PSO2	U

**PO – Programme Specific Outcome; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply**

### PRESCRIBED TEXT BOOKS

1. J. D. Lee, (1996), '*Concise Inorganic Chemistry*', 5th ed., Blackwell Science, London.
2. F. A. Cotton, G. Wilkinson and P. L. Guas, (1994), '*Basic Inorganic Chemistry*', 3rd ed., John Wiley, New York.
3. B. Douglas, D. McDaniel and J. Alexander, (1994), '*Concepts and Models of Inorganic Chemistry*', 3rd ed., John Wiley, New York.
4. B. R. Puri, L. R. Sharma, K. C. Kalia, (1996), '*Principles of Inorganic Chemistry*', Shoban Lal Nagin Chand and Co, New Delhi.
5. Soni P.L. and Chawla H.M. (2014). '*Text Book of Organic Chemistry*' (26<sup>th</sup> edn):. Sultan Chand and sons, New Delhi.
6. John Mc Murray, (2012). '*Organic chemistry*', 8<sup>th</sup> Edition, International Edition.
7. Paula Yurkanis Bruice, (2016). '*Organic chemistry*', 8<sup>th</sup> Edition, Pearson Education Ltd.

### BOOKS FOR REFERENCES

1. J. E. Huheey, E. A. Keiter and R. L. Keiter, (1993), '*Inorganic Chemistry*,' 4th ed., Harper Collins, New York.
2. D. F. Shriver and P. W. Atkins, (1999), '*Inorganic Chemistry*', 3rd ed., W. H. Freeman and Co, London.
3. T. Moeller, (1994), '*Inorganic Chemistry: A Modern Introduction*', Wiley, New York.
4. Jain M.K, Sharma S.C. (2007), '*Modern Organic Chemistry*', Vishal Publishing Co
5. Bahl B.S., Arun Bahl (2010), '*A Text Book of Organic Chemistry*', New Delhi, Sultan Chand and Sons, New Delhi.

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**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>MAJOR CORE :7 – PHYSICAL CHEMISTRY PRACTICAL - I</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4 Hrs /Wk</b>
<b>Code</b>	<b>U20CH3MCP07</b>
<b>Course Type</b>	<b>Theory Cum Lab</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

### GENERAL OBJECTIVE

To expose the students to various concepts in Phase Rule and Solutions, to gain skill in Physical experiments through virtual lab.

### COURSE OBJECTIVES

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
<b>CO -1</b>	understand the principles involved in phase rule.
<b>CO -2</b>	understand the principles involved in solutions.
<b>CO -3</b>	determine the molecular weight of the substances.
<b>CO -4</b>	determine the partition co-efficient
<b>CO -5</b>	determine the viscosity of organic solvents by virtual lab.

### UNIT I: PHASE EQUILIBRIA AND PHASE RULE

**12hrs**

- 1.1 Meaning of the terms – phase, component and degree of freedom. Criteria of phase equilibrium, Gibb’s phase rule.
- 1.2 Phase equilibria in one component systems – phase diagrams of water, carbon di-oxide and sulphur system.
- 1.3 Simple eutectic system – Lead-Silver system and Potassium iodide-Water system.



- 1.4 Systems giving rise to compounds with congruent melting point – Zinc-Magnesium system. Systems giving rise to compounds with incongruent melting point – Sodium-Potassium system.
- 1.5 Partially miscible liquids – Phenol-Water system, triethylamine-water and Nicotine-Water systems.

*Extra Reading / key words: Three component system.*

## **UNIT II : SOLUTIONS AND DISTRIBUTION LAW**

**12hrs**

- 2.1 Solutions of liquids in liquids – ideal and non-ideal solutions – Raoult's law – criteria for ideal solutions, non-ideal solutions – Type I, Type II and Type III.
- 2.2 Fractional distillation of binary liquid solutions -Type I, II and III solutions. Distillation of immiscible liquids- steam distillation
- 2.3 Colligative properties – Lowering of vapour pressure by a non-volatile solute, Measurement of vapour pressure lowering by Ostwald-Walker method, Osmosis and osmotic pressure – Measurement of osmotic pressure by Berkeley – Hartley method, Isotonic solutions, Reverse osmosis.
- 2.4 Elevation in boiling point and depression in freezing point by a non volatile solute – thermodynamic derivation and experimental determination
- 2.5 Abnormal molecular weights – Van't Hoff factor, association and dissociation. Nernst distribution law & its applications.

*Extra reading/ Keywords : Application of colligative properties and distribution law*

## **PRACTICALS**

**(3hrs External)**

1. Determination of Molecular Weight by Rast method
2. Phase diagram of a Simple eutectic system: Naphthalene – Biphenyl.
3. Phase diagram of compound formation
4. Determination of transition temperature of a salt hydrate
5. Determination of partition co-efficient.

## **VIRTUAL LAB EXPERIMENTS**

6. Determination of viscosity of organic solvents
7. Calorimetry-Heat of neutralization

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

### **COURSE OUTCOMES (CO)**

#### **The learners**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs addressed</b>	<b>Cognitive Level</b>
CO-1	apply the principle of phase rule in simple eutectic system	PSO5	U
CO-2	differentiate ideal and non ideal solutions	PSO5	U
CO-3	calculate the molecular weight of the substances.	PSO4	An
CO-4	calculate the transition temperature of salt hydrate and partition co-efficient of	PSO5	Ap
CO-5	calculate the viscosity of organic solvents by virtual lab.	PSO6	An

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap – Apply; An – Analyse**

### **PRESCRIBED TEXT BOOKS**

6. Puri B.R., Sharma L.R. and Madan S. Pathania, (2013). *Principles of Physical Chemistry* (35<sup>th</sup> edn). New Delhi: Shoban Lal Nagin chand and Co.
7. Bahl B.S, Arun Bahl and Tuli G.D. (2012), *Essentials of Physical Chemistry*, New Delhi: Sultan Chand and sons.

### **BOOK FOR REFERENCE**

1. Venkateswaran V., Veeraswamy R., Kulandaivelu A.R., (1997), '*Basic Principles of Practical Chemistry*', Second edition, Sultan Chand & Sons.

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**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>MAJOR ELECTIVE-2 – PHYTOCHEMISTRY</b>
<b>Total Hours Code</b>	<b>60</b>
<b>Hours/Week</b>	<b>4 Hrs /Wk</b>
<b>Code</b>	<b>U20CH3MEP03</b>
<b>Course Type</b>	<b>Lab cum Theory</b>
<b>Credits</b>	<b>3</b>
<b>Max Marks</b>	<b>100</b>

### **GENERAL OBJECTIVE**

To provide the necessary practical skills and theoretical knowledge to separate, identify and estimate the active Phyto- chemical constituents of a given plant material.

### **COURSE OBJECTIVES**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
<b>CO -1</b>	find out the suitable plant materials for phytochemical analysis.
<b>CO -2</b>	identify the types of plant constituents and to classify them.
<b>CO -3</b>	understand the types and steps involved in extraction of plant constituents.
<b>CO -4</b>	interpret the UV and FTIR spectra of the plant extract.
<b>CO-5</b>	detect the functional groups.

### **UNIT: I- INTRODUCTION TO PHYTOCHEMISTRY**

**12 Hrs**

- 1.1 Phytochemistry- Definition. Selection, filtration, concentration and drying of Plant material for Phytochemical analysis.

- 1.2 Primary metabolites- Definition and examples. Secondary metabolites - sources, functions and usefulness of secondary metabolites. Differences between primary and secondary metabolites.
- 1.3 Study on the basic structure and identification of the phytochemical constituents- alkaloids, flavanoids, terpenoids, anthocyanins, Reducing and non-reducing sugars, phenolic components and amino acids.

**Extra reading/Keywords:** *Difference between phytochemical constituents and synthetic metabolites.*

**UNIT: II- EXTRACTION AND IDENTIFICATION TECHNIQUES OF PHYTO-CHEMICAL CONSTITUENTS** **12Hrs**

- 2.1 Types of Extract Preparation, Standardized Extraction, General Techniques of Extraction, Choices of Solvents & Properties of a good solvent in plant extractions.
- 2.2. Steps involved in the Extraction Techniques – maceration, percolation, digestion and decoction. Types of Extraction - Soxhlet and Microwave assisted extraction.
- 2.3. Sample handling and interpretation of UV, FTIR and <sup>1</sup>H NMR Spectra- Identification of functional groups in the plant Extract.

**Extra reading/Keywords:** Electromagnetic Spectrum, Instrumentation of UV, FTIR and <sup>1</sup>H NMR

**PRACTICALS:** **(3Hrs Internal)**

1. Preparation and filtration of Aqueous extracts and organic extracts of the plant sample.
2. Preliminary phytochemical screening, detection of various plant constituents and functional groups such as
  - a) Carbohydrates.
  - b) Alkaloids.
  - c) Flavonoids.
  - d) Phenolic & Polyphenolic compounds.
  - e) Proteins and Amino acids.
  - f) Glycosides
  - g) Terpenoids
  - h) Anthocyanins
  - i) Carbonyl compounds
  - j) Acidic components

3. Interpretation of FTIR spectra of:

- a) *Aspartic acid*
- b) *phenyl alanine*
- c) *Glycine*
- d) *Quercetin*
- e) *Morphine*

### **COURSE OUTCOMES (CO):**

#### **The learners**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	identify the types of phytochemical constituents.	PSO2	Ap
CO-2	find out the plant materials suitable for phytochemical analysis.	PSO1	U
CO-3	categorize the types of extraction.	PSO3	R
CO-4	interpret the IR spectra of the plant extract.	PSO4	Ap
CO-5	identify the nature of the functional groups.	PSO5	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### **PRESCRIBED TEXT BOOKS**

1. Harborne JB, (1988), *Phytochemical Methods : A Guide to Modern Techniques of Plant Analysis*, II Ed., Chapman and Hall, London and New York.
2. Prof. N. Raaman, (2006), *Phytochemical Techniques*, New India Publishing Agency, New Delhi.
3. N.S. Gnanapragasam and G. Ramamurthy, (1998), *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd.

### **BOOKS FOR REFERENCE**

1. H.H: Willard, D. Merrit and John A Dean, (1966), *Instrumental methods of Analysis* D. Van Nostrand Company, New York.
2. R.M. Silverstein, G.C. Bassier and T.C. Morill, (1974). *Spectrometric Identification of Organic Compounds*, John Wiley Eastern, New Delhi.
3. B.K. Sharma, (1999), *Instrumental Methods of Chemical Analysis* Goel Publishing House, Meerut, 1999.

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**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>MAJOR ELECTIVE-2 – CHEMISTRY FOR BIOLOGISTS</b>
<b>Total Hours Code</b>	<b>60 Hrs</b>
<b>Hours/Week</b>	<b>4 Hrs Wk</b>
<b>Code</b>	<b>U20CH3MEP04</b>
<b>Course Type</b>	<b>Lab Cum Theory</b>
<b>Credits</b>	<b>3</b>
<b>Max Marks</b>	<b>100</b>

**GENERAL OBJECTIVE**

To gain practical skills in analyzing the given organic substance and to understand the theory behind it.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the safety measures while handling the chemicals.
CO-2	prepare the solutions in different concentration units.
CO-3	analyse the different functional groups in an organic substance.
CO-4	learn the methodology of extraction of natural products. .
CO-5	differentiate between crystallization and recrystallization techniques.

**UNIT I- LABOTATORY SAFETY AND PREPARATION OF SOLUTIONS: 12 Hrs**

- 1.1 Storage and handling of chemicals, handling of acids, ethers, toxic and poisonous chemicals, antidotes, threshold vapour concentration and first aid procedure. Material Safety Data Sheet- Blue, Red, Yellow and White parts and Sections in MSDS.
- 1.2 Preparation of solutions in different concentration units - normality, molarity, molality, mole fraction, ppm, mole and mass percent.
- 1.3 Primary and secondary standards - Equivalent weight of acids, bases, saturated, unsaturated and supersaturated solutions.

**Extra reading/Keywords:** *Principles of Volumetric Analysis*

## **UNIT II – ORGANIC ANALYSIS AND EXTRACTION OF NATURAL PRODUCTS**

**12 hrs**

- 2.1 Identification of acidic, basic, phenolic and neutral organic substances, Detection of N, S and halogens, Test for aliphatic and aromatic nature of substances. Test for saturation and unsaturation.
- 2.2. Identification of functional groups- Carboxylic acids, Phenols, Aldehydes, Ketones, Carbohydrates, Primary amines and amides (Confirmatory Tests)
- 2.3 Extraction of Natural Products from plant sources, Principle of Recrystallization, Techniques and steps of Recrystallization.

**Extra reading/Keywords:** Sources of Natural Products.

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

### **PRACTICALS:**

**(3Hrs Internal)**

Organic Analysis:

- a) Identification of acidic, basic, phenolic and neutral organic substances
  - b) Detection of N, S and halogens
  - c) Test for aliphatic and aromatic nature of substances.
  - d) Test for saturation and unsaturation.
  - e) Identification of functional groups:
    - i) Carboxylic acid
    - ii) Phenols
    - iii) Aldehydes
    - iv) Ketones
    - v) Carbohydrates
    - vi) Primary amines
    - vii) Amides
2. Extraction of Natural Products:
- i) Isolation of Caffeine from Tea (Demonstration)

- ii) Isolation of Lactose from Milk.
- iii) Isolation of Citric Acid from Lemon.

### **COURSE OUTCOMES(CO):**

#### **The learners**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	recognize the types of chemicals and their careful handling	PSO1	U
CO-2	prepare solutions with different concentrations.	PSO2	Ap
CO-3	identify the functional groups of the give organic substances.	PSO3	Ap
CO-4	learn the techniques of separation of natural products.	PSO4	Ap
CO-5	differentiate the crude and recrystallized sample.	PSO5	U

**PO – Programme Specific Outcome; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply**

### **PRESCRIBED TEXT BOOKS**

1. R. Gopalan, P.S. Subramanian and K. Rengarajan, (1997), *Elements of Analytical Chemistry*, Sultan Chand & Sons, New Delhi.
2. Gurdeep Chatwal, (2000), *Organic Chemistry of Natural Products*, Himalaya Publications, Mumbai.
3. Puri, Sharma B. R., L.R. and Pathania, S (2011), *Principles of Physical Chemistry*, Edition: 50th edition, New Delhi, Shoban Lal Nagin Chand & Co.
4. N.S. Gnanapragasam and G. Ramamurthy,( 1998), *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd.

### **BOOKS FOR REFERENCE**

1. D.A. Skoog, D.M. West and F.J. Holler, (1990 ), *Analytical Chemistry: An Introduction*, 5th edition, Saunders college publishing, Philadelphia,
2. U.N. Dash, (1995),*Analytical Chemistry: Theory and Practice*, Sultan Chand and Co., Educational Publishers, New Delhi
3. J.N. Gurtu and R. Kapoor, (1987),*Advanced Experimental Chemistry (Organic)*, Sultan Chand and Co. Educational Publishers, New Delhi.
4. V.Venkateswaran, R.Veerassamy , A.R. Kulandaivelu,(2006), *Basic Principles of Practical Chemistry*, Second Edition , Sultan Chand & Sons , New Delhi..



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**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002**  
**SCHOOL OF PHYSICAL SCIENCES**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>ALLIED 4: CHEMISTRY PAPER I (FOR BIOCHEMISTRY MAIN)</b>
Total Hours	<b>60</b>
Hours/Week	<b>4 Hrs./ Wk.</b>
Code	<b>U20CH3ALT04</b>
Course Type	<b>Theory</b>
Credits	<b>2</b>
Marks	<b>100</b>

**GENERAL OBJECTIVE:**

To make the students to understand the basic concept in organic reactions, quantum numbers, chemical bonding, energy sources and storage devices, solutions, colligative properties and phase equilibria.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	illustrate the different theories in coordination chemistry.
CO-2	recognize the essential and traces elements in biology and their toxicity.
CO-3	understand the chemistry of water.
CO-4	explain the different types of conductometric titrations, Kohlrausch's law and its application.
CO-5	define the laws of photochemistry, photosensitized reactions.

**UNIT 1 -CO-ORDINATION CHEMISTRY**

**12Hrs**

- 1.1 Nomenclature of mono nuclear complexes, Theories of coordination compounds – Werner, Sidgwick and Pauling theories.
- 1.2 Chelation and its industrial importance with particular reference to EDTA.
- 1.3 Biological role of haemoglobin and chlorophyll.

**Extra reading/Keywords:** *Industrial applications of Coordination compounds*

## **UNIT II – METALS IN BIOLOGY**

**12Hrs**

- 2.1 Metal ions in Biology- Essential and trace elements in biological system
- 2.2 Biological importance and toxicity of elements such as Fe, Cu, Zn, Co and Mn in biological system and their vital role in the active site.
- 2.3 Biological importance and toxicity of elements such as Mo, W, V Cr in biological system and their vital role in the active site.

## **UNIT III - CHEMISTRY OF WATER**

**12Hrs**

- 3.1. Hard and Soft water- types of hardness, temporary and permanent hardness – Disadvantages of hard water- DO, BOD and COD – definition and determination (any one method)
- 3.2. Water softening methods – Zeolite process, reverse osmosis.
- 3.3. Preparation of Deionized Water, Distilled Water, Packaged Drinking Water.

**Extra Reading/Keywords:** *Industrial applications of water.*

## **UNIT IV-ELECTROCHEMISTRY – I**

**12 Hrs**

- 4.1 Electrical conductance, Ohm's law, specific conductance, equivalent conductance, molar conductance. Determination of conductance, variation of equivalent conductance with dilution.
- 4.2 Kohlrausch's law and its application – Calculation of molar conductance at infinite dilution for weak electrolyte.
- 4.3 Conductometric titrations - HCl with NaOH, CH<sub>3</sub>COOH with NaOH, CH<sub>3</sub>COOH with NH<sub>4</sub>OH and KCl with AgNO<sub>3</sub>.

**Extra reading/Keywords:** *Conductance determination by experiments*

## **UNIT V- PHOTOCHEMISTRY**

**12Hrs**

- 5.1 Photochemical reactions – Differences between thermal and photochemical reactions. Stark-Einstein law of photochemical equivalence, Lambert – Beer's law.
- 5.2 Quantum yield – definition, classification of photochemical reactions based on quantum yield, reasons for high and low quantum yield with one example for each.

5.3 Photosensitized reactions, photo physical processes – fluorescence, phosphorescence and chemiluminescence.

**Extra reading/ Keywords:** *Problems in quantum yield and applications of photochemistry*

**COURSE OUTCOMES(CO):**

**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	discuss the different theories in coordination chemistry and nomenclature of complexes.	PSO1	Ap
CO-2	identify the essential and trace elements in biology and their toxicity.	PSO2	An
CO-3	elaborate the chemistry of water.	PSO4	U
CO-4	Understand the different types of conductometric titrations, Kohlrausch's law and its application.	PSO1	Ap
CO-5	apply the laws of photochemistry, photosensitized reactions.	PSO2	U

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse; E- Evaluate**

**PRESCRIBED TEXT BOOKS:**

1. Puri B.R. and Sharma L.R. and Kalia K.C. (1997), *Principles of Inorganic Chemistry*, Shoban Lal Nagin chand and Co.
2. Puri B.R. Sharma L.R and Madan S. Pathania, (1994) *Principles of Physical Chemistry*, 35<sup>th</sup> edition, shoban Lal Nagin Chand and Co.
3. Veeraiyan .V (1997), *Text Book of Allied Chemistry*, Volume I and Volume II.

**BOOKS FOR REFERENCE:**

1. Huheey, J.E., Ellen. A. Keiter & Richard .L. Keiter. (2003). *Inorganic Chemistry* (4<sup>th</sup> Ed.). London: Addison & Wesley.
2. Lee, J.D. (1995). *A New Concise Inorganic Chemistry* (4th Ed.). London:ELBS.

3. Vasudevan A.N.S. (1981), *Ancillary Chemistry*, Part I and Part II.

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**SCHOOL OF PHYSICAL SCIENCES**

**PG & RESEARCH DEPARTMENT OF CHEMISTRY**

**CHOICE BASED CREDIT SYSTEM**

**Second Year - Semester – III**

<b>Course Title</b>	<b>ALLIED 4: CHEMISTRY PAPER I (FOR PHYSICS MAIN)</b>
Total Hours	<b>60</b>
Hours/Week	<b>4 Hrs./ Wk.</b>
Code	<b>U20CH3ALT05</b>
Course Type	<b>Theory</b>
Credits	<b>2</b>
Marks	<b>100</b>

**GENERAL OBJECTIVE:**

To make the students to understand the basic concept in organic reactions, quantum numbers, chemical bonding, energy sources and storage devices, solutions, colligative properties and phase equilibria.

**COURSE OBJECTIVES**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	illustrate the types of organic reactions and the influence of field effects.
CO-2	recognize the concept of grouping elements based on their properties in periodic table.
CO-3	understand the basic concepts of ionic and covalent bonding.
CO-4	explain the working of nuclear reactor and batteries.
CO-5	differentiate ideal and non-ideal solutions and to draw the phase diagram of water and lead- silver system.

**UNIT: I INTRODUCTION TO ORGANIC CHEMISTRY**

**12 Hrs**

- 1.1 Types of organic reactions and reagents, common electrophiles, nucleophiles and free radicals.
- 1.2 Inductive, resonance, hyperconjugation and steric effects – an elementary idea.

- 1.3 Aromatic compounds - Benzene, phenol, benzaldehyde and acetophenone –preparation, properties and uses.

*Extra reading/keywords: Carbenes and Nitrenes*

## **UNIT: II QUANTUM NUMBERS AND PERIODIC TABLE**

**12 Hrs**

- 2.1 Quantum numbers: - Principal, Azimuthal, Magnetic and spin quantum numbers. Electronic configuration of elements – Aufbau's principle, Hund's rule and Pauli's exclusion principle.
- 2.2 Long form of periodic table, division of elements into s, p, d and f blocks, cause of periodicity.
- 2.3 Periodic properties – atomic radius, ionic radius – Ionization energy - Electron affinity – Electronegativity - definitions and variation along a group and period.

*Extra reading/keywords: Discovery of new elements - Nihonium and Moscovium*

## **UNIT: III CHEMICAL BONDING**

**12 Hrs**

- 3.1 Ionic bond – definition, Factors influencing formation of ionic bonding, variable electrovalency, properties of ionic compounds.
- 3.2 Covalent bond - orbital overlap concept of molecules like H<sub>2</sub>, F<sub>2</sub>, O<sub>2</sub> and HF, Variable covalency, properties of covalent compounds.
- 3.3 Polarity in covalent bonds, Fajan's rules. Polarization of molecules, Effects of polarization, percent ionic character.

*Extra reading/keywords: Problems in dipole moment*

## **UNIT: IV ENERGY SOURCES AND STORAGE DEVICES**

**12Hrs**

- 4.1 Introduction – nuclear energy, nuclear fission – controlled nuclear fission-nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear reactor, power generator.
- 4.2 Classification of nuclear reactor – light water reactor – breeder reactor – solar energy conversion – solar cells and wind energy.
- 4.3 Batteries and fuel cells – Types of batteries – alkaline battery – lead storage battery – nickel cadmium battery – lithium battery – fuel cells - H<sub>2</sub>-O<sub>2</sub> fuel cell.

*Extra reading/keywords: Applications of fuel cell*

**UNIT: V SOLUTIONS AND PHASE EQUILIBRIA****12Hrs**

- 5.1 Solutions of liquids in liquids – ideal and non-ideal solutions – Raoult’s law – criteria for ideal solutions, non-ideal solutions – Type I, Type II and Type III.
- 5.2 Colligative properties – Lowering of vapour pressure by a non-volatile solute, Measurement of vapour pressure lowering by Ostwald-Walker method, Osmosis and osmotic pressure – Measurement of osmotic pressure by Berkeley – Hartley method, Isotonic solutions, Reverse osmosis.
- 5.3 Phase Equilibria: - Phase, component, degree of freedom, Phase rule (derivation not required). One component system – water system. Two component system – simple eutectic system (Pb-Ag system) and Freezing mixture (NaCl –H<sub>2</sub>O).

*Extra reading/keywords: Alloy and three component phase diagram*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

**COURSE OUTCOMES(CO):****The learners**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	identify the type of organic reaction and field effect in the given examples.	PSO1	U
CO-2	predict the periodic trends along the group and the period	PSO2	Ap
CO-3	Calculate the percent ionic character for the molecules.	PSO4	An
CO-4	Distinguish the nuclear fission and fusion reaction.	PSO1	U
CO-5	Construct the phase diagram of water and lead - silver system.	PSO2	Ap

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse**

**PRESCRIBED TEXT BOOKS:**

1. Puri B.R. and Sharma L.R. and Kalia K.C. (1997), *Principles of Inorganic Chemistry*, Shoban Lal Nagin chand and Co.
2. Puri B.R. Sharma L.R and Madan S. Pathania, (1994) *Principles of Physical Chemistry*, 35<sup>th</sup> edition, shoban Lal Nagin Chand and Co.
3. Parmer V.S. & Chawla B.M., (1973), *Principles of reaction mechanism in Organic Chemistry*, 2<sup>nd</sup> edn. Sultan Chand.
4. Ravikrishnan A.,(2000), *Engineering Chemistry – I & II*, 14<sup>th</sup> Edition, Srikrishna Hitech Publishing Company Pvt., Ltd.

**BOOKS FOR REFERENCE:**

1. Huheey, J.E., Ellen. A. Keiter & Richard .L. Keiter. (2003). *Inorganic Chemistry* (4<sup>th</sup> Ed.). London: Addison & Wesley.
2. Lee, J.D. (1995). *A New Concise Inorganic Chemistry* (4th Ed.). London:ELBS.
3. Vasudevan A.N.S. (1981), *Ancillary Chemistry*, Part I and Part II.
4. Veeraiyan .V (1997), *Text Book of Allied Chemistry*, Volume I and Volume II.

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>MAJOR SKILL-BASED ELECTIVE-1: DAIRY ENTREPRENEURSHIP</b>
<b>Total Hours</b>	<b>30</b>
<b>Hours/Week</b>	<b>2 Hrs Wk</b>
<b>Code</b>	<b>U20CH3MSBT01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>1</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To make the students to understand the composition and chemistry of milk, creams, butter, milk powder, ice cream and dairy detergents.

**COURSE OBJECTIVES:**

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	illustrate the composition of milk and the process involved in boiling.
CO-2	discuss the reactions of milk proteins, milk carbohydrate and milk vitamins
CO-3	understand the chemistry of creaming process
CO-4	explain the manufacture of milk powder and ice cream
CO-5	analyse the washing procedure using dairy detergents

**UNIT I: INTRODUCTION TO MILK**

6 Hrs

Milk: General composition of milk, factors affecting the gross composition of milk, physio-chemical change taking place in milk due to processing parameters-boiling pasteurization- sterilization and homogenization.

**Extra Reading/keywords:** *Physical properties of milk*



**UNIT II: MILK PROTEINS AND CARBOHYDRATES**

6 Hrs

Milk proteins: Physical properties of milk proteins-Electrical properties and hydration, solubility. Reaction of milk proteins with formaldehyde and ninhydrin. Milk carbohydrate-Lactose- Estimation of lactose in milk. Milk vitamins-water and soluble vitamins, effect of heat and light on vitamins.

*Extra Reading/keywords: Ash and mineral matters in milk.*

**UNIT III: MILK CREAMS**

6 Hrs

Creams: Definition-composition-chemistry of creaming process, gravitational and centrifugal methods of separation of cream-Factors influencing cream separation (Mention the factors only)- Cream neutralization. Estimation of fat in cream. Butter: Definition- percentage composition-manufacture-Estimation of fat, acidity, salt and moisture content-Desi butter.

*Extra Reading/keywords: Detection of rancidity*

**UNIT IV: MILK POWDER**

6 Hrs

Milk powder: Definition-need for making powder-drying process- principles involved in spraying, drum drying, jet drying and foam drying. Manufacture of whole milk powder by spray drying process-keeping quality of milk powder. Ice cream - Definition-percentage composition-types- ingredients needed -manufacture of ice-cream stabilizers-emulsifiers and their role.

*Extra Reading/keywords: Fermentation of milk*

**UNIT V: DAIRY DETERGENTS**

6 Hrs

Dairy Detergents: Definition-characteristics-classification-washing procedure (modern method) sterilization-Chloramine-T and hypochlorite solution.

*Extra Reading/keywords: Use of Sanitizers in dairy industry*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

**COURSE OUTCOMES(CO):**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	identify the physiochemical changes of various process	PSO1	U
CO-2	estimate the amount of lactose present in milk	PSO3	An

CO-3	determine the Factors influencing cream separation	PSO5	Ap
CO-4	explain the principle of drying process.	PSO4	U
CO-5	Discuss the washing procedure using the dairy detergents	PSO2	U

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse; E- Evaluate**

**PRESCIBED TEXT BOOKS:**

1. Seema Yadav, (1997) , *Food Chemistry*, Anmol Publishing (P) Ltd., New Delhi.
2. Sri lakshmi B., (2003), *Food Processing and Preservation*, New age international Pvt. Ltd. Publishers, III edn.
3. Alex. V.Ramani, (2009) *Food chemistry*, MJP Publishers, Chennai..

**BOOKS FOR REFERENCE**

1. Gandhi, K., Sharma, R., Gautam, P.B., Mann, B, (2020), *Chemical Quality Assurance of Milk and Milk Products*. Springer publication.
2. Edgar Roberts Ling, “*A Textbook of Dairy Chemistry*”, Springer US
3. M. Swaminathan (1985) ‘*Essentials of food and nutrition*’ the Bangalore printing & publishing Co., Ltd. 1985.
4. Sumati Mudambi R. Rajagopal M.V., *Fundamentals of food and nutrition*, third edition.
5. Sukumar De, (2015) “*Outlines of Dairy Technology*”, Oxford University Press.
6. Paul L. H. McSweeney and Patrick F. Fox,(2013) “*Advanced Dairy Chemistry*”, Springer, 4<sup>th</sup> Edition. .

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>MAJOR SKILL-BASED ELECTIVE-1: HEALTH CHEMISTRY</b>
<b>Total Hours</b>	<b>30</b>
<b>Hours/Week</b>	<b>2 Hrs Wk</b>
<b>Code</b>	<b>U20CH3MSBT02</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>1</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To make the students to understand the functions of enzymes, hormones and body fluids and to know about the common diseases and their treatment.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	discuss the causes and remedies of mal, under and over nutrition
CO-2	Illustrate the applications of different types of drugs.
CO-3	understand the chemistry and functions of body fluids
CO-4	explain the actions of enzymes and hormones
CO-5	identify the symptoms and remedies for common diseases.

**UNIT I HEALTH**

**6 Hrs**

Definition: Food, Food Pyramid - Health-Hygiene- mal, under and over nutrition, their causes and remedies, sanitation.

*Extra Reading/keywords: Best exercises for health management*

## **UNIT II DRUGS**

**6 Hrs**

Drugs - Types of drugs-depressant, anticonvulsant, narcotics, antipyretics, antibiotics, antiseptics, analgesics, muscle relaxants and cardiovascular and vaso depressants, steroids (Only Applications).

*Extra Reading/keywords: Chemical composition of drugs*

## **UNIT III BODY FLUIDS**

**6 Hrs**

Blood volume, groups, coagulation, blood pressure, anaemia, blood sugar, haemoglobin. Chemistry of urine.

*Extra Reading/keywords: Chemistry of coagulation of blood*

## **UNIT IV ENZYMES AND HORMONES**

**6 Hrs**

Types of enzymes and enzyme action, Characters of hormone action, examples of essential hormones.

*Extra Reading/keywords: Chemical structure of enzymes and hormones*

## **UNIT V COMMON DISEASES**

**6 Hrs**

Common diseases - Jaundice, Malaria, Dengue, Chicken guinea, night blindness, ulcer, and diabetes.

*Extra Reading/keywords: Pandemic and epidemic prone diseases*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

### **COURSE OUTCOMES(CO):**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	list out the causes and remedies of mal, under and over nutrition	PSO2	U
CO-2	outline the applications of drugs	PSO4	AP
CO-3	analyse the chemistry of body fluids	PSO5	An

CO-4	discuss the actions of enzymes and hormones	PSO3	U
CO-5	discuss the remedies of common diseases.	PSO1	U

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse**

**PRESCRIBED TEXT BOOKS:**

1. Alex .V Ramani, *Food Chemistry*, MJP Publishers, Chennai, 2009
2. Deb A C, *Fundamentals of Biochemistry*, New Central Book Agency, Calcutta, 1994.
3. Satake M and Mido Y, *Chemistry for Health Science*, Discovery Publishing House, New Delhi, 2003.

**BOOKS FOR REFERENCE:**

1. Jayashree Ghosh, A (1999) *Text book of Pharmaceutical Chemistry*, S. Chand and Co.Ltd.
2. Ashutosh Kar, (1993) *Medicinal Chemistry*, Wiley Easterns Limited, New Delhi.

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>NON MAJOR ELECTIVE – 1: FOOD AND NUTRITION</b>
<b>Total Hours</b>	<b>45 Hrs</b>
<b>Hours/Week</b>	<b>3 Hrs /Wk</b>
<b>Code</b>	<b>U20CH3NMT01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To enable the students to identify the functions of carbohydrates, vitamins and minerals, and learn about Food Preservation and Processing, Food Poisoning and Adulteration.

**COURSE OUTCOMES**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the nutritive value that influence food quality in the food industry.
CO-2	develop the social thinking and ability in context of balanced diet and its nutrition contents.
CO-3	improve the knowledge about various techniques used in Food Processing
CO-4	analyse and apply the food Adulteration techniques
CO-5	explain the significance of Sensory Evaluation and food quality control

**UNIT-I - CONSTITUENTS OF FOODS**

**9Hrs**

Introduction, classification, sources of food – (animal and plant sources), functions and uses of food. Nutritional value – sources, functions, bioavailability and deficiency diseases of Carbohydrates, Proteins, Lipids, vitamins and minerals.

*Extra Reading/keywords: classification of food based on its nutritive value*

## UNIT-II – NUTRITION AND DIET

9Hrs

Nutrition – calorific value of food –Respiratory quotient of food – basal metabolic rate – factors influencing BMR (Body Metabolic Rate), specific dynamic action (SDA) of food. Thermogenic effect – energy requirements of individuals – diet and its components.

*Extra Reading/keywords: Diet plan for different age groups*

## UNIT-III - FOOD PROCESSING

9Hrs

Types of food spoilage and deterioration. Methods of food preservation and processing (heating, sterilization, Deep freezing and pasteurization). Objectives of cooking and different modes of cooking fruits and vegetables.

*Extra Reading/keywords: Various food processing techniques*

## UNIT-IV - FOOD ADULTERATION

9Hrs

Food Adulterants - Common adulterants in different foods - milk and milk products, vegetable oils and fat, spices, cereals, pulses, sweetening agents and beverages. Contamination with toxic chemicals- pesticides and insecticides. Detection of common food adulterants.

*Extra Reading/keywords: food safety parameters*

## UNIT-V - FOOD QUALITY CONTROL

9Hrs

Quality Control, Quality Assurance and its importance. Role and Functions of Implementing Agencies with references to Indian Scenario. Tips to Consumers for Buying Safety Food. Sensory Characteristics of Food, Factors affecting Food Acceptance - Sensory and Psychological. Objective Method of Sensory Evaluation

*Extra Reading/keywords: Good Manufacturing Practices and Sanitation*

## COURSE OUTCOMES(CO):

### The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	list out the important nutrients of healthy diet	PSO 3	U
CO-2	gain knowledge to give awareness about balanced diet and nutrition.	PSO 4	Ap

CO-3	prepare a diet chart for hypertension and diabetes	PSO 2	Ap
CO-4	explain the different food processing techniques	PSO 1	R & U
CO-5	identify the chemicals used in food processing	PSO 6	An
CO-6	evaluate the adulterants present in food	PSO 5	An
CO-7	develop Knowledge about Food Quality Control and Sensory Evaluation	PSO 3	Ap

### PRESCRIBED TEXT BOOKS

1. Seema Yadav, (1997) *Food Chemistry*, Anmol Publishing (P) Ltd., New Delhi.
3. Sri lakshmi B., (2003) *Food Processing and Preservation* New age international Pvt. Ltd .Publishers,III ed.
4. Swaminathan. M. (2010) *Textbook on Food Chemistry*’. Bangalore: Printing and Publishing Co. Ltd.
5. Owen R. Fennema. (2006)‘*Food Chemistry*’, New York: Marcel Decker Inc.

### BOOKS FOR REFERENCES:

1. Carl H, Synder, (1992) “*The Extraordinary chemistry for ordinary things*”, John Wiley & Inc., New York.
2. Alex .V.Ramani, (2009)“*Food chemistry*” MJP Publishers, Chennai.
3. John M. deMan.(2006) '*Principles of Food Chemistry*'. Maryland USA: ASPEN Publication, Norman.
4. N. Potter. (2004) '*Food Science*', New Delhi: CBS Publishers and Distributors, 2004
5. William Hogoland Mayer. (1994) '*Food Chemistry*', New Delhi: CBS Publishers and Distributors
6. Damodaran, S., Parkin, K. L., and Fennema, O.R. Fennema's (2008) '*Food Chemistry*' 4th Edition, CRC Press.



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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>NON MAJOR ELECTIVE – 1: EVERYDAY CHEMISTRY</b>
<b>Total Hours</b>	<b>45 Hrs</b>
<b>Hours/Week</b>	<b>3 Hrs /Wk</b>
<b>Code</b>	<b>U20CH3NMT02</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To enable the students to learn about the manufacture of cement and paints, corrosion of metals, plastics, its standard nature, importance of drugs and biologically useful chemicals.

**COURSE OUTCOMES**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	study the manufacture of the cements and paints
CO-2	learn about corrosion of metals and most commonly used metals in homes
CO-3	acquire knowledge about plastics and its standard
CO-4	improve the knowledge about the nature and importance of drugs
CO-5	understand the importance of water and the biologically useful chemicals

**UNIT I: INDUSTRIAL CHEMISTRY:**

**9Hrs**

Cement: Introduction, types of cement, raw materials and manufacture, setting of cement.

Paints: Introduction, classification of paints, constituents of paints, manufacture, requirements of a good paint, special applications of paints, varnishes, enamels, solvent.

*Extra Reading/keywords: Different grades of cements*

**UNIT-II: METALS**

**9Hrs**

Metals: physical and mechanical properties, metal structure. Corrosion of metals-atmospheric corrosion, electrochemical corrosion. Metals commonly used in homes- iron, copper, aluminium, nickel, tin, lead, titanium, zinc and their alloys. Precious metals - silver, gold and platinum.

*Extra Reading/keywords: Mechanism and applications of Corrosion*

### **UNIT-III: PLASTICS**

**9Hrs**

Introduction – types of polymerization, Measurement of molecular weight, size, structure and properties of polymer. Significance and identification of plastics, standard and specifications of plastics. Recycling of plastics and biodegradable plastics.

*Extra Reading/keywords: Utility of plastics depending on the grades*

### **UNIT IV: PHARMACEUTICAL CHEMISTRY:**

**9hrs**

Drugs: Classification based on chemical nature, source and target organ. Anaesthesia: types, examples of Anaesthetics - Antiseptics & Disinfectants - Antibiotics: Uses and examples.

*Extra Reading/keywords: Drugs for Common diseases*

### **UNIT V: DYES AND DYE INTERMEDIATES**

**9Hrs**

Dye – definition – colour and constitution. Classification of dyes (based on their use and on their structures) – Classes of Dyes for dyeing on different fabrics (Natural & Man Made). Important dye stuff intermediates – their names.

*Extra Reading/keywords: Mechanism of dyeing in different fabrics*

#### **Course Outcomes**

#### **The learners**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	summarise various applications of industrial chemicals in daily life	PSO1	R&U
CO-2	explain the physical, chemical properties of metals and the applications of metals used in homes	PSO2	Ap
CO-3	narrate the steps involved in prevention of corrosion in metals.	PSO4	An
CO-4	gain knowledge about recycling of plastics	PSO6	U & Ap
CO-5	discuss the various properties of Anaesthetics, Antiseptics & Antibiotics.	PSO4	An
CO-6	categorize the Dyes and Dye Intermediates	PSO3	U
CO-7	develop knowledge about Classes of Dyes for dyeing on different fabrics	PSO5	Ap

### **PRESCRIBED TEXT BOOKS:**

1. Krishnamurthy N., Jayasubramanian K and Vallinayagam, (1990) *Applied Chemistry*, Prentice Hall of India, New Delhi.
2. Sharma B.K., '*Industrial Chemistry*', COEL Publishing house, Meerut.
3. Prof. (Dr.) S.K.Nayak, *Text Book on Fundamentals of Plastics Testing*

### **BOOKS FOR REFERENCE:**

1. Jeyashree Ghosh, (1993). *A text book of Pharmaceutical Chemistry*, Tata McGraw Hill Publishing, New Delhi
2. Gem Mathew G D., (2014). *Chemistry in Everyday Life*, Vishal Publishing
3. Gem Mathew G. D , (2011) '*Chemistry in Everyday Life*:', Vishal Publishing)
4. Brydson's J.A, (1999) '*Plastics Materials*' 7<sup>th</sup> edition Butterworth-Heinemann Publisher
5. Fred W. Billmeyer (2007) "*Textbook of Polymer Science*" 3<sup>rd</sup> edition copy right @ 1984 by John Wiley and Sons. Inc

(For Candidates admitted from the academic year 2020-21 onwards)  
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**SCHOOL OF PHYSICAL SCIENCES**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>MAJOR CORE 8- INORGANIC AND PHYSICAL CHEMISTRY</b>
<b>Total Hours</b>	<b>75 Hours</b>
<b>Hours/Week</b>	<b>5 Hrs./Wk.</b>
<b>Code</b>	<b>U20CH4MCT08</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To understand the general characteristics of p block elements and their compounds and learn about the kinetics of reaction rate

**COURSE OBJECTIVES:**

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
<b>CO -1</b>	outline the characteristics of p- block elements and find out the anomalous behavior of Carbon.
<b>CO -2</b>	understand the preparation, properties, structure and compounds of nitrogen group, carbon group, halogens and noble gases
<b>CO -3</b>	analyze the characteristics of d-block elements and outline the industrially important compounds of d-block elements
<b>CO -4</b>	measure the reaction rates and determine the rate laws.
<b>CO -5</b>	understand the basic concepts involved in photochemistry.

**UNIT I: P- BLOCK ELEMENTS-I**

**15Hrs**

- 1.1 General characteristics of p-block elements with respect to oxidation states, inert pair effect, allotropy, catenation, flame coloration, metallic and non-metallic properties.
- 1.2 Boron group- Diagonal relationship between B and Si, structure of diborane, preparation, properties and structure of borax and borazole, comparison of borazole with benzene, dimeric structure of  $AlCl_3$ .

- 1.3 Carbon group-Allotropy-structure of diamond and graphite, differences between  $\text{CO}_2$  and  $\text{SiO}_2$ ,  $\text{CCl}_4$  and  $\text{SiCl}_4$ . Preparation and properties of silicon carbide and silicones.
- 1.4 Anomalous behavior of carbon, reducing character of stannous chloride, carbon nanotubes.
- Extra reading/Keywords:** *Industrially important compounds of p- block elements.*

## UNIT II: P- BLOCK ELEMENTS-II

15Hrs

- 2.1 Nitrogen group- Preparation, properties and structure of hydrazine, dinitrogen complexes, NPK fertilizers
- 2.2 Oxygen group- Anomalous behavior of Oxygen, Paramagnetic nature of Oxygen, structure, preparation and properties of Caro's acid, Marshall's acid and Ozone, Ozone depletion in the atmosphere, role of xerography, classification of oxides based on oxygen content- normal oxides, peroxides, superoxides, dioxides, oxidizing and reducing properties of hydrogen peroxide.
- 2.3 Halogens- Unique character of fluorine, properties of pseudo halogens, positive nature of iodine, applications and hazards of chloro fluoro carbons, biological functions and toxicity of iodine.
- 2.4 Noble gases- Position of noble gases in the periodic table, isolation from the atmosphere, general characteristics, structure and shape of xenon compounds- $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{XeF}_6$ ,  $\text{XeO}_3$

**Extra reading/Keywords:** *Industrially important compounds of halogens and noble gases.*

## UNIT III- CHEMISTRY OF d-BLOCK ELEMENTS

15 Hrs

- 3.1 General characteristics of d-block elements with reference to oxidation state, magnetic properties, complex formation, catalytic activity and colour. Trends in physical and chemical properties in passing from the first to the second series and to the third series.
- 3.2 Biological function and toxicity of the elements- Cr, Mn, Co, Ni, Cu, Mo, Cd, Hg, Pb, Fe and Zn.
- 3.3 Roussin's red salt, Verdigris,  $\text{TiO}_2$ ,  $\text{V}_2\text{O}_5$ , Sodium nitro prusside – preparation, properties and uses, chrome tanning- process and consequences
- 3.4 Oxidising properties of  $\text{KMnO}_4$ , Amalgams, Philosophers's wool, Tungsten carbide, Wilkinson's catalyst, Vermilion – preparation, properties and uses.

**Extra reading/Keywords:** *Industrially important compounds of d-block elements*

## UNIT IV-CHEMICAL KINETICS I

15Hrs

- 4.1 Rate of reaction, its determination, rate equation, rate constant, factors influencing rate of reaction, stoichiometry, order and molecularity of reactions.

- 4.2 Setting up and solving simple differential equations and derivation of half-life periods for first, second, third and zero order reactions, determination of order of reactions.
- 4.3 Experimental techniques involved in following the kinetics of reactions – volumetry, manometry, dilatometry, polarimetry and colorimetry – typical examples for each of the techniques.
- 4.4 Theoretical aspects: Effect of temperature on the rate constant – Arrhenius equation – derivation, activation energy and its determination.

**Extra reading/Keywords:** *Problems in activation energy*

### UNIT V – Photochemistry

- 5.1 Photochemical reactions – Differences between thermal and photochemical reactions. Grothus Draper’s law, Stark-Einstein law of photochemical equivalence, Lambert – Beer’s law.
- 5.2 Quantum yield – definition, classification of photochemical reactions based on quantum yield and its determination, reasons for high and low quantum yield with one example for each.
- 5.3 Photosensitized reactions, Photo physical processes – fluorescence, phosphorescence and chemiluminescence.
- 5.4 Photochemical kinetics of hydrogen – bromine reaction, photochemical kinetics of hydrogen – chlorine reaction, Laser and their applications, Elementary aspects of photosynthesis.

**Extra reading/Keywords:** *Photochemical kinetics of hydrogen – chlorine, iodine reaction.*

### COURSE OUTCOMES(CO):

#### The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	summarize the characteristics and periodic properties of boron and carbon group elements	PSO2	R ,U
CO-2	identify the applications and hazards of chloro fluoro carbons	PSO1	Ap
CO -3	compare the periodic properties of d-block elements.	PSO1	An
CO-4	recognize the industrially important d-block elements, their toxicity and applications.	PSO1	Ap
CO -5	derive the rate equation of the first, second, third and zero order reactions.	PSO 3	R,U
CO -6	calculate the activation energy using Arrhenius equation.	PSO 2	Ap
CO -7	explain the laws of photochemistry	PSO2	U

**PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### **PRESCRIBED TEXT BOOKS**

1. B. R. Puri, L. R. Sharma, K. C. Kalia, (1996), 'Principles of Inorganic Chemistry', Shoban Lal Nagin Chand and Co. New Delhi
2. B.R Puri. L.R Sharma and Madan S. Pathania, (1994) *Principles of Physical Chemistry*, 35th edition, Shoban Lal Nagin Chand and Co. New Delhi
3. Bahl B.S. Arun Bahl and Tuli, (2007) *Essentials of Physical Chemistry*, Sultan Chand and sons. New Delhi

### **BOOKS FOR REFERENCE:**

1. J. D. Lee. (1995) *A New Concise Inorganic Chemistry* 4<sup>th</sup> edition Chapman &Hall London
2. J.E Huheey,., Ellen. A. Keiter and Richard L. Keiter. (2003) *Inorganic Chemistry.:* 4<sup>th</sup> edition., Addison & Wesley. London
3. F. A. Cotton, G. Wilkinson and P. L. Guas, (1994), 'Basic Inorganic Chemistry', 3rd ed., John Wiley, New York.
4. Walter J Moore, (1999) *Physical Chemistry*, 5th edn.,., Prentice-Hall. London
5. Mohan katyal, (2013), *Text book of Inorganic Chemistry*, 20<sup>th</sup> revised edn., Sultan Chand and sons. New Delhi

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>MAJOR CORE 7- APPLIED CHEMISTRY PRACTICAL</b>
<b>Total Hours</b>	<b>45 Hrs</b>
<b>Hours/Week</b>	<b>3 Hrs /Wk</b>
<b>Code</b>	<b>U20CH4MCP09</b>
<b>Course Type</b>	<b>PRACTICALS</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To develop practical skills in the separation of solid and liquid mixtures and the determination of melting and boiling point and identifies the amino acids using paper chromatographic technique.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	apply the different types of separation techniques for both solid and liquid mixtures
CO-2	determine the melting and boiling point of the separated substance
CO-3	illustrate the separation of amino acids using paper chromatography
CO-4	estimate the amount of hardness present in water
CO-5	calculate the molecular weight of a polymer by viscometer

**PRACTICALS:**

- Separation of the solid mixtures into its constituents, Purification and determination of Melting point using Bicarbonate separation
  - Benzoic acid + m-dinitro benzene
  - Benzoic acid + Biphenyl
- Separation of the solid mixtures into its constituents, Purification and determination of Melting point using Sodium hydroxide separation
  - Resorcinol + m-dinitrobenzene
  - Naphthol + m-dinitrobenzene
- Separation of the liquid mixtures into its constituent, Purification and determination of



### Boiling point

- a. Water + Ethyl acetate
- b. Water + Benzene
- c. Water + Ethyl methyl ketone

4. Separation of amino acids using Paper Chromatography
5. Separation of analgesics / dyes / quinones using Thin Layer Chromatography
6. Determination of total hardness, temporary hardness and permanent hardness of water.
7. Determination of molecular weight of a polymer using Oswald's Viscometer.

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

### COURSE OUTCOMES (CO)

#### The learners

CO No.	Course Outcomes	PSOs addressed	Cognitive Level
CO-1	determine the melting and boiling points of the given organic compounds.	PSO5	Ap
CO-2	separate the given amino acids using paper chromatography.	PSO5	Ap
CO-3	identify the phytoconstituents present in plant extracts.	PSO4	U
CO-4	separate the given sample using thin layer chromatography.	PSO5	Ap
CO-5	differentiate the different parameters of given water sample	PSO6	An

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap – Apply; An – Analyse**

### BOOKS FOR REFERENCE:

1. Harborne J.B(1998)., *Phytochemical methods*, 3<sup>rd</sup> edition, Chapman and Hall, New York
2. A.K. De (2017). *Environmental Chemistry*, 8<sup>th</sup> edition, New Age International (P) Limited, Publishers, New Delhi.
3. Gopalan R, Subramanian PS and Rengarajan K ('1993), *Elements of Analytical Chemistry'* Second revised edition, Sultan Chand, New Delhi.

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**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>MAJOR ELECTIVE-3 – BIOANALYTICAL TECHNIQUES</b>
<b>Total Hours Code</b>	<b>60</b>
<b>Hours/Week</b>	<b>4 Hrs /Wk</b>
<b>Code</b>	<b>U20CH4MET05</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>3</b>
<b>Max Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To learn about the principles of basic instruments used in Bioanalytical sciences laboratory

**COURSE OBJECTIVES:**

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
<b>CO -1</b>	understand the functioning and handling of instruments used in Bio-analysis.
<b>CO -2</b>	learn about the principle and types of centrifugation.
<b>CO -3</b>	describe the types of chromatographic techniques.
<b>CO -4</b>	know about the techniques of distillation.
<b>CO -5</b>	analyze the compounds using spectroscopical methods.

**UNIT:I- BASIC INSTRUMENTS IN BIO-ANALYSIS AND LABORATORY SAFETY**  
**12Hrs**

- 1.1 Basic Principle and Instrumentation of Autoclave, Centrifuge, Conductometer, pH meter, Rotary Evaporator, Gas analyzer and TDS meter.
- 1.2 Automation in Analysis- Introduction to Automation, Need for automation, Automation involved in general laboratory equipments and instruments like auto-pipette, pH meter, rotary shaker, ultrasonicator. Significance and advantages of automation.

- 1.3 General Laboratory Safety Measures. Storage and handling of chemicals, handling of acids, ethers, toxic and poisonous chemicals, antidotes, threshold vapour concentration and first aid procedure.

**Extra reading/Keywords:** *Incubator, Sonicator, Cyclomixer*

**UNIT: II CENTRIFUGATION TECHNIQUES**

**12Hrs**

- 2.1 Centrifugation: Principle of Centrifugation, basic rules of Sedimentation, Sedimentation coefficient .
- 2.2 Types of centrifuges- Bench, Ultracentrifuge, Refrigerated, Continuous flow centrifuge and Microfuge.
- 2.3 Differential and density gradient centrifugation.

**Extra reading/Keywords:** *Application in Water Treatment*

**UNIT: III CHROMATOGRAPHIC TECHNIQUES**

**12 Hrs**

- 3.1 Classification of chromatographic techniques and their principles, Theory of chromatography, band broadening, rate and plate theory, factors responsible for separation.
- 3.2. Liquid Chromatography and HPLC: Instrumentation, pumps, solvent delivery system, isocratic and gradient programming modes, sample introduction system, columns and detectors.
- 3.3. Gas Chromatography: Instrumentation, carrier gas supply, injectors, columns, packed and capillary columns, column oven and temperature programming, different detectors.

**Extra reading/Keywords:** *Paper and Thin Layer Chromatography.*

**UNIT: IV- PURIFICATION TECHNIQUES**

**12Hrs**

- 4.1 Technique of drying of solids, Distillation: Types, Theory and techniques of fractional, Steam and Vacuum distillation.
- 4.2 Desiccants: Types, efficiency, regeneration and choice of desiccants.
- 4.3 Re-crystallisation, Sublimation - Types, techniques and applications.

**Extra reading/Keywords:** *Criteria and test for purity- melting point and boiling point*

**UNIT: V- SPECTROSCOPIC TECHNIQUES AND SPECTROCHEMICAL METHODS**

**12 Hrs**

- 5.1 Introduction to Spectroscopy, Beer-Lambert's law-statement and deviation; UV- Visible-instrumentation and applications.

- 5.2 Nephelometry and Turbidimetry- Principle, Instrumentation and Applications- determination of TDS of water sample
- 5.3 Principle, Instrumentation and Applications of Flame photometry (estimation of K/Na) and Fluorimetry (estimation of Fluorescein).

**Extra reading/Keywords:** *Phenomenon of Fluorescence*

**COURSE OUTCOMES(CO):**

**The learners will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	understand the importance of automation in bio-chemical analysis.	PSO-1	U
CO-2	recall the types of chromatographic techniques.	PSO-3	R
CO-3	carry out distillation of the given liquids.	PSO-4	Ap
CO-4	understand the types of centrifugation processes.	PSO-2	R
CO-5	categorize the bio-chemical techniques in analyzing the samples.	PSO-5	Ap

**PO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply**

**PRESCRIBED TEXTBOOKS**

1. R. Gopalan, P.S. Subramanian and K. Rengarajan, (1997), *Elements of Analytical Chemistry*, Sultan Chand & Sons, New Delhi.
2. B.K. Sharma, (1999), *Instrumental Methods of Chemical Analysis*, Goel Publishing House, Meerut,
3. U.N.Dash , (1995),*Analytical Chemistry : Theory and Practice*, Sultan Chand and Sons Educational Publishers, New Delhi.
4. T.G. Cooper, (1977), *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA.

**BOOKS FOR REFERENCE**

1. Douglas A Skoog, Donald M. West, F. James Holler, Stanely R. Crouch, (2004), *Fundamentals of Analytical Chemistry*, Thompson Books, Bangalore.
2. H.H: Willard, D. Merrit and John A Dean, (1966), *Instrumental methods of Analysis* D. Van

Nostrand Company, New York.

3. Freifelder, D. (1982), *Physical Biochemistry*, 2nd edition, W.H. Freeman and Co., San Francisco.

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>MAJOR ELECTIVE-3 – FORENSIC SCIENCE</b>
<b>Total Hours Code</b>	<b>60 Hrs</b>
<b>Hours/Week</b>	<b>4 Hrs Wk</b>
<b>Code</b>	<b>U20CH4MET06</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>3</b>
<b>Max Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To incorporate the application of scientific knowledge to crime investigation.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	gain a sound knowledge to pursue advance study in crime investigation.
CO-2	understand the importance of sound science and ethics in the analysis of forensic evidence.
CO-3	summarize the prevalent chemical principles, methods and instrumentation in crime investigation.
CO-4	learn the chemistry behind combustible materials and polymers.
CO-5	categorize and identify the types of poisons, their adverse effects and treatment

**Unit I- LAW FOR FORENSIC SCIENTISTS**

**12 Hrs**

- 1.1 Chronology of History of Forensic Medicine-Definition and scope for Forensic Science.
- 1.2 Forensic medicine and Courts of law, appeal trial and inquiry. Legal procedure –criminal procedure code, hierarchy of courts and their powers.
- 1.3 Punishments authorized by Indian Law.

**Extra reading/Keywords:** *Court Procedure for a Medical Witness.*

## **Unit II – PERSONAL IDENTIFICATION TECHNIQUES**

**12Hrs**

- 2.1 Anthropometry, Passive and Active Biometrics and its applications.
- 2.2 Investigation of Scar marks ,Human hair , and fibers collected from the crime scene.
- 2.3 DNA finger printing –X-ray Crystallography and techniques in DNA finger printing. Advantages and disadvantages of DNA printing.

**Extra reading/Keywords:** *Lip Print/ Chieloscopy*

## **Unit III- INVESTIGATION TECHNIQUES**

**12 Hrs**

- 3.1 Medico Legal Importance of Blood, Types of blood groups. General Physical and chemical examination of blood.
- 3.2 Classification of fingerprints, Procedure of taking fingerprints and comparing, Medico-legal importance of finger print system and foot prints.
- 3.3 Blood group, salivary stain identification and Dactylography.

**Extra reading/Keywords:** *Examination of Tatoo –Marks.*

## **Unit IV –CHEMICAL ANALYSIS OF PHYSICAL EVIDENCE**

**12 Hrs**

- 4.1 Chemistry of Combustion –Explosives, gelatin sticks RDX and gun shots.
- 4.2 Chemistry of Colors – Inks and paints analysis.
- 4.3 Chemistry of Polymers- Fibers, paper, plastics and adhesives.

**Extra reading/Keywords:** *Fire arm Injuries*

## **Unit V- TOXICOLOGY**

**12 Hrs**

- 5.1 Introduction and Definition of Toxicology, Laws of toxicology and sources of poison.
- 5.2 Types of poison –corrosive, inorganic and organic irritant poisons, insecticides and pesticides and fate of poisons in the body.

5.3 General line of treatment for poisoning and Elimination of poisons.

**Extra reading/Keywords:** *Food poisoning*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**COURSE OUTCOMES(CO):**

**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	recognize the various types of poisons and their antidotes.	PSO5	R
CO-2	help to explain the chemistry of combustion, colors and polymers.	PSO4	U
CO-3	recall the legal procedure in crime investigation.	PSO2	U
CO-4	apply the biochemical techniques in crime investigation	PSO3	Ap
CO-5	have knowledge acquired to investigate the crime scenes	PSO1	Ap

**PO – Programme Specific Outcome; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply**

**PRESCRIBED TEXT BOOKS**

1. Rabindra Basu,( 2009 ), *Fundamentals of Forensic Medicine and Toxicolgy*, Books and Allied (P) Ltd., Kolkata,
2. Jain M.K., Sharma S.C., (2012), *Modern Organic Chemistry*, Fourth edition, Vishal Publishing Co., Jalandhar.
3. B.R.Sharma,(2020), 6<sup>th</sup> Edition, *Forensic Science in Criminal Investigation and Trials*, Universal Law Publishing Co.Pvt.Ltd., Delhi.



## **BOOKS FOR REFERENCE**

1. R.A. Gregory's, (2005) *Identification of Disputed Documents, Fingerprints and Ballistics*, Eastern Book Company, Lucknow.
2. Soni P.L., Chawla H.M., (2006), *Text Book of Organic Chemistry*, 6<sup>th</sup> Reprint, Sultan Chand & sons, New Delhi.
3. Henry C.Lee,(2006), *Physical Evidence in Forensic Science*, Lawyers and Judges Pub.Co.,Tucson, Arizona.

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>ALLIED 5: CHEMISTRY PAPER II (FOR BIOCHEMISTRY MAIN)</b>
Total Hours	<b>60</b>
Hours/Week	<b>4 Hrs. /Wk.</b>
Code	<b>U20CH4ALT06</b>
Course Type	<b>Theory</b>
Credits	<b>2</b>
Marks	<b>100</b>

**GENERAL OBJECTIVE:**

To learn about the basic concepts in photochemistry, electrochemistry, data analysis, chemical kinetics and fuels.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	explain the preparation, properties and uses of polymers, heterocyclic compounds and stereochemistry
CO-2	illustrate the various types of fuel gases, fertilizers, cleansing action of soaps.
CO-3	demonstrate cell reactions of primary, secondary batteries and corrosion
CO-4	differentiate order and molecularity of the reaction, determine the order of the reaction.
CO-5	understand the types of catalysis, theories of catalysis

**UNIT 1 –POLYMERS, HETEROCYCLIC COMPOUNDS AND STEREOISOMERISM**  
**12Hrs**

- 1.1 Synthetic polymers – preparation, properties and uses of Teflon, Epoxy resins, polyester resins
- 1.2 Heterocyclic compounds – Furan, pyrrole and Pyridine - – preparation, properties and uses-  
Basicity of pyrrole and Pyridine

- 1.3 Stereoisomerism: optical isomerism – Lactic and Tartaric acid – Racemic mixture and Resolution. Geometrical isomerism – maleic and fumaric acid

**Extra reading/Keywords:** *Industrially important polymers*

## **UNIT II - CHEMICAL ASPECTS IN INDUSTRIES**

**12Hrs**

- 2.1 Fuel gases – water gas, producer gas, LPG, Gobar gas and Natural gas
- 2.2 Fertilizers – NPK, micronutrients and mixed fertilizers
- 2.3 Soaps and Detergents- an elementary idea of soaps, detergent, cleansing action of soaps and detergents

**Extra reading/Keywords:** *Industrially important chemicals*

## **UNIT III-ELECTROCHEMISTRY – II**

**12 Hrs**

- 3.1 Galvanic cell – Daniel cell, single electrode potential, standard electrode potential, determination of electrode potential.
- 3.2 Reference electrodes – hydrogen and calomel electrodes. Electrochemical series and its applications.
- 3.3 Corrosion – definition, types, electrochemical theory of corrosion, prevention. Over-voltage – definition and application of over-voltage.

**Extra reading/Keywords:** *Fuel cells and batteries*

## **UNIT IV- CHEMICAL KINETICS**

**12 Hrs**

- 4.1 Order and molecularity of reactions, setting up and solving simple differential equation and half-life period for first order reaction.
- 4.2 Setting up and solving simple differential equations and half-life periods for second order and zero order reactions.
- 4.3 Determination of order of reactions, effect of temperature on reaction rate – Arrhenius equation, the activation energy.

**Extra reading/Keywords:** *Problems in chemical kinetics*

## **UNIT V- CATALYSIS**

**12 Hrs**

- 5.1 Catalysis – positive and negative catalysis, auto catalysis, induced catalysis, enzyme catalysis
- 5.2 Promoters, catalytic poisons with examples, characteristics of catalysis
- 5.3 Types of catalysis – homogeneous catalysis – intermediate compound formation theory. Heterogeneous catalysis – adsorption theory.

**Extra reading/Keywords:** *Mechanism of Catalysis*

**COURSE OUTCOMES(CO):**

**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	recognise the types of polymers, heterocyclic compounds and their properties	PSO2	U
CO-2	describe the applications of industrially important compounds	PSO1	Ap
CO-3	discuss the important concepts of electrochemical series and their applications	PSO4	Ap
CO-4	determine the order of the reaction.	PSO4	An
CO-5	explain various theories of catalysis	PSO1	U

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse;**

**PRESCRIBED TEXT BOOKS:**

1. Puri B.R. and Sharma L.R., (2002), *Principles of Inorganic Chemistry*, Shoban Lal Nagin Chand and Co, New Delhi.
2. Puri B.R. Sharma L.R and Madan S. Pathania, (1994) *Principles of Physical Chemistry*, 35<sup>th</sup> edition, shoban Lal Nagin Chand and Co, New Delhi.
3. Soni P.L. and Chawla H.M., (1997), *Text Book of Organic Chemistry*, 27<sup>th</sup> Edition, Sultan Chand and sons, New Delhi.

### **BOOKS FOR REFERENCE:**

1. Cotton F.A. and Wilkinson. G. (1999). *Advanced Inorganic Chemistry*, 4<sup>th</sup> Ed.. John Wiley and Sons Inc, London.
2. Huheey, J.H. (2002). *Inorganic Chemistry*, 4<sup>th</sup> Ed: Pearson Education Pvt., Ltd. London.
3. Vasudevan A.N.S. (1981), *Ancillary Chemistry*, Part I and Part II.
4. Dr. V Veeraiyan (1997), *Text Book of Allied Chemistry*, Volume I and Volume II.

(For Candidates admitted from the academic year 2020-21 onwards)  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002**  
**SCHOOL OF PHYSICAL SCIENCES**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – IV**

Course Title	<b>ALLIED 5: CHEMISTRY PAPER II (FOR PHYSICS MAIN)</b>
Total Hours	<b>60</b>
Hours/Week	<b>4 Hrs. /Wk.</b>
Code	<b>U20CH4ALT07</b>
Course Type	<b>Theory</b>
Credits	<b>2</b>
Marks	<b>100</b>

**GENERAL OBJECTIVE:**

To learn about the basic concepts in photochemistry, electrochemistry, data analysis, chemical kinetics and fuels.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	explain the photochemical and photophysical processes and their mechanisms.
CO-2	illustrate the various types of conductometric titration and corrosion control.
CO-3	calculate the mean, median, deviations, types of errors and different types of tests
CO-4	describe the general forms of rate equations and state the Arrhenius equation.
CO-5	understand the proximate and ultimate analysis of coal and combustion of fuels.

**UNIT: I PHOTOCHEMISTRY AND SURFACE CHEMISTRY**

**12Hrs**

- 1.1 Photochemical reactions – Differences between thermal and photochemical reactions. Stark-Einstein law of photochemical equivalence, Lambert – Beer’s law. Quantum yield- Examples with hydrogen and chlorine reaction

- 1.2 Jablonski Diagram-Radiative Process-Fluorescence, Phosphorescence, non-radiative Process-Internal conversion and Intersystem crossing, Chemiluminescence and Photosensitization.
- 1.3 Surface Chemistry: Emulsions, gels – preparation, properties - Electrophoresis and applications

*Extra reading/Keywords: Problems in quantum yield.*

## **UNIT: II ELECTROCHEMISTRY AND CORROSION**

**12Hrs**

- 2.1 Electrical conductance, Ohm's law, specific conductance, equivalent conductance, molar conductance. Determination of conductance, variation of equivalent conductance with dilution.
- 2.2 Kohlrausch's law and its application – Calculation of molar conductance at infinite dilution for weak electrolyte. Conductometric titrations - HCl with NaOH, CH<sub>3</sub>COOH with NaOH, CH<sub>3</sub>COOH with NH<sub>4</sub>OH and KCl with AgNO<sub>3</sub>.
- 2.3 Corrosion- causes, factors, types – chemical, electrochemical corrosion and corrosion control.

*Extra reading/Keywords: Conductance determination by experiments.*

## **UNIT: III DATA ANALYSIS**

**12 Hrs**

- 3.1 The mean, The median, significant numbers, confidence limits, data ethics, precision and accuracy. Methods of expressing precision: mean, median, deviation, average deviation and coefficient of variation
- 3.2 Errors – Types of errors, correction of determinate errors. Methods for improving accuracy.
- 3.3 Statistical tests of data - F test, t test and Q test, the method of least squares. Presentation of tabulated data – Scatter diagram – S.I. units.

*Extra reading/Key words: Problems in error analysis.*

## **UNIT: IV CHEMICAL KINETICS**

**12Hrs**

- 4.1 Rate of reaction, Order and Molecularity. Zero order, First order, Pseudo unimolecular and Second order reactions.

- 4.2 Determination of order – Graphical, Half - life, Integrated rate equation and Ostwald's isolation methods
- 4.3 Energy of activation- Effect of temperature on reaction rates - Arrhenius equation

*Extra reading/Key words: Problems in order and molecularity.*

**UNIT: V FUELS AND COMBUSTION**

**12Hrs**

- 5.1 Fuel – Introduction – classification of fuels – calorific value – higher and lower calorific values – coal – analysis of coal (proximate and ultimate) – carbonization – manufacture of metallurgical coke (Otto – Hoffmann method)
- 5.2 Petroleum – manufacture of synthetic petrol (Bergius process) – knocking – octane number – diesel oil – cetane number – natural gas – compressed natural gas (CNG) – liquefied petroleum gases (LPG) – producer gas –water gas. Power alcohol and bio diesel.
- 5.3 Combustion of fuels – calorific value – theoretical calculation of calorific value- ignition temperature – explosive range – flue gas analysis (Orsat method)

*Extra reading/Keywords: Problems in calorific value.*

**COURSE OUTCOMES(CO):**

**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	construct the Jablonski diagram.	PSO2	A
CO-2	explain the different types of conductometric titrations.	PSO1	U
CO-3	evaluate the statistical tests and summarize the types of errors	PSO4	An
CO-4	derive the rate equation for first order and second order equations.	PSO4	Ap



CO-5	describe the manufacture of coal by Bergius process	PSO1	U
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**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse**

**PRESCRIBED TEXT BOOKS:**

1. Puri B.R. and Sharma L.R., (2002), *Principles of Inorganic Chemistry*, Shoban Lal Nagin Chand and Co, New Delhi
2. Puri B.R. Sharma L.R and Madan S. Pathania, (1994) *Principles of Physical Chemistry*, 35<sup>th</sup> edition, shoban Lal Nagin Chand and Co, New Delhi.
3. Soni P.L. and Chawla H.M., (1997), *Text Book of Organic Chemistry*, 27<sup>th</sup> Edition, Sultan Chand and sons, New Delhi.
4. Ravikrishnan A.,(2000), *Engineering Chemistry – I & II*, 14<sup>th</sup> Edition, Srikrishna Hitech Publishing Company Pvt., Ltd Chennai.

**BOOKS FOR REFERENCE:**

1. Cotton F.A. and Wilkinson. G. (1999). *Advanced Inorganic Chemistry*, (4<sup>th</sup> Ed.). John Wiley and Sons Inc. London
2. Huheey, J.H. (2002). *Inorganic Chemistry*, (4<sup>th</sup> Ed.). Pearson Education Pvt., Ltd. London.
3. Vasudevan A.N.S. (1981), *Ancillary Chemistry*, Part I and Part II.
4. Dr. V Veeraiyan (1997), *Text Book of Allied Chemistry*, Volume I and Volume II.

(For Candidates admitted from the academic year 2020-21 onwards)  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>ALLIED 6: CHEMISTRY PRACTICAL PAPER III (FOR BIOCHEMISTRY MAIN)</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4 Hrs. /Wk.</b>
<b>Code</b>	<b>U20CH4ALP08</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To expose the students to various concepts in volumetric analysis and to gain skill in volumetric analysis and organic analysis

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the basic terms and the principle involved in volumetric analysis.
CO-2	categorize the primary standard ,standard solution and their requirements.
CO-3	illustrate the theories behind the acid-base indicators.
CO-4	determine the strength of the given solution from different types of titrations like acid base, redox, precipitation and complexometric titration.
CO-5	analyse the nature of the given organic substance

**UNIT I – VOLUMETRIC AND ORGANIC ANALYSIS**

**12 Hrs**

- 1.1 Definitions - Titration, Back Titration, End point, Equivalence point, Indicator, Normality, Molality, Molarity, Mole Fraction, Equivalent weights of acid, base, salt, oxidizing and reducing agents.
- 1.2 Standard solution, requirements of a primary standard, preparation of standard solution, secondary standard, principle of volumetric analysis.
- 1.3 Acid-Base titrations – HCl with NaOH, CH<sub>3</sub>COOH against NaOH, Mohr salt against KMnO<sub>4</sub>, Oxalic acid with KMnO<sub>4</sub>. Iodometry - Estimation of Potassium dichromate
- 1.4 Test for carbohydrates, carboxylic acids, aldehydes , ketones, amides and amines.

**Extra reading/Keywords:** EDTA Titrations

**VOLUMETRIC ANALYSIS (DOUBLE TITRATION WITH WEIGHING):**

(3 hrs. External)

I Acidimetry and Alkalimetry:

1. Estimation of sodium hydroxide.
2. Estimation of Acetic acid.

II Permanganometry:

3. Estimation of Mohr's Salt.
4. Estimation of Oxalic acid.

III Iodometry:

5. Estimation of potassium dichromate

**IV ORGANIC ANALYSIS**

Analysis of carbohydrates, carboxylic acids, aldehydes, ketones, amides and amines.

**COURSE OUTCOMES(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	find the various concentration units	PSO 5	Ap
CO-2	list the requirements of primary standard	PSO 5	K
CO-3	prepare the standard solution of different strength.	PSO 6	An
CO-4	differentiate the acid base, redox and complexometric titrations with examples.	PSO 5	U
CO-5	analyse the given organic substance	PSO 6	An

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse**

**PRESCRIBED TEXT BOOKS**

1. Puri B.R. and Sharma L.R., (2002), '*Principles of Inorganic Chemistry*', Shoban Lal Nagin Chand and Co New Delhi.
2. Venkateswaran V., Veeraswamy R., Kulandaivelu A.R., (1997), '*Basic Principles of Practical Chemistry*', Second edition, Sultan Chand & Sons New Delhi.

**BOOKS FOR REFERENCE**

1. Svehla G. (1996) *Vogel's Qualitative Inorganic Analysis*. US: 7th Edition, Prentice Hall, London.

2. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. (2000) *Vogel's Prescribed Book of Qualitative Chemical Analysis*,: 6th Edition, Prentice Hall. US

(For Candidates admitted from the academic year 2020-21 onwards)

**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**

**PG & RESEARCH DEPARTMENT OF CHEMISTRY**

**CHOICE BASED CREDIT SYSTEM**

**Second Year - Semester – IV**

<b>Course Title</b>	<b>ALLIED 6: CHEMISTRY PRACTICAL PAPER III (FOR PHYSICS MAIN)</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4 Hrs. /Wk.</b>
<b>Code</b>	<b>U20CH4ALP09</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVE:**

To expose the students to various concepts in volumetric analysis and to gain skill in volumetric analysis.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the basic terms and the principle involved in volumetric analysis.
CO-2	examine the primary standard ,standard solution and their requirements.
CO-3	illustrate the theories behind the acid-base indicators.
CO-4	determine the strength of the given solution from different types of titrations like acid base, redox, precipitation and complexometric titration.
CO-5	calculate the unknown concentration in various units

## **VOLUMETRIC ANALYSIS:**

**12 Hrs**

- 1.1 Definitions: - Titration, Back Titration, End point, Equivalence point, Indicator, Normality, Molality, Molarity, Mole Fraction, Equivalent weights of acid, base, salt, oxidizing and reducing agents.
- 1.2 Standard solution, requirements of a primary standard, preparation of standard solution, secondary standard, principle of volumetric analysis.
- 1.3 Acid-Base titrations – HCl with NaOH, CH<sub>3</sub>COOH against NaOH, Na<sub>2</sub>CO<sub>3</sub> with HCl. Acid-Base indicators – Ostwald's theory and quinonoid theory.
- 1.4 Redox titrations – Mohr salt against KMnO<sub>4</sub>, Oxalic acid with KMnO<sub>4</sub>, FeSO<sub>4</sub> against K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. Redox indicator – Diphenyl amine, Iodometry - Estimation of copper sulphate.
- 1.5 Complexometric titrations – EDTA titrations and indicators of EDTA titrations.

*Extra reading/Keywords: Iodimetric Titrations.*

## **VOLUMETRIC ANALYSIS (DOUBLE TITRATION WITH WEIGHING)**

**(3 hrs. External)**

### **I Acidimetry and Alkalimetry:**

1. Estimation of sodium hydroxide.
2. Estimation of hydrochloric acid.

### **II Permanganometry:**

3. Estimation of Mohr's Salt.
4. Estimation of Oxalic acid.

### **III Iodometry:**

5. Estimation of copper sulphate
6. Estimation of dissolved oxygen

### **IV Dichrometry:**

7. Estimation of iron (internal indicator)

### **V Complexometry:**

8. Estimation of hardness of water sample by EDTA method.

**COURSE OUTCOMES(CO):**

**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	find the various concentration units	PSO 5	Ap
CO-2	list the requirements of primary standard	PSO 5	U
CO-3	evaluate the standard solution of different strength.	PSO 6	An
CO-4	differentiate the acid base, redox and complexometric titrations with examples.	PSO 5	U
CO-5	calculate the strength of the given unknown solution	PSO 6	An

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse**

**PRESCRIBED TEXT BOOKS**

1. Puri B.R. and Sharma L.R., (2002), '*Principles of Inorganic Chemistry*', Shoban Lal Nagin Chand and Co, New Delhi.
2. Venkateswaran V., Veeraswamy R., Kulandaivelu A.R., (1997), '*Basic Principles of Practical Chemistry*', Second edition, Sultan Chand & Sons< New Delhi.

**BOOKS FOR REFERENCE**

1. Svehla G. (1996) *Vogel's Qualitative Inorganic Analysis*. US: 7th Edition, Prentice Hall, London
2. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. (2000) *Vogel's Prescribed Book of Qualitative Chemical Analysis*,; 6th Edition, Prentice Hall. US

(For Candidates admitted from the academic year 2020-21 onwards)  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**  
**SCHOOL OF PHYSICAL SCIENCES**  
**B.A/B.SC/B.COM/B.B.A – SEMESTER IV**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>NON-MAJOR ELECTIVE – 2 HOME SCIENCE</b>
Total Hours	<b>45</b>
Hours/Week	<b>3 Hrs./ Wk.</b>
Code	<b>U20CH4NMT03</b>
Course Type	<b>Theory</b>
Credits	<b>3</b>
Marks	<b>100</b>

**GENERAL OBJECTIVE:**

To learn about human growth and development, management of resources, food science, meal planning, food and personal hygiene

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the various stages of human life and its behavioral changes
CO-2	appraise the importance of various family resources and its management
CO-3	understand the functions, sources, deficiency diseases, objectives of cooking and its types
CO-4	understand the importance of personal hygiene of food handlers.
CO-5	understand and analyse the nutritive value of food , meal planning for various age groups.

**UNIT I: HUMAN GROWTH & DEVELOPMENT:**

**9 Hrs**

- 1.1 Play (birth-5 years), role of play in growth & development of children. Types of play active, passive, natural, serious and exploratory, selection of play material for children. Childhood (3 to11 years)-Age specific milestones- Physical, motor ,social, emotional, cognitive and language.

- 1.2 Adolescents : Special Features- Physical and biological, motor ,social, emotional, Cognitive and language - Problems of Adolescents: Consequences and management- Eating disorders (Anorexia Nervosa ,Bulimia Nervosa) - Anti social behavior.

*Extra Reading/Keywords: psychological problems related old age*

**UNIT II: MANAGEMENT OF RESOURCES: TIME, ENERGY AND MONEY 9 Hrs**

- 2.1 Time Management - Definition and Importance Time plans - Factors affecting time plan
- 2.2 Energy Management : Definition and Importance - Family Income and Types Expenditure and Importance of Saving.

*Extra Reading/Keywords: Best money saving Schemes in India*

**UNIT III FOOD SCIENCE 9Hrs**

- 3.1 Terminology, Food groups, Food in relation to health.
- 3.2 Cooking – Objectives of Cooking- Preliminary preparations and cooking methods – Moist heat methods, dry heat methods, Microwave cooking and solar cooking.

*Extra Reading/Keywords: Benefits of Germination and Fermentation*

**UNIT IV: FOOD AND PERSONAL HYGIENE 9 Hrs**

- 4.1 Principles of hygienic handling and serving of food - Practical rules for good sanitation of food.
- 4.2 Food poisoning by micro organisms, insects and rodents- prevention and its Control - Hygiene in kitchen - Personal hygiene of food handler - Hygiene during food storage

*Extra Reading/Keywords: Harmful infectious Diseases*

**UNIT V: MEAL PLANNING 9 Hrs**

- 5.1 Concept of Meal Planning - Use of food groups in planning balanced meal for self and family.
- 5.2 Meal planning: Meal planning for various age groups – Infant nutrition, Nutrition of weaned infants, pre-school children, school children, adolescents, expectant and nursing mothers and geriatric nutrition.

*Extra Reading/Keywords: Diet plan for obesity*



**COURSE OUTCOMES(CO):****The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	illustrate the various special features of adolescents.	PSO1	U
CO-2	classify the various family resources and their management	PSO2	A
CO-3	classify the various cooking methods involved in food preparation.	PSO4	An
CO-4	examine the food poisoning by microbes, rodents and insects.	PSO1	U
CO-5	prepare diet chart for various age groups in family	PSO2	Ap

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse; E- Evaluate**

**PRESCRIBED TEXT BOOKS;**

1. `Elective Course For Bsc. Home Science (Honours) -Dr. Sangita Gupta, Dr. Mithilesh Verma, Dr. Smita Tripathi Dr.Neelma Kunwar and Kumari Amisha
2. Family Resource Management – Tami James Moore & Sylvia M. Asay(2016) Sage Publication 3<sup>rd</sup> Edition
3. Thankamma Jacob, (1979) A Text Book of Applied Chemistry for Home science and Allied Science, 1st edn., Macmillan company of India Limited.
4. Fundamentals of Human Nutrition E-Book: for Students and Practitioners in the Health Sciences – Catherine Geissler and Hilary Powers
5. Srilakshmi .B (2003) Reprint “Food Science” 3<sup>rd</sup> edition New Age Internation (P) Ltd., New Delhi.

**BOOKS FOR REFERENCE**

1. Lillian Hoagland Meyer, (2004) Food Chemistry, 1st edn., CBS Publishers, New Delhi.

2. Mahindru S. N. (2004), Food Safety – Concept and Reality, 1st edn., APH Publishers.
3. Sumathi R, Mudambi, M.V, Rajagopal M.V, Fundamentals of Food and Nutrition 3rd edn., Wiley Eastern Ltd.
4. Swaminathan M., (1982), Handbook of Food and Nutrition, 2nd edition, Bappco Publications.
5. Andrew Schloss and David Joachim with A. Philip Handel,(2009).The Science of Good Food (Paper Back). Oriented Paper Backs.

(For Candidates admitted from the academic year 2020-21 onwards)  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002**  
**SCHOOL OF PHYSICAL SCIENCES**  
**B.A/B.SC/B.COM/B.B.A – SEMESTER IV**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>NON-MAJOR ELECTIVE – 2: CHEMISTRY FOR HUMAN WELFARE</b>
Total Hours	<b>45</b>
Hours/Week	<b>3 Hrs./ Wk.</b>
Code	<b>U20CH4NMT04</b>
Course Type	<b>Theory</b>
Credits	<b>3</b>
Marks	<b>100</b>

**GENERAL OBJECTIVE:**

To learn about general composition of house hold toiletries, importance of health and hygiene, energy conservation, green indicators, biogas plant and first aid safety measures against accidents.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the general composition of toothpaste, mouth wash and different types of skin and their effects on climate and various skin infection.
CO-2	appraise the classification of food groups and therapeutic nutrition during anaemia, blood pressure, diabetes, fever and jaundice.
CO-3	illustrate energy conservation and green building and utility of biogas plant
CO-4	understand biofortication, food fortification and nutraceuticals
CO-5	understand safety and first aid measures against accidents.

**UNIT I SKIN AND DENTAL CARE**

**9 Hrs**

- 1.1 Requirements of an ideal toothpaste. Oral care: Building blocks and formulation of toothpaste and mouth wash
- 1.2 **Skin:** Study of Skin: Types, functions, diet and skin, threats to skin, effects of summer, winter, wind and rain on skin. Common skin disease – acne and warts.

*Extra Reading Skin diseases : Leucoderma and Psoriasis*

## UNIT 2 HEALTH

- 2.1 Terminology, Food groups, ICMR Classification of Food, Food in relation to health.
- 2.2 Therapeutic nutrition- special feeding methods, Diets during anaemia, blood pressure, diabetes, fever and jaundice.

*Extra Reading/keywords Nutrition and Dietetics followed by heart patients*

## UNIT 3 : ENERGY CONSERVATION

9 Hrs

- 3.1 Needs for Energy Conservation – Power consumption of domestic appliances – Electrical Energy Audit – Strategies for Energy Conservation. Modern lighting systems– Light emitting diode (LED), Compact Fluorescent lamps (CFL),
- 3.2 Green indicators and Inverter, Green building - Home lighting using Solar cell - Solar water heaters- Water and waste management - Biogas plant.

*Extra Reading/keywords: Solid waste management*

## UNIT 4 FOOD TECHNOLOGY:

9 Hrs

- 4.1 Food technology- Bio-technology in food - Biofortification – Golden rice Food fortification – criteria for selecting vehicle - Double fortified salt, fortification in rice, wheat sugar edible oil tea and curry powder
- 4.2 Nutraceuticals Phytochemicals as nutraceuticals – isoprenoids, polyphenols, Dominant phytochemical pigments – phytosterols – Food having nutraceutical properties and Dietary fibre

*Extra reading/keywords: Phytonutrients present in Herbal drinks*

## UNIT 5 SAFETY AND FIRST AID MEASURES

9Hrs

- 5.1 An idea of various toxic and house hold chemicals, Prevention measures to be adopted against them.
- 5.2 First aid measures to be undertaken in the event of accidents involving chemicals, chemical fire - Classification of fire – Types of Portable fire extinguishers,
- Extra reading/keywords: Antidote given for metallic poisons*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

## COURSE OUTCOMES(CO):

### The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	classify the types of skin and their effects on climate.	PSO1	U

CO-2	examine special feeding methods and diet plan during fever anaemia, blood pressure, diabetes, fever and jaundice.	PSO2	Ap
CO-3	evaluate strategies for Energy Conservation, water and waste management	PSO4	An
CO-4	list the various fortified food products and phytonutrients.	PSO1	U
CO-5	classify the various types of fire extinguishers and their maintenance.	PSO2	Ap

**PSO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap Apply; An – Analyse; E- Evaluate**

#### **PRESCRIBED TEXT BOOKS:**

1. Alex V Ramani, (2009) *Food Chemistry*, MJP Publishers, Chennai.
2. Srilakshmi .B (2003) Reprint “*Food Science*” 3<sup>rd</sup> edition New Age Internationl (P) Ltd., New Delhi.
3. Trevor Linsley, (2011) *Basic electrical installation work*. Newnes rint of Elsevier .
4. Materials concepts for solar cells (Energy Future), Thomas Dittrich, Imperial College Press, First Edition 2014.
5. Understanding Green Building Materials, T.R. Rider, S. Glass and J. McNaughton, W.W. Norton & Company, first editon 2011
6. Parvesh Handa, “ A complete book on Beauty, Body, Make-up and Hairstyles, Goodwill publishing House, New Delhi.

#### **BOOKS FOR REFERENCES**

1. Mc Millan India Ltd.Satake M and Mido Y, (2003) *Chemistry for Health Science*, Discovery Publishing House, New Delhi,.
2. A Thankamma Jacob (1979), A Text Book of Applied Chemistry, 1st edition,
3. Gopalan R., Subramanian P.S. and Rengarajan K, (2013) *Elements of Analytical Chemistry*. (3<sup>rd</sup> Edition)New Delhi: Sultan Chand and sons.

For Students Admitted in the Academic year 2015onwards  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Third Year – Semester- V**

<b>Course Title</b>	<b>Main Core – 7: Inorganic Chemistry</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4 Hrs Wk</b>
<b>Code</b>	<b>U15CH5MCT07</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General objective:**

To make the students to learn about the nomenclature, isomerism, theories, distortion and stability of coordination complexes, the structure of solids and defects in crystals, the concepts of nuclear chemistry, important bio-inorganic molecules, lanthanides and actinides.

**Course Objectives (CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	differentiate different types of isomerism
CO-2	discuss the characteristic properties of complexes.
CO-3	explain the structure of crystalline solids, crystal axis, planes, lattices and defects and apply XRD analysis for characterization of crystalline materials.
CO-4	apply the principles of nuclear chemistry in various nuclear reactions and understand the applications of radioactive isotopes.
CO-5	Analyse the chemistry of metal ions in different biological co-ordination compounds and describe the differences and similarities between the chemistry of lanthanides and actinides.

## UNIT 1 - CO-ORDINATION CHEMISTRY I

12Hrs

- 1.1 Double salts, co-ordination compounds, co-ordination complexes and complex ions, co-ordination number, classification of ligands, chelates, physical methods in the study of complexes.
- 1.2 Nomenclature of co-ordination compounds, Werner's theory, Effective atomic number (EAN) and 18 electron rule.
- 1.3 Structural isomerism – hydrate isomerism, co-ordination isomerism, linkage isomerism, coordination position isomerism, ionization isomerism and polymerization isomerism.
- 1.4 Stereoisomerism – Geometrical isomerism and optical isomerism in 4 and 6 co-ordinated complexes.

**Extra reading/Keywords:** *The spectral data to elucidate the structure of complexes.*

## UNIT 2 -CO-ORDINATION CHEMISTRY II

12Hrs

- 2.1 Valence bond theory – Postulates, formation of inner and outer sphere complexes, application of VBT (Magnetic property and geometry of complexes), defects of VBT.
- 2.2 Crystal field theory – crystal field splitting of energy levels of d-orbitals in octahedral, tetrahedral and square planar complexes, Crystal field stabilization energy, Factors affecting the magnitude of  $\Delta_o$ . Application of CFT – colour, magnetic properties and spin states of the complexes. Distortion of octahedral complexes and John-Teller theorem, cause and types of distortion, Defects of CFT.
- 2.3 Stability of complexes – stepwise formation and overall formation constant. Labile and inert Complexes. Factors affecting the stability of complexes. Experimental determination of stability constant (Job's method, Bjerrum method). Irving Williams theory.

**Extra reading/Keywords:** *Jahn Teller theorem and MOT*

## UNIT 3 -SOLID STATE

12Hrs

- 3.1 Structure of solids – Classification, isotropy and anisotropy, interfacial angle, symmetry in crystals – cubic and hexagonal systems. Space lattice and unit cell, Bravais lattices, designation of planes in crystals – Miller indices. Diffraction of X-rays by crystals – Bragg's equation – derivation, rotating crystal technique.
- 3.2 Types of crystals, close packing of identical solid spheres - interstitial sites, limiting Radius ratios (derivation not needed), radius ratio rule and shapes of ionic crystals. Structures of NaCl, CsCl, ZnS, CaF<sub>2</sub> and Rutile.
- 3.3 Defects in stoichiometric crystals – Schottky and Frenkel defects. Defects in Non-stoichiometric crystals – metal excess and metal deficiency defects. Impurity defects – semi conductors – n-type and p-type semi conductors.

**Extra reading/Keywords:** *Applications of semiconductors.*

**UNIT 4 -NUCLEAR CHEMISTRY****12Hrs**

- 4.1 Subatomic particles, nuclear size, nuclear forces – Meson theory of nuclear forces. Magic number, nuclear shell structure - Liquid drop model.
- 4.2 Mass defects in atomic nucleus, nuclear binding energies. Nuclear stability – n/p ratio, the whole number rule and packing fraction. Isotopes, Isobars, Isotones and isomers – definition and examples.
- 4.3 Definition of nuclear transformation, Bohr’s theory of nuclear reactions. Classification of nuclear reactions, Q value of nuclear reactions, Nuclear fission - controlled nuclear fission. Nuclear fusion - stellar energy.
- 4.4 Artificial transmutation of elements, induced radioactivity, applications of radioisotopes in medicine, agriculture and industry, carbon dating.

**Extra reading/Keywords:** *Types of Radioactive decay and their effect on the nucleus.*

**UNIT 5 - BIO-INORGANIC CHEMISTRY AND f- BLOCK ELEMENTS****12Hrs**

- 5.1 The porphyrin ring system –Oxygen transport- Hemoglobin and Myoglobin- biological functions only. Cytochrome-C - structure and biological functions. Blue copper proteins, Fe-S protein – Ferridoxin and vitamin B<sub>12</sub>- biological functions only.
- 5.2 Lanthanide series - Properties of lanthanides – electronic configuration, oxidation states, ionic radii, lanthanide contraction, colour, magnetic properties, basic character, solubility of compounds and chemical reactivity, separation of lanthanides.
- 5.3 Actinide series – electronic configuration, oxidation states, ionic radii, colour and formation of complexes, Transuranic elements. Comparison between actinides and lanthanides.

**Extra reading/Keywords:** *Spectral properties of lanthanides.*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**Course outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Classifies the various types of isomerism of coordination compounds.	PSO1	R
CO-2	Analyzes the stability of complex based on EAN and 18 electron rule.	PSO4	An
CO-3	Compares the various theories of coordination complexes.	PSO2	U
CO-4	Categorizes the different types of crystals and its defects,	PSO1	U



CO-5	Sketches and explains the packing arrangements of atoms and the structures of few ionic crystals	PSO6	U
CO-6	Classifies the subatomic particles and explain the nuclear shell and liquid drop model.	PSO1	U
CO-7	Evaluates the nuclear stability based of n/p ratio, whole number rule, mass defect and packing fraction	PSO4	E
CO-8	Categorizes the various nuclear reactions and summarize the applications of radio isotopes.	PSO6	U
CO-9	Sketches and explain the biological functions of few bio inorganic compounds.	PSO5	U
CO-10	Summarizes the chemistry of inner transition elements.	PSO4	An

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate;**

#### **TEXT BOOKS**

1. Puri B.R. and Sharma L.R., *Principles of Inorganic Chemistry*, New Delhi: Sultan Chand.1989.
2. Madan R.D., *Modern Inorganic Chemistry* S.Chand and company (PVT) limited, Ist edn.1987.

#### **BOOKS FOR REFERENCE**

1. Soni P.L. and Chawla H.M *Text Book of Inorganic Chemistry* (26<sup>th</sup> edn), New Delhi, Sultan Chand and sons, 2004.
2. Lee J D, *Concise inorganic chemistry*, 5<sup>th</sup>edn, Wiley India Edition, 2009.
3. Cotton F A, Wilkinson G, MurilloC. A and Bochmann, M *Advanced Inorganic Chemistry*, 6<sup>th</sup>edn, John Wiley & Sons,2008.
4. Huheey J. E., KeiterE. A., KeiterR. L. and MedhiO. K., *Inorganic Chemistry - Principles of Structure and Reactivity*, 4<sup>th</sup>edn, Pearson Education, 2006.
5. Atkins P, Overton T,Rourke J M. Weller and Armstrong F, *Inorganic Chemistry*, 5 th edn, Oxford University Press, 2010.
6. Puri B.R., Sharma, L.R and Madan S. Pathania . *Principles of Physical Chemistry* (35<sup>th</sup> edn), New Delhi, :Shoban Lal Nagin Chand and Co.2008.
7. Gopalan R., Ramalingam, V. *Concise Co-ordination Chemistry*, Vikas Publishing House Pvt. Ltd.2001.

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Third Year - Semester – V**

<b>Course Title</b>	<b>Major Core 8 – ORGANIC CHEMISTRY-I</b>
<b>Total Hours</b>	<b>60Hrs</b>
<b>Hours/Week</b>	<b>4 Hrs Wk</b>
<b>Code</b>	<b>U15CH5MCT08</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General Objectives:**

The student learns the preparations and properties involved in the organic compounds containing oxygen and nitrogen.

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the preparation, properties and strength of aliphatic,aromatic carboxylic, sulphonic acids and their derivatives.
CO-2	appraise and justify the preparation, properties and basicity of nitrogen containing organic compounds.
CO-3	classify, formulate and discuss the concepts of amino acids, prorteins and nucleic acids.
CO-4	reproduce and describe the preparation, properties of oxygen and sulphur containing compounds.
CO-5	classify, distinguish and elucidate the structures of few carbohydrates

**UNIT 1 -ORGANIC ACIDS AND DERIVATIVES**

**12Hrs**

1. General methods of preparation and properties of aliphatic and aromatic mono carboxylic acids. Ionization of carboxylic acids. Acidity constant. Comparison of acid strengths of substituted halo acids and substituted benzoic acids.
- 1.2 Aromatic sulphonic acid – preparation and properties. Aliphatic hydroxy acids – Action of heat on  $\alpha$ ,  $\beta$ ,  $\gamma$  hydroxy acids. Acyl substitution.

- 1.3 Aliphatic dicarboxylic acid – Blanc's rule. Problems related to mono and dicarboxylic acids.  
1.4 Malonic and aceto acetic ester – characteristics and synthetic uses.

**Extra reading/Keywords:** *Benefits of Hydroxy citric acids*

## **UNIT 2- NITRO COMPOUNDS AND AMINES**

**12Hrs**

- 2.1 Aliphatic nitro compounds – comparison between primary, secondary and tertiary Nitrocompounds. Conversion of nitrobenzene to o, m and p-dinitro benzene. TNT. Reduction of nitrobenzene in neutral, acidic and alkaline media.  
2.2 Relative basic characters of aliphatic, aromatic amines and guanidine. Separation of aliphatic amines. Phenylene diamines – preparation, properties and uses.  
2.3 Diazotisation - Illustration and mechanism. Synthetic applications of diazonium salts.  
2.4 Diazomethane and diazo acetic ester – preparations, structure and their synthetic uses.

**Extra reading/Keywords:** *Role of Nitrogen containing compounds in daily life*

## **UNIT 3- AMINO ACIDS, PROTEINS AND NUCLEIC ACIDS**

**12Hrs**

- 3.1 Amino acids – introduction, classification, zwitter ions, iso electric point, Preparation and Properties.  
3.2 Polypeptides – peptide synthesis. Structural determination of polypeptides – end group analyses.  
3.3 Proteins – classification based on physical and chemical properties. Physiological functions, Primary, secondary and tertiary structures of proteins.  
3.4 Nucleic acids: RNA and DNA - Biological functions.

**Extra reading/Keywords:** *Nuclear bases*

## **UNIT 4-OXYGEN AND SULPHUR CONTAINING COMPOUNDS**

**12Hrs**

- 4.1 Alcohols - distinction of primary, secondary and tertiary alcohols. Thioalcohol (Ethyl Mercaptan), Poly-hydric alcohols ( Glycol and Glycerol), Unsaturated alcohol (Allyl alcohol) – preparation and properties.  
4.2 Ethers - (Diethyl ether and anisole), Epoxide (Ethylene oxide), Thioether (Ethyl Sulphide) - Preparation and properties. Mustard gas – structure and preparation.  
4.3 Phenols : Preparation and acidic character of phenols - explanation on the basis of resonance stabilization, Effect of substituent on acidity. Ring substitution in phenols – Orientation of phenolic group towards electrophiles. Esterification, nitration, sulphonation, halogenation, coupling, Kolbes reaction (mechanism), Reimer-Tiemann reaction (mechanism).

Lederer-Manasse, Liebermann's, Hoesh reactions, Elb's persulphate oxidation, phthalein reaction and Peckmann condensation.

4.4 Cresols, Di and Trihydric phenols and naphthols – reactions.

**Extra reading/Keywords:***Harmful effects of Resorcinol*

## UNIT 5-CARBOHYDRATES

12Hrs

- 5.1 Introduction. Classification. Preparation and reactions of glucose and fructose.
- 5.2 Ascending and descending of sugar series. Interconversions. Mutarotation and its mechanism. Epimerization. Constitution of glucose and fructose.
- 5.3 Disaccharides – preparations, reactions and structure of maltose, lactose and sucrose (Structural elucidation not expected).
- 5.4 Polysaccharides : Starch and cellulose – properties and uses.

**Extra reading/Keywords:***Deficiency of Carbohydrates*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**Course Outcomes(CO)**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Formulates and discriminate the preparation, properties and strength of aliphatic, Aromatic carboxylic, sulphonic acids and their derivatives.	PSO 1	R, U
CO-2	Explains the preparation, properties and basicity of nitrogen containing organic compounds.	PSO 2	U
CO-3	Describes the physiological functions and structures of proteins, amino acids and nucleic acids.	PSO 2	Ap
CO-4	Lists the preparation, properties of oxygen and sulphur containing compounds.	PSO 3	R
CO-5	Elucidates the structure of glucose and fructose	PSO 4	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply**

### **TEXT BOOKS**

1. Jain M.K., Sharma S.C., *Modern organic chemistry*, Fourth edition, Vishal Publishing Co., Jalandhar, 2012.
2. Tewari K.S., Vishnoi N.K., Mehrotra S.N., “*A Text Book of Organic Chemistry*”, 2<sup>nd</sup> Revised edition, Vikas Publishing House Pvt. Ltd.

### **BOOKS FOR REFERENCE**

1. Soni P.L. and Chawla H.M., “*Text Book of organic Chemistry*”, 27<sup>th</sup> Edition, Sultan Chand and Sons, 1997.
2. Subash Chandra Rastogi, Satis Kumar, Agarwala, Ashok Kumar Sharma. “*Natural Products*” – Vol. I.
3. I.L.Finar, *Organic chemistry*, Vol. I- 6<sup>th</sup> edition, vol.2 – fifth edition, Pearson Education, 2002.
4. Jonathan Clayden, Nick Greeves, Stuart Warren, *Organic chemistry*, 2nd Edition, Oxford University Press, 2012.
5. John McMurray, *Organic chemistry*, 8<sup>th</sup> Edn., International Edition, Mary Firch, 2011.
6. Robert Thornton Morrison, Robert Neilson Boyd, Saibal Kanti Bhattacharjee, *Organic Chemistry*, 7<sup>th</sup> Edition, Pearson Education India, Chennai, 2011.

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**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Third Year – Semester- V**

<b>Course Title</b>	<b>Main Core – 9: Physical Chemistry – I [Electro chemistry and Phase rule]</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4 Hrs Wk</b>
<b>Code</b>	<b>U15CH5MCT09</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General Objectives:**

To make the students learn the basic concepts of electrolytic conductance, understand the different types of electro chemical cells, EMF of cell and its measurement and concepts of phase rule.

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the basic concepts of electrolytic conductance and transport number measurements.
CO-2	classify the electrolytes and interprets the various theories of electrolytes
CO-3	implement electrode potential and apply Nernst equation for calculating the emf of the galvanic cell.
CO-4	apply emf measurements and outlines corrosion and overvoltage as electrochemical processes
CO-5	interpret Gibbs phase rule and its application in separation of metals from ores and alloys

**UNIT 1 - ELECTROLYTIC CONDUCTION – I**

**12 Hrs**

- 1.1 Specific conductance, equivalent conductance, relation between specific conductance and equivalent conductance, molar conductance, variation of molar conductance with dilution.
- 1.2 Determination of conductance and cell constant. Ionic mobility and its determination, discharge of ions on electrolysis – Hittorf's theoretical device.

- 1.3 Transport number, determination of transport number – Hittorf's method and moving boundary method, effect of concentration on transport number.

**Extra reading/Keywords:** *Conductance determination by experiments*

## **UNIT 2- ELECTROLYTIC CONDUCTION – II**

**12Hrs**

- 2.1 Kohlrausch's law – statement, applications of Kohlrausch's law – calculation of molar conductance at infinite dilution for weak electrolyte and determination of transport number.
- 2.2 Applications of conductance measurements – determination of degree of dissociation of weak electrolyte, ionic product of water, solubility of sparingly soluble salt and conductometric titrations.
- 2.3 An elementary treatment of Debye Huckel theory of strong electrolytes, significance of Debye - Huckel - Onsagar equation. Conductance at high field and high frequencies - Wein & Debye – Falkenhagen effects.

**Extra reading/Keywords:** *Degree of dissociation of strong and weak electrolytes and solubility product determination by experiments*

## **UNIT 3- ELECTROCHEMICAL CELLS – I**

**12 Hrs**

- 3.1 Galvanic cells, reversible electrodes and their types – metal/metal ion, gas/ion, metal/insoluble salt/anion, oxidation – reduction electrodes.
- 3.2 Single electrode potential, sign of electrode potential, reference electrodes – hydrogen, calomel and silver/silver chloride electrodes.
- 3.3 Thermodynamics of reversible cells and reversible electrodes – electrical energy in a galvanic cell, electrical energy and free energy change of the cell reaction, relation between electrical energy and enthalpy of a cell reaction. Effect of concentration of electrolyte on cell potential and electrode potential – Nernst equation.
- 3.4 E.M.F. of a cell and its measurement, Weston standard cell, the electrochemical series and its applications.

**Extra reading/Keywords:** *Fuel cells, primary and secondary batteries*

## **UNIT 4 - ELECTROCHEMICAL CELLS – II**

**12 Hrs**

- 4.1 Electrolyte concentration cells with and without transference, liquid junction potential.
- 4.2 Applications of E.M.F. measurements – determination of valency of ions, solubility product and pH – hydrogen electrode, quinhydrone electrode and glass electrode, potentiometric titrations.
- 4.3 Over Voltage – definition, determination and applications. Corrosion of metals – definition, types, electrochemical theory of corrosion and prevention.

**Extra reading/Keywords:** *Electrical double layer and corrosion inhibitors*

## UNIT 5- PHASE EQUILIBRIA AND PHASE RULE

12Hrs

- 5.1 Meaning of the terms – phase, component and degree of freedom. Criteria of phase equilibrium, Derivation of Gibb's phase rule.
- 5.2 Phase equilibria in one component systems – phase diagrams of water, carbon di-oxide and sulphur system.
- 5.3 Simple eutectic system – Lead-Silver system and Potassium iodide-Water system. Applications of thermal analysis in the construction of simple eutectic diagram.
- 5.4 Systems giving rise to compounds with congruent melting point – Zinc-Magnesium system. Systems giving rise to compounds with incongruent melting point – Sodium-Potassium system. Partially miscible liquids – Phenol-Water system, triethylamine-water and Nicotine-Water systems.

**Extra reading/Keywords:** *Three component systems*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Analyzes the variation of specific and equivalent conductance with dilution	PSO2	An
CO-2	summerizes the applications of conductance measurement	PSO4	Ap
CO-3	Classifies the types of electrodes	PSO1	U
CO-4	Explains the electrochemical theory of corrosion	PSO5	U
CO-5	Sketches and discuss the phase diagram of simple eutectic systems	PSO2	U

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### TEXT BOOKS

1. Puri B.R., Sharma L.R. and Madan Pathania S. , *Principles of Physical Chemistry*, 35<sup>th</sup> edn., Shobanlal nagin Chand and Co, 1994..
2. Arun Bahl, B.S. Bahl & G.D. Tuli, *Essentials of Physical Chemistry*, S.Chand & company Pvt. Ltd, 2014.



## BOOKS FOR REFERENCE

1. Negi, A.S. & Anand, S.C., *A Text book of Physical Chemistry*, 3<sup>rd</sup> edn., Wiley EasternLtd, 1994.
2. Walter J Moore *Physical Chemistry*, 5th edn.,, Prentice-Hall, 1999.
3. Bockris, J.O.M and Reddy, A.K.N. *Modern Electro Chemistry* 2<sup>nd</sup> edn.,, New York: Plenum Press, 1998.
4. Crow, D.R. *Principles And Applications To Electrochemistry*, Chapman And Hall, 1991.
5. Samuel Glasstone, *An Introduction to Electrochemistry* McMillan India Ltd.,2015.

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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Third Year – Semester- V**

<b>Course Title</b>	<b>Main Elective – 2 : Chemistry of Biomolecules</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5 Hrs Wk</b>
<b>Code</b>	<b>U15CH5MET03</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General objective:**

To make the students to learn about carbohydrates, lipids, proteins, enzymes, blood and bile pigments describe the functions and properties of blood, Haemoglobin, bile pigments, bile acids and distinguish blood groups.

**Course Objectives(CO):**

**The Learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the importance and different classes of lipids and describe the metabolism and functions of lipids.
CO-2	describe what happens during carbohydrate digestion, glycolysis, glycogenesis, glycogenolysis and gluconeogenesis.
CO-3	analyse the metabolism, anabolism and catabolism of proteins and detect the effects of starvation on different metabolism.
CO-4	analyse the properties, mechanism of action metabolic effects of Thyroxine and find out the diseases associated with abnormal metabolism of thyroxine.
CO-5	describe the functions and properties of blood, Haemoglobin, bile pigments, bile acids and distinguish blood groups.

**UNIT 1 - CARBOHYDRATES**

**15 Hrs**

- 1.1 Definition, Biological Significance, Digestion and absorption of carbohydrates, Chemical and Physical changes of glucose after absorption (Preliminary idea).

- 1.2 Intermediary metabolism of carbohydrates – glycogenesis, glycogenolysis, glycolysis, gluconeogenesis.
- 1.3 Regulation of blood sugar – Regulation by liver and regulation by kidney, Glucose Tolerance Tests. Diabetics – types, pathological condition and treatment, glycosuria.

**Extra reading/Keywords:** *Carbohydrates as valuable tool for product development.*

## **UNIT 2 – LIPIDS**

**15 Hrs**

- 2.1 Introduction, Biological significance of fats, classification, Blood lipids.
- 2.2 Oxidation of fatty acids – $\beta$ -oxidation cycle of saturated fatty acids.
- 2.3 Ketogenesis, Ketosis, Ketolysis, role of liver in fat metabolism.
- 2.4 Cholesterol – absorption, factors influencing absorption, Cholesterol content of serum, fatty liver. Hyper and Hypocholesterolemia – pathological condition and treatment.

**Extra reading/Keywords:** *Characterization and analysis of lipids.*

## **UNIT 3 – PROTEINS**

**15 hrs**

- 3.1 Absorption, metabolic pool, general pathway of protein metabolism, nitrogen metabolism. Diseases due to abnormal composition of urine.
- 3.2 Anabolism of protein – protein turnover and Biosynthesis of protein.
- 3.3 Catabolism of proteins – Removal of amino group, Fate of amino group and fate of Carbon skeleton, diseases due to deficiency of protein.
- 3.4 Inborn errors of phenylalanine metabolism, effects of starvation on different metabolism.

**Extra reading/Keywords:** *Importance and deficiency of proteins.*

## **UNIT 4 - ENZYMES AND THYROXINE**

**15 Hrs**

- 4.1 Enzymes – properties, classification, mechanism of enzyme action, Factors influencing enzyme action, enzyme inhibitors, introduction to co-factors.
- 4.2 Digestive enzymes and their action – salivary digestion, gastric digestion, pancreatic and intestinal digestion.
- 4.3 Intestinal fermentation and putrefaction – Action of Bacteria on  $\text{CH}_2\text{O}$ , Fat, Protein and Bilirubin.
- 4.4 Thyroxine – Circulating thyroid hormone, metabolic effects of thyroxine, Agents interfering with the synthesis of thyroid hormone, Diseases associated with abnormal metabolism of thyroxin – treatment.

**Extra reading/Keywords:** *Consequences of enzyme deficiency in human body.*

## UNIT 5 - BLOOD, BILE ACIDS AND PIGMENTS

15 Hrs

- 5.1 Blood – functions of blood and plasma proteins, blood groups and Rh factor, coagulation of blood mechanism.
- 5.2 Haemoglobin – structure, properties of Hb, metabolism.
- 5.3 Bile pigments – examples, properties, Types of Jaundice (preliminary idea).
- 5.4 Bile acids – examples, function and diseases associated.

**Extra reading/Keywords:** *Types and Derivatives of Haemoglobin.*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**Course Outcomes(CO):**

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explains the digestion and absorption of carbohydrates, processes involved in their metabolism and regulation of blood sugar.	PSO2	An
CO-2	Recognizes the different types of blood lipid, discuss the metabolism of fatty acids and analyze the factors influencing the absorption of cholesterol.	PSO4	An
CO-3	Describes the metabolic pathway of proteins and recognize the effect of starvation on metabolism.	PSO2	U
CO-4	Categorizes the different classes of enzymes, list their properties and describe the action of enzymes and bacteria on digestion of various nutrients.	PSO2	U
CO-5	Analyzes the metabolic effects of thyroxine.	PSO3	An
CO-6	summerizes the function and properties of blood, bile pigments and bile acids.	PSO3	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### TEXT BOOKS

1. Ambika Shanmugam. *Fundamentals of Biochemistry for medical students*. 4<sup>th</sup> edn., Navabharat offset works, 1983.
2. Satyanarayana U. and Chakrapani U. *Biochemistry*, 4<sup>th</sup> Revised edn., Elsevier, 2013.

## **BOOKS FOR REFERENCE**

1. Dulsy Fatima, Narayanan L.M. and Co-workers. *BioChemistry*, Saras Publication.1993.
2. Richard A. Harvey and Denise R. Ferrier, *Biochemistry* 4<sup>th</sup> edn., Lippincott Williams andWilkins, 2008.
3. David L. Nelson, Albert L. Lehninger and Michael M. Cox , *Principles of Biochemistry*. New York: 5<sup>th</sup> edn., Worth *Publishers*,2008.

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**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Third Year - Semester – V**

<b>Course Title</b>	<b>MAJOR ELECTIVE – 2 : FOOD CHEMISTRY</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5Hrs /Wk</b>
<b>Code</b>	<b>U17CH5MET03A</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General objective:**

The student learns various concepts of all the nutrients, food preparation, preservation and adulteration.

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Appraise the functions, sources, deficiency diseases, daily allowances of major nutrients.
CO-2	Enumerate the functions, sources, deficiency diseases, daily allowances of minor nutrients.
CO-3	Categorize and summarize the various techniques of food preparation and recommend steps to retain the nutritive value.
CO-4	Describe the concepts involved in food preservation techniques
CO-5	Identifie the different types of food adulteration and suggest few tests for their detection and relates chemical structure of ingredients with taste.

**UNIT I: NUTRIENTS –I**

**15 Hrs**

- 1.1 Protein – functions, sources, deficiency diseases, daily allowances.
- 1.2 Carbohydrates – functions, sources, deficiency diseases, daily allowances.
- 1.3 Fats and oils – functions, sources, deficiency diseases, daily allowances, disorders due to excess of fat.

- 1.4 Minerals – Ca, P, Fe, I, Na – functions, sources, deficiency diseases and disorders of taking excess. Importance of micronutrients.

**Extra reading/Keywords:***Organic sources of nutrients.*

## **UNIT II: NUTRIENTS –II**

**15 Hrs**

- 2.1 Vitamins – H<sub>2</sub>O soluble and fat soluble vitamins – sources, functions, deficiency and disorders of taking excess of vitamins.
- 2.2 H<sub>2</sub>O – functions, sources, deficiency diseases.
- 2.3 Fibre – functions, requirements and sources. Effects of deficiency of fibre.
- 2.4 Algae and fungi as foods, Toxicants naturally present in foods. Fermented foods and pickles.

**Extra reading/Keywords:***Preparation of Spirulina and dosage*

## **UNIT III: FOOD PREPARATION**

**15 Hrs**

- 3.1 Food preparation - Effect of cooking and heat processing on the nutritive value of foods. Food faddism and faulty food habits.
- 3.2 Cooking methods: Moist heat methods and dry heat methods – merits and demerits. Biofortification and Nutraceuticals – definition and examples.
- 3.3 Retention of nutritive value during preparation. Microwave cooking, solar cooking – description, advantages and disadvantages.

**Extra reading/Keywords:***Obesity*

## **UNIT IV: FOOD PRESERVATION**

**15 Hrs**

- 4.1 Food preservation: Importance of food preservation, causes of food spoilage. Principles of food preservation. Home scale methods of food preservation.
- 4.2 Methods of food preservation: Low temperature, high temperature, preservatives, osmotic pressure, dehydration, irradiation – merits and demerits.
- 4.3 Practical rules for good sanitation, food selection, purchase and storage – Non perishable foods, semi-perishable and perishable foods.
- 4.4 Browning reactions in foods – enzymic browning and non-enzymic browning.

**Extra reading/Keywords:***Organic insecticides*

## **UNIT V: FOOD ADULTERATION AND TASTE SENSATION**

**15 Hrs**

- 5.1 Food Adulteration – Types, international, Metallic, incidental adulteration and their ill effects.
- 5.2 Simple physical and chemical tests for detection of food adulterants, consumer protection.
- 5.3 Packaging hazards, Food borne diseases. Control of insects and rodents.

5.4 Physiological and chemical aspects of taste sensation – mechanism of sensation of taste, factors affecting taste response. Relation between chemical structure and taste.

**Extra reading/Keywords:***Adulteration in Maida*

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Lists the important nutrients of healthy diet	PSO1	U
CO-2	Analyses the nutrients presents of balanced diet	PSO2	An
CO-3	Summarizes the various cooking methods and its effects.	PSO1	U
CO-4	Explains the different food preservation techniques	PSO4	U
CO-5	Evaluates the adulterants present in food	PSO5	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### **TEXT BOOKS**

1. Dr. M. Swaminathan, Hand book of food and Nutrition’ Reprint, published by The Bangalore printing and publishing co. ltd. 2008.
2. B. Srilakshmi, Food Sceince, Third Edition, New Age international publishers, 2003.

### **BOOKS FOR REFERENCE**

1. Dr. M. Swaminathan, Food Science Chemistry and Experimental foods, second enlarged edition, published by Bangalore press. (1987)
2. Dr. M. Swaminathan, ‘Advanced test Book on Food and Nutrition’ Volume I and II second edition, The Bangalore printing and publishing co. ltd.
3. Sumathi.R. Mudambi, ‘Fundamentals of food and Nutrition’, Second edition, Wiley Eastern Limited, “1983.



For Students Admitted in the Academic year 2015 onwards  
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**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**III Year- Semester V/VI**

<b>Course Title</b>	<b>NON MAJOR ELECTIVE – 1: HOME CARE</b>
<b>Total Hours</b>	<b>30</b>
<b>Hours/Week</b>	<b>2 Hrs /Wk</b>
<b>Code</b>	<b>U15CH5NMT01/U15CH6NMT01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To enable the students to learn about balanced diet, food nutrition, marriage and family, fire prevention and protection, care of household metals and safe use of pesticides.

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
<b>CO-1</b>	Understand and identify the different types of food nutrition.
<b>CO-2</b>	Categorize the types of Marriage and Family
<b>CO-3</b>	Describe the concepts involved in fire prevention techniques.
<b>CO-4</b>	List the preventive measures of house hold metals.
<b>CO-5</b>	Outline the general methods of handling Pesticides.

**UNIT 1- DIETETICS AND FOOD NUTRITION**

**6 Hrs**

Balanced diet, Specific functions of nutrients, Effects of cooking on various nutrients.

**Extra reading/Keywords:***Nutraceuticals*

**UNIT 2- MARRIAGE AND FAMILY**

**6 Hrs**

Family life cycle, Different types of marriage, Parenting styles, Single parenthood, Types of family.

**Extra reading/Keywords:***Balancing Family and Social responsibility in life.*

**UNIT 3-FIRE PREVENTION****6 Hrs**

Major causes of fire in homes, Fire prevention and fire fighting in homes, Methods of extinguishing fire – starvation, cooling and smothering. Simple extinguishing agents. Chemical fire extinguisher – CO<sub>2</sub> extinguisher.

**Extra reading/Keywords:** *First Aid techniques and Rescue Victims.*

**UNIT 4- CARE OF HOUSE HOLD METALS****6 Hrs**

Metal polishes – functions, composition, mode of action. General rules for cleaning and polishing, cleaning and polishing of aluminium utensils, silverwares, copper and brassware, gold and teflon.

**Extra reading/Keywords :** *Applications of metals in day today life.*

**UNIT 5- SAFE USE OF PESTICIDES****6 Hrs**

Need of pesticides at home, Types of insect and their control at home - mosquitoes, flies, ants, cock roaches, termites and head lice. Precautions in application of pesticides.

**Extra reading/Keywords :** *Pest Management and Control.*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Categorizes the Composition of a balanced diet.	PSO 1	R, U
CO-2	Explains the different types of marriages	PSO 1	U
CO-3	Describes the methods of fire prevention and fire fighting in homes	PSO 1	Ap
CO-4	Lists the rules involved in cleaning and polishing of various metal ware.	PSO 4	Ap
CO-5	Enumerates the Precautions in application of pesticides.	PSO 4	An

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

**TEXT BOOKS**

1. Swaminathan M., 'Essentials of food and *nutrition*' the Bangalore printing & publishing Co., Ltd. 1985.
2. Sumati Mudambi R. and Rajagopal M.V., *Fundamentals of food and nutrition*, third edition.

3. Thankamma Jacob '*A Text Book of Applied Chemistry*' Macmillan India Ltd. 1987.
4. Matin Khan, '*Consumer Behaviour*' New age international (p) Ltd., publishing 2008.
5. Raheena Begum, '*A Text Book of applied Chemistry*' Sterling publishers private Ltd, 1991.

#### BOOKS FOR REFERENCE

1. Bharathi V.V. and M. Jacinth '*Family resource management*' Discovery publishing house, 1994.
2. Shankar Rao C.N., '*Sociology*' S.Chand & Company Ltd., 1997.

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**B.Sc. CHEMISTRY**  
**Third Year - Semester – VI**

<b>Course Title</b>	<b>MAJOR CORE PAPER – 11: ORGANIC CHEMISTRY - II</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5Hrs /Wk</b>
<b>Code</b>	<b>U15CH6MCT12</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

#### General objective:

The student learns the concepts of stereochemistry, mechanisms of rearrangement reactions, chemistry of heterocyclic compounds and structural elucidation of few natural products.

#### Course Objectives(CO):

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	elaborate the concepts of optical isomerism and illustrate, assign the notations for the same..
CO-2	discuss and justify the conformational analysis of alkanes, cycloalkanes, geometrical isomers and their stability.
CO-3	illustrate and apply the mechanism of various molecular rearrangements to the given substrates.
CO-4	classify, formulate and defend the preparation, properties of Heterocyclic compounds.
CO-5	outline the general methods of structural elucidation and apply to the prescribed natural products.

## UNIT 1-STEREOCHEMISTRY I

15 Hrs

- b. Isomerism-Types and examples. Tautomerism-Types and examples.
- c. Optical isomerism - Asymmetric centre, chirality, achiral and prochiral molecules. Elements of symmetry.
- d. Enantiomers and diastereomers – properties. Racemisation, Resolution, Asymmetric synthesis, Walden Inversion. Vant Hoff's rule of superposition, Freudenberg's rule of shift.
- e. Notations of optical isomers – Cahn, Ingold, Prelog rules, R – S notations for optical isomers with one asymmetric carbon.
- f. Optical activity in compounds containing no asymmetric carbon – Biphenyls, allenes and spiranes(Elementary treatment only) Optical isomers of lactic, tartaric and maleic acid - Structures and preparations.

**Extra reading/Keywords:** *Conversion of Enantiomers into Diastereomers*

## UNIT 2-STEREOCHEMISTRY II

15 Hrs

- 2.1 Geometrical Isomerism- Nomenclature of geometrical isomers ( E and Z, syn and anti system for aldoximes and ketoximes)
- 2.2 Cycloalkanes: Introduction – preparation and reactions, Baeyer's strain theory and theory of strainless rings, Coulson and Moffit's concept, orbital picture of angle strain.
- 2.3 Conformational analysis: Introduction of terms – conformers, configuration, dihedral angle, torsional strain. Conformational analyses of ethane and n - butane. Conformation of 1,3-butadiene.
- 2.4 Conformers of cyclohexane – axial and equatorial bonds, ring flipping showing axial and equatorial bonds and their inter-conversions. Conformations of mono substituted cyclohexanes – 1,3-diaxial interaction.

**Extra reading/Keywords:***Conformation in cis-1,4-di-t-butylcyclohexane*

## UNIT 3- MOLECULAR REARRANGEMENTS

15 Hrs

- 3.1 Molecular Rearrangements: Classification.
- 3.2 Mechanism of Pinacol – Pinacolone, Beckmann, Benzidine rearrangements.
- 3.3 Hofmann, Curtius, Schmidt, Cope rearrangement.
- 3.4 Claisen, Fries, Benzil – Benzilic acid rearrangements.

**Extra reading/Keywords:***Rearrangements extended to unknown substrate*

## UNIT 4- HETEROCYCLIC COMPOUNDS

15 Hrs

- 4.1 Aromatic characteristics of heterocyclic compounds. Importance of Heterocyclic compounds.
- 4.2 Five membered Hetero cyclics- Furan, pyrrole, thiophene- Preparation and properties .
- 4.3 Six membered heterocyclics – pyridine- Preparation and Properties. Comparison of basicity of pyrrole and aniline with pyridine.

- 4.4 Condensed Heterocyclics - Indole, Quinoline, Isoquinoline – properties only. Examples of condensed heterocyclics containing more than one hetero atom.

**Extra reading/Keywords:** *Nonaromatic Heterocyclics*

## UNIT 5- NATURAL PRODUCTS

15 Hrs

- Alkaloids: Introduction, General methods of structural elucidation. Structural elucidation of Coniine, Piperine and Nicotine.
- Terpenes: Introduction, classification, Isoprene rule. Structural elucidation of Menthol and  $\alpha$  – terpineol.
- Vitamins: Introduction, classification and structural elucidation of Ascorbic acid and Pyridoxine.

**Extra reading/Keywords:** *Terpenes are the volatile constituents of palanresins and essential oils*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	identify the chirality and configuration in various organic compounds.	PSO-1	U
CO-2	predict the nomenclature of geometrical isomers.	PSO-3	An
CO-3	analysis the conformers of alkanes, cycloalkanes and their stability.	PSO-3	An
CO-4	discuss the mechanisms of various molecular rearrangements.	PSO-1	U
CO-5	list out the preparation and properties of heterocyclic compounds.	PSO-1	U
CO-6	elucidate the structure of terpenes and alkaloids.	PSO-2	U

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

## TEXT BOOKS

- Parmar V.S. and Chawla H.M., “*Principles of reaction mechanism in Organic Chemistry*”, 2<sup>nd</sup> edition, Sultan Chand, 1978.
- Soni P.L. and Chawla H.M., “*Text Book of Organic Chemistry*”, 27<sup>th</sup> edition, Sultan Chand, 1997.

## BOOKS FOR REFERENCE

1. Jain M.K. "*Organic Chemistry*", 12<sup>th</sup> edition, Shoban Lai Nagin Chand and Co.
2. Jerry March, "*Advanced Organic Chemistry*" Reactions, Mechanisms and Structure", 4<sup>th</sup> Edition, John Wiley and Sons(Asia)Pte. Ltd, New delhi, 1997.
3. Robert Thornton Morrison, Robert Neilson Boyd , Saibal Kanti Bhattacharjee, *Organic Chemistry*, 7<sup>th</sup> Edition, Pearson Education India, Chennai, 2011.
4. I.L. Finar, "*Organic Chemistry*" 5<sup>th</sup> Edition, Dorling Kindersly (India) Pvt.Ltd., 1975.
5. Subhash Chandra Rastogi, Satis Kumar Agarwala, Ashok Kumar Sharma, "*Chemistry of Natural Products*", Vol I & Vol. II, I Edition 1974-75. Jai Prakash Nath & Co., Leading Educational Publishers.

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**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Third Year-SEMESTER VI**

<b>Course Title</b>	<b>MAJOR CORE – 12 : PHYSICAL CHEMISTRY – II [SPECTROSCOPY]</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5Hrs/Wk</b>
<b>Code</b>	<b>U15CH6MCT13</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**General objective:**

To study the basic principles and applications involved in Rotational spectra, IR spectra, Raman spectra, Electronic spectra, Mass spectra, NMR spectra and ESR spectra.

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	identify different molecular energies, interprets rotational spectrum of diatomics, apply the interpretation to calculate bond length, rotational constant, moment of inertia and analyze the rotational spectra of simple molecules.
CO-2	distinguish between harmonic and anharmonic vibrations, interprets the spectrum of vibrating rotator and attribute to group frequencies, hydrogen bonding and finger print region.
CO-3	recognize the existence of Raman lines, differentiate Raman from IR and elucidate structures of simple inorganic molecules based on the mutual exclusion principle.
CO-4	explain electronic spectroscopy, fragmentation pattern in mass spectrometry and apply it to simple organic molecules.
CO-5	understand the processes responsible for NMR chemical shifts, identify, interpret the signals in simple molecules, recalls the theory of ESR and explain the ESR spectrum for simple organic radicals.

**UNIT 1- ROTATIONAL SPECTROSCOPY**

**15Hrs**

- 1.1 Properties of electromagnetic radiation, electromagnetic spectrum, Molecular energies, interaction of electromagnetic radiation with matter.
- 1.2 Microwave spectroscopy – rotation of molecules, rotational spectra – diatomic molecules.

- 1.3 Rotational spectra of polyatomic molecules – linear molecules, symmetric top molecules. Applications to simple molecules.

**Extra reading/Key words:** *Microwave assisted synthesis*

## UNIT 2 - VIBRATIONAL SPECTROSCOPY

15Hrs

- 2.1 Infra – red spectroscopy – energy of a diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator – fundamental absorption, overtones and hot bands.
- 2.2 The diatomic vibrating rotator, the vibrations of polyatomic molecules – CO<sub>2</sub> and H<sub>2</sub>O, combination and difference bands.
- 2.3 Analysis by infrared techniques – finger print region, group frequencies, hydrogen bonding, structure of thio acetic acid.

**Extra reading/Key words:** *Interpret and elucidate structures from IR data*

## UNIT 3- RAMAN SPECTROSCOPY

15Hrs

- 3.1 Raman spectroscopy – Occurrence of Raman lines, stokes and antistokes lines, classical theory of Raman effect, Quantum theory of Raman effect.
- 3.2 Pure rotational Raman spectrum of linear molecules, symmetric top molecules, Raman activity of vibrations of CO<sub>2</sub> and water, Rule of mutual exclusion.
- 3.3 Structure determination from Raman and infrared spectroscopy – CO<sub>2</sub>, N<sub>2</sub>O, H<sub>2</sub>O, SO<sub>2</sub>, NH<sub>3</sub>, NO<sub>3</sub><sup>-</sup>, ClO<sub>3</sub><sup>-</sup> and ClF<sub>3</sub>.

**Extra reading/Key words:** *Application of Group theory in IR and Raman*

## UNIT 4 - ELECTRONIC AND MASS SPECTROSCOPY

15Hrs

- 4.1 Electronic spectroscopy of molecules – Electronic spectra of diatomic molecules, Born-Oppenheimer Approximation, Vibrational course structure, Intensity of vibrational electronic spectra - Franck–Condon principle.
- 4.2 Dissociation energy – determination from electronic spectrum, V<sub>max</sub> and Birge–Sponer method, Pre–dissociation.
- 4.3 Mass spectrometry – Basic Principles of Mass spectrometry – Molecular ion peak – Base peak – isotopic peak – Meta stable peak – nitrogen rule – Modes of fragmentation of simple organic compounds - n-butane, 2& 3 pentanone.

**Extra reading/Key words:** *Elucidate structure from UV and Mass spectrum, Photoelectron spectroscopy*

## UNIT 5 - NMR AND ESR SPECTROSCOPY

15Hrs

- 5.1 Nuclear Magnetic Resonance spectroscopy – spin of nucleus – Theory of NMR spectroscopy.
- 5.2 Chemical shift – spin-spin splitting – NMR spectrum of ethanol – Applications to simple organic molecules like simple alkanes, alkenes, alkyl halides, aldehydes, ketones and benzene.



- 5.3 Electron Paramagnetic Resonance spectroscopy – Theory of EPR spectroscopy – presentation of the spectrum – Hyperfine splitting in some simple systems – proton, methyl free radical. General rules governing hyperfine splitting – applications to simple organic radicals like methyl, ethyl, benzene, naphthalene, anthracene and para semibenzoquinone.

**Extra reading/Key words:** *Interpretation of NMR spectrum, 2DNMR, ESR of complexes*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explains the principles of Rotational spectroscopy calculate moment of inertia from rotational spectra of diatomic molecules.	PSO 1	U
CO-2	Distinguishes harmonic and anharmonic vibrations	PSO 2	U
CO-3	Recognises the Classical and Quantum theories of Raman effect	PSO 2	An
CO-4	Outlines Salient features of fragmentation pattern of organic compounds	PSO 4	Ap
CO-5	Demonstrates NMR chemical shifts and splitting patterns with illustrations	PSO 5	Ap
CO-6	Determines the dissociation energy using Birge-Sponer method.	PSO 2	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

#### TEXT BOOKS

- Colin Bannwell N and Elaine McCash M, *Fundamentals of molecular spectroscopy*, 4<sup>th</sup> edition, McGraw hill Publishing company limited, 1994.
- Sharma Y.R. *Elementary Organic spectroscopy*, Chand S. and Co., 1989.

#### BOOKS FOR REFERENCE

- Russell S. Drago, *Physical methods for chemists*, Saunders, 1992.
- Manas Chanda, *Atomic structure and Chemical Bond Including Molecular Spectroscopy*, Tata McGraw-Hill Publishing Company Ltd, 1972.
- McHale, J.L “*Molecular spectroscopy*”, Prentice Hall Publishers, 1999.
- Sindhu, P.S “*Fundamentals of Molecular spectroscopy*” 1<sup>st</sup> edition, New Age International publishers, 2006.

5. William Kemp “*Organic Spectroscopy*”, 3<sup>rd</sup> edition, ELBS publishers, 1991.
6. Russell S. Drago, *Physical methods in Inorganic Chemistry*, East West student edition, 1978.
7. Manas Chanda , *Atomic structure and Chemical Bond Including Molecular Spectroscopy*, Tata McGraw-Hill Publishing Company Ltd, 1972.
8. Levine, I.N “*Molecular spectroscopy*”, John Wiley and Sons, 2000.

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**B.Sc. CHEMISTRY**

**Third Year – Semester- VI**

<b>Course Title</b>	<b>Major Elective – 3 : Analytical Chemistry</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5 Hrs Wk</b>
<b>Code</b>	<b>U15CH6MET04</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**General objective:**

To make the students to learn about the laboratory hygiene and safety, data analysis, dipole moment and magnetic properties, principle of precipitation, applications of thermogravimetric analysis, photochemical reactions and colorimetric estimation.

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	identifies various chemicals used in the laboratory and explain first aid techniques and treatment for specific poisons.
CO-2	Understands, applies and analyses the various tests in data analysis and different chromatographic techniques.
CO-3	analyses the applications of dipole moment and magnetic properties for inorganic and organic molecules.
CO-4	analyses the thermogram of various compounds using thermoanalytical methods.
CO-5	applies and evaluate the principle of photometric techniques in the estimation of metal ions.

## UNIT 1 - LABORATORY, HYGIENE AND SAFETY

15Hrs

- 1.1 Storage and Handling of chemicals – carcinogenic chemicals – Handling of Ethers – Toxic and Poisonous chemicals – safe limits of vapour concentrations.
- 1.2 Waste disposal – Fume disposal - precautions for avoiding accidents, Material safety data sheet (MSDS).
- 1.3 First Aid techniques , precautions to avoid poisoning,t reatment for specific poisons laboratory safety measures.

**Extra reading/Key words:***Hazardous waste management.*

## UNIT 2 - DATA ANALYSIS

15Hrs

- 2.1 The mean, The median, significant numbers, confidence limits, data ethics, precision and accuracy, standard deviation.
- 2.2 Errors – Types of errors, correction of determinate errors. Methods for improving accuracy – Rejection of data – Q test. Presentation of tabulated data – Scatter diagram – Method of least squares, S.I. units.

### **Separation Techniques:**

- 2.3 Precipitation,solventextraction , chromatography – Types, Column chromatography,Thin ayer chromatography.
- 2.4 Paper chromatography – Paper electrophoresis , Ion exchange chromatography, Gas liquid chromatography. HPLC, GC-MS, LC-MS- preliminary idea.

**Extra reading/Key words:***GC-MS Techniques.*

## UNIT 3 - DIPOLE MOMENT AND MAGNETIC PROPERTIES

15Hrs

- 3.1 Dipole moment and magnetic properties – Dipole moment – polar and non polar molecules – polarization of molecules – atomic, induced and orientation polarizations – Mosotti-Clausius equation and Debye equation.
- 3.2 Measurement of dipole moment and its applications to structural studies of simple inorganic and organic molecules including substituted benzenes - estimation of percent ionic character.
- 3.3 Magnetic properties of matter – diamagnetism – paramagnetism – ferro magnetism – antiferromagnetism – magnetic flux – magnetic permeability. Magnetic susceptibility – its determination using Guoy balance,Application to structural problems.

**Extra reading/Key words:***Dipole moment and magnetic properties in spectroscopy.*

## UNIT 4 - GRAVIMETRIC ANALYSIS AND THERMO ANALYTICAL METHODS

15Hrs

- 4.1 Principles of Gravimetric analysis- Methods of gravimetric analysis – requirements of gravimetric analysis. Precipitation – Theory of precipitation.
- 4.2 Types of precipitates – co-precipitation, post precipitation and precipitation from Homogeneous solution – Digestion, filtration and washing, drying and ignition. Inorganic and organic precipitating agents and sequestering agents. Types, care and use of crucibles.
- 4.3 Thermogravimetric analysis – Principles, thermal analysis of silver nitrate, methods of obtaining thermograms – Derivative thermogravimetry. Factors influencing the thermogram – TGA. Instrumentation – precautions in the use of thermobalance – Application of TGA.
- 4.4 Differential thermal analysis - DTA of calcium oxalate monohydrate – thermal analysis of calcium acetate monohydrate.

**Extra reading/Key words:** *Electrogravimetry.*

## UNIT 5 - VISIBLE SPECTROPHOTOMETRY AND COLORIMETRY

15Hrs

- 5.1 Beer-Lamberts law, Molar absorptivity and absorbance, Types of photochemical reactions – Fluorescence, Phosphorescence, Chemiluminescence, photosensitisation.
- 5.2 Instrumentation – Radiation sources, filters and monochromators, photo tubes, photomultiplier tubes, power supply.
- 5.3 Visual comparators – multiple standard methods, duplication and dilution method, balance method, photoelectric colorimeter, spectrophotometer.
- 5.4 Criteria for satisfactory colorimetric estimation, advantages of colorimetric estimation, determination of composition of complexes, colorimetric estimation of iron, chromium and nickel.

**Extra reading/Key words:** *AAS and flame photometry.*

**Note:** Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Categorizes the various chemicals and recognizes the precautions to handle poisonous chemicals and to avoid the accidents.	PSO1	An
CO-2	Summarizes the principles and applications of various chromatographic techniques.	PSO5	A
CO-3	Explains the different types of polarization and differentiate the magnetism.	PSO2	U
CO-4	Evaluates the determination, application of dipole moment and magnetic susceptibility of molecules.	PSO4	E

CO-5	Categorizes the various types of precipitation and analyze the theories of precipitation.	PSO2	An
CO-6	Summarizes the principle, instrumentation and application of thermogravimetric analysis.	PSO4	An
CO-7	Sketches the schematic instrumentation of various photometric methods.	PSO4	An

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate**

### **TEXT BOOKS**

1. Gopalan R, Subramanian PS and Rengarajan K '*Elements of Analytical Chemistry*' Second revised edition, Sultan chand.1993
2. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry* :New Delhi.Sultan Chand.1989

### **BOOKS FOR REFERENCE**

1. Puri B.R., Sharma, L.R and Madan S. Pathania , *Principles of Physical Chemistry*New Delhi: 35<sup>th</sup>edn, Shoban Lal Nagin Chand and Co.2008
2. Willard H H, MerrittL. L., and Dean J. A., *Instrumental Methods of analysis*, Delhi, 6th edn, CBS Publishers & Distributors, Shahdara 1986.
3. Skoog D and West D, *Principles of Instrumental Analysis*; 6<sup>th</sup> edn,Cengage Learning 2006.
4. Gurdeep R. Chatwal, Sham K. Anand *Instrumental methods of chemical analysis*, Himalaya publishing house.2005
5. Gary D. Christian, *Analytical Chemistry*, John Wiley & Sons, 6th edition, 2007.
6. BobbittJ. M, Roy Gritter, *Introduction to chromatography*, Holden Day; 2nd edition.1985
7. Soni P.L., Chawla H.M., *Text Book of Organic Chemistry*, 6<sup>th</sup> Reprint, New Delhi: Sultan Chand & sons, 2006.

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**CHOICE BASED CREDIT SYSTEM**  
**UG COURSE PATTERN – B.Sc. CHEMISTRY**  
**Third Year – Semester- V&VI**

<b>Course Title</b>	<b>MAJOR CORE – 10: PRACTICAL PAPER II/III</b>
<b>Total Hours</b>	
<b>Hours/Week</b>	<b>8 Hrs Wk</b>
<b>Code</b>	U15CH5MCP10/ U15CH6MCP11
<b>Course Type</b>	<b>PRACTICAL PAPER</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Analyse the organic compounds qualitatively and quantitatively.
CO-2	Prepare the derivative of analysed compound
CO-3	Prepare the different organic compounds and check their purity .
CO-4	Identify various types of organic compounds and confirm them by different tests.
CO-5	Understand, apply and analyze the principles of gravimetric analysis

Gravimetric analysis:

1. Nickel as nickel dimethyl glyoxime.
2. Lead as lead chromate.
3. Barium as barium sulphate.
4. Calcium as calcium oxalate.
5. Calcium as calcium carbonate.

Organic Preparation:

1. Preparation involving oxidation, hydrolysis, nitration and halogenation (Internal valuation only).
2. Characterization of organic compounds by their functional groups and confirmation by preparation of derivative.

### Substances for organic analysis:

Urea, Nitrobenzene, Glucose, Phthalic acid, m-dinitro benzene, aniline, benzoic acid, cinnamaldehyde, resorcinol, acetanilide, benzamide, succinic acid, sucrose, ethyl benzoate, acetophenone, benzaldehyde, phenol, cinnamic acid.

### **Course Outcomes(CO):**

#### **The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recalls the procedure to analyse an organic compound	PSO5	Ap
CO-2	Develops the skill to prepare different organic compounds	PSO1	U
CO-3	Applies the techniques of gravimetric analysis to find out the quantity of an ion in a given solution.	PSO4	Ap
CO-4	Purifies the crude sample.	PSO4	An
CO-5	Records and analyse the results of the experiments	PSO5	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### **TEXT BOOKS**

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 2<sup>nd</sup> edn, Sultan Chand & Sons, 1997.

### **BOOKS FOR REFERENCE**

1. Svehla G. *Vogel's Qualitative Inorganic Analysis*. US: 7<sup>th</sup> Edition, Prentice Hall, 1996.
2. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Prescribed Book of Qualitative Chemical Analysis*, US: 6<sup>th</sup> Edition, Prentice Hall, 2000.
3. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.

For Students Admitted in the Academic year 2015 onwards  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**UG COURSE PATTERN – B.Sc. CHEMISTRY**  
**Third Year – Semester- V & VI**

<b>Course Title</b>	<b>MAJOR CORE – 13: MAIN PRACTICAL III/II</b>
<b>Total Hours</b>	
<b>Hours/Week</b>	<b>8hrs./wk</b>
<b>Code</b>	<b>U15CH5MCP11/ U15CH6MCP10</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Determine the equivalence point of titration using the conductometric and electric potential method
CO-2	Determine the colored compounds in solutions by colorimetrically
CO-3	Measure the pH of various solution using pH meter
CO-4	Determine the rate constant of chemical reaction changes as function of time
CO-5	Understand the interaction of plane polarized light with a solution of chiral substances

**Conductivity:**

1. Determination of cell constant.
2. Determination of equivalent conductance of a strong electrolyte.
3. Determination of dissociation constant of a weak electrolyte.

**Conductometric titrations:**

4. Strong acid versus strong base. (HCl Vs NaOH)
5. Weak acid versus strong base. (CH<sub>3</sub>COOH Vs NaOH)

**Potentiometric Titrations:**

6. To find the strength of HCl potentiometrically using quinhydrone electrode.
7. To determine the strength of Ferrous ammonium Sulphate potentiometrically.

**Colorimetry:**



- To verify Beer's law for  $K_2Cr_2O_7$  solution using photoelectric colorimeter and determine the unknown concentration.
- Estimation of Fe (III) as ferric thiocyanate complex.

**PH Meter:**

- To determine the strength of the given  $CH_3COOH$  by titrating with given NaOH.

**Polarimetry:**

- To determine the concentration of the given sugar solution using a polarimeter.

**Chemical Kinetics:**

- I order - Acid catalysed hydrolysis of ester.
- II order - Saponification of ester.

**Nernst Distribution law:**

- Determination of partition coefficient of iodine between  $CCl_4$  and  $H_2O$ .

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recognises the principles involved in the experiments	PSO5	Ap
CO-2	Calibrates the conductometry and potentiometry	PSO1	U
CO-3	Applies the techniques of conductometry, potentiometry, pH, colorimetry to solve chemical problems	PSO4	Ap
CO-4	Determines the strength of the given unknown solution	PSO4	An
CO-5	Analyses the results of the experiments	PSO5	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

**TEXT BOOKS**

- Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 2<sup>nd</sup> edn, Sultan Chand & Sons, 1997.

**BOOKS FOR REFERENCE**

- Svehla G. *Vogel's Qualitative Inorganic Analysis*. US: 7<sup>th</sup> Edition, Prentice Hall, 1996.
- Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Prescribed Book of Qualitative Chemical Analysis*, US: 6<sup>th</sup> Edition, Prentice Hall, 2000.

3. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.

For Students Admitted in the Academic year 2012 onwards  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**

<b>Course Title</b>	<b>Skilled based elective – 4: Forensic Science</b>
<b>Total Hours</b>	<b>30 HRS</b>
<b>Hours/Week</b>	<b>2 hrs./wk</b>
<b>Code</b>	<b>U15CH5SBT04</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

**General Objectives:**

To make the students learn about the basics of forensic science, poisons and its treatment, Examination of blood, handwriting, comparison and drugs.

**Course Objectives(CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the history and basics of forensic science and the services provided by the forensic science laboratories
CO-2	understand and identify the different types of poisons and suggests treatments
CO-3	attaches forensic importance to the samples at the site of crime
CO-4	compare the different type of handwritings and signatures and analyse the forgeries involved in the signatures and documents
CO-5	categorizes drugs and briefs their dependence

**UNIT 1 - HISTORY OF FORENSIC SCIENCE LABORATORIES**

**6 hrs**

Definition and scope of Forensic Science – History and development of Forensic Science - Basic services provided by Forensic science Laboratories.

**Extra Reading / Keywords :** *History and origin of Indian Forensic Science Laboratories*

**UNIT 2 - POISONS**

**6 hrs**

Poison – classification – General treatments - causes modifying the action of poison - Gastric lavage – uses of antidote –Isolation, purification and identification of organophosphorus, organochlorine, vegetable and metallic poisons from viscera.

**Extra Reading / Keywords :** *Chemical and gaseous poisons*

**UNIT 3 - BLOOD AND DNA TYPING**

**6 hrs**

Nature of blood – Characterization of blood – Forensic importance of Hairs, fibers, Saliva and seminal stains – DNA – DNA typing

**Extra Reading / Keywords :** *Gene Technology*

**UNIT 4 - DOCUMENT EXAMINATION**

**6hrs**

Handwriting comparison – Handwriting characteristic of an individual –signature forgeries - Anonymous letters - Procedure for obtaining suitable standards for comparison –Alteration, Erasures and Obliteration – Decipherment of charred documents – Cryptography.

**Extra Reading / Keywords :** *Applications of Cryptography in Army*

**UNIT 5 - DRUGS**

**6hrs**

Drugs – Drug Dependence – Narcotic drugs – Hallucinogens –Depressants – Stimulants – Anabolic steroids.

**Extra Reading / Keywords :** *Prepare a list of various drugs with commercial names*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

**Course Outcomes(CO):**

**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describes the history and development of forensic science.	PSO1	U
CO-2	Lists the types of poison and their treatment methods.	PSO2	An
CO-3	Explains the forensic importance of hair and fibre.	PSO2	U
CO-4	Recalls the forgeries involved in document examination.	PSO4	Ap

CO-5	Recognises the types and characteristics of drugs	PSO4	An

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### **BOOKS FOR REFERENCE**

1. Singhal S.K. *Toxicology at a Glance*.
2. Richard Saferstein *Criminalistics an Introduction to Forensic Science*.
3. Majr. Narayanan T.V. (Retd.) *Modern techniques of Bomb detection and Disposal*.
4. Dr. Sharma B.R. *Foot prints Tracks and Trails in Criminal Investigation and Trials*.
5. Kumar K. *Identification of disputed documents, finger prints and ballistics*

(for candidates admitted from 2017 onwards)

**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**  
**PG & RESEARCH DEPART MENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**THIRD YEAR - SEMESTER VI**

<b>Course Title</b>	<b>SBE – 5 Computer Literacy for Chemistry Students</b>
<b>Total Hours</b>	<b>30</b>
<b>Hours/Week</b>	<b>2</b>
<b>Code</b>	U19CH6SBT05
<b>Course Type</b>	Theory
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

### **Course Objectives(CO):**

**The student will be able to**

CO 1	apply the office packages to gain a better understanding of the computer.
CO 2	understand the functions of smart devices and online transactions
CO 3	Analyse the purpose of social networking and cyber security in the e-world
CO 4	Understand the C programming tools used
CO 5	Apply the C language tools to write the programs

**Unit I:Office Packages:****(6hrs)**

**MS- Word :**Creation of Documents (letters, Bio- data, etc).Creation of Tables, Formatting Tables (Time table, Calendar,etc).Working with Mail Merge(Circular letters).

**MS – Excel:** Creation of Worksheet (Mark Sheet, Pay Slip, PF Contribution list, etc). Excel Function (Date, Time, Statistical, Mathematical, Financial Functions). Creating charts (Line, Pie, Bar, etc).

**MS- PowerPoint:** Creation of Presentations(Duplicate and New slides, Layouts, View, Slide show, etc.). Working with objects (Movie, Sound, Word, Excel, etc.,) Working with Transition and Animation effects(Text, Object, Pictures)

**Extra Reading/Key words:***Units of Data Storage.*

**Unit II: Smart Devices and Online Transactions:****(6hrs)**

**Smart phone – Types :** Tablet PC , Smart TV, Smart Camera, Smart Watch and Smart Oven.Operating system for Smart phones- Apple iOS, Android, Windows 10, Blackberry, Symbian and Bada. Benefits of Smart Phones.

**E-Commerce and M-Commerce:** Components of E-Commerce- history, types, and benefits of each (B2B, B2C, C2B, C2C). Business to Government E-Commerce.M-Commerce-History, customers point of view and the provider point of view. Applications of M-Commerce- Mobile ticketing, mobile money transfer, mobile banking, mobile marketing and advertising. Payment methods in M-Commerce- Premium rate telephone numbers, Direct mobile dealing , Macro, Micro payment services and mobile wallets.

**Extra Reading/Key words:** *Google play for Android Phones.*

**Unit III: Social Networking and Cyber Security****(6hrs)**

**Social Networking Sites:** Characteristics of Social Networking Website- Examples of Social Networking Services (Facebook, SnapChat, Instagram, Whatsapp, Pinterest, Tumblr,Linkedin, Twitter, Quora and Patreon). Advantages and Disadvantages of Social Network.

**Cyber law:** Evolution and Historical events in cyber law. Case studies- Article taken from Media. Building blocks of cyber law( Netizens, Cyber space and Technology). Cyber Crime, Electronic and Digital devices, Intellectual Property, Data Protection and Privacy.Merits and Demerits of Cyber crime.

**Extra Reading/Key words:***How to stay out of trouble from Social Network.*

**Unit IV: Fundamentals of C****(6hrs)**

**C programming:** Introduction – character set – keywords – constants – operators, input and output in C – control statements – functions of C.

**Chemsketch:** Introduction – modes of applications – templates – drawing structures of simple molecules – 3D viewer – IUPAC naming and calculated properties.

**Extra Reading/Key words:** *How to draw the structures of organic compounds*

### Unit V:C programming in Chemistry

(6hrs)

**C programming in Chemistry:** Basic structure of C programming – conversion of temperature from Kelvin to Celsius – calculation of pH of a buffer solutions using Henderson equation – calculation of Molarity, molality – calculation of electronegativity of an element – calculation of empirical formula of a hydrocarbon – calculation of RMS and Average velocities.

**Extra Reading/Key words:** *How to write simple programs to solve problems in chemistry*

### Course Outcomes(CO):

#### The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Gains knowledge to work in MS office	PSO2	R
CO-2	Describes the importance of smart devices and online transactions	PSO1	Ap
CO-3	Analyses the merits and demerits of social networking.	PSO1	U
CO-4	Explains fundamentals of C	PSO6	An
CO-5	Applies C programming to solve chemistry problems	PSO3	An
CO-6	Gains computer skills to overcome day to day needs.	PSO3	Ap

**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse**

### BOOKS FOR REFERENCE

1. Mastering Ms-Office by Bittu Kumar
2. [https://www.webopedia.com/DidYouKnow/Hardware\\_Software/mobile-operating-systems-mobile-os-explained.html](https://www.webopedia.com/DidYouKnow/Hardware_Software/mobile-operating-systems-mobile-os-explained.html)
3. <https://makeawebsitehub.com/social-media-sites/>

4. [https://www.tutorialspoint.com/information\\_security\\_cyber\\_law/information\\_security\\_cyber\\_law\\_tutorial.pdf](https://www.tutorialspoint.com/information_security_cyber_law/information_security_cyber_law_tutorial.pdf)
5. [https://www.tutorialspoint.com/information\\_security\\_cyber\\_law/information\\_security\\_cyber\\_law\\_tutorial.pdf](https://www.tutorialspoint.com/information_security_cyber_law/information_security_cyber_law_tutorial.pdf)
6. <https://www.irjet.net/archives/V4/i6/IRJET-V4I6303.pdf>
7. K.V. Raman, "Computers in Chemistry", Tata McGraw Hill Education Private Limited, 2004
8. <http://www.acdlabs.com/download/chemsketch/download.html>
9. <http://www.acdlabs.com/chemsketch/>

For Students Admitted in the Academic year 2015 onwards  
**HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. CHEMISTRY**  
**Third Year - Semester – VI**

<b>Course Title</b>	<b>NON MAJOR ELECTIVE – 2: COSMETOLOGY</b>
<b>Total Hours</b>	<b>30</b>
<b>Hours/Week</b>	<b>2Hrs /Wk</b>
<b>Code</b>	<b>U15CH6NMT02</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To expose the students to the study of skin, hair, facial, cosmetics and hazards of cosmetics.

**Course Objectives(CO):**

The learner will be to

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	categorize and identifies the types, functions and threats to the skin
CO-2	understand and identify the types and problems of hair and suggests treatments
CO-3	list out the advantages and disadvantages of manual massage and mask treatment
CO-4	outline the preparations of facecreams, toilet powders and suggest facial packs for different types of skin
CO-5	enumerate the hazards due to cosmetics and appraise various techniques for the beautification of facial skin.

**UNIT 1 -SKIN**

**6 Hrs**

Study of Skin: Types, functions, diet and skin, threats to skin, effects of summer, winter, wind and rain on skin. Common skin disease – acne and warts.

**Extra reading/Keywords:***Skin diseases :Leucoderma and Psoriasis*

## **UNIT 2-HAIR**

**6 Hrs**

Types of hair, problems of hair – Hair falling, baldness, graying of hair, problems with lice, dandruff, hair care conditioning.

**Extra reading/Keywords:***Ill effects of using chemical hair conditioner and hair colourants*

## **UNIT 3 - FACIAL**

**6Hrs**

Manual massage – advantages, disadvantages. Mask treatment – setting and non-setting masks and uses.

**Extra reading/Keywords:** *Ayurvedic Massage Techniques*

## **UNIT 4 – COSMETICS**

**6 Hrs**

Face creams, toilet powders – ingredients, preparations. Preparation of facial packs for different types of skin, Dentifrices.

**Extra reading/Keywords:** *Herbal Facial Packs*

## **UNIT 5- STEPS IN FACIAL**

**6 Hrs**

Hazards due to cosmetics, skin – cleansing, toning, moisturizing, exfoliation – types, preparation, applications and uses.

**Extra reading/Keywords:** *Advantages of Herbal Cleansers, Toners and Moisturizers*

**Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

### **Course Outcomes:**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	Explains the different types of skins and their functions	PSO1	U
CO-2	Identifies the various hair problems	PSO2	U
CO-3	Outlines the advantages and disadvantages of mask treatment.	PSO2	U
CO-4	Prepares the natural facial packs on their own.	PSO3	An
CO-5	Summarizes the hazards due to usage of cosmetics.	PSO4	Ap



**PSO – Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;An – Analyse**

### **TEXT BOOKS**

1. Thankamma Jacob ‘A Text Book of Applied Chemistry’ Macmillan India Ltd. 1987.

### **BOOKS FOR REFERENCE**

1. ParveshHanda, “ A complete book on Beauty, Body, Make-up and Hairstyles, Goodwill publishing House, New Delhi.
2. ParveshHanda, “ Herbal Beauty Care”, Orient paperbacks, New Delhi 2004



**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2**  
**Affiliated to Bharathidasan University**  
**Nationally Accredited(4<sup>th</sup> Cycle) with A<sup>++</sup>Grade (CGPA 3.75/4) by NAAC**  
**College with potential for Excellence**  
**Tiruchirappalli - 620002**  
**PG AND RESEARCH DEPARTMENT OF CHEMISTRY**

<b>PO No.</b>	<b>Programme Outcomes</b> <i>Upon completion of the M.Sc. Degree Programme, the graduate will be able to</i>
PO-1	acquire knowledge and understanding of essential facts, concepts, principles and theories of Chemistry.
PO-2	develop Skills to evaluate, analyze and interpret the chemical information and data
PO-3	solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem
PO-4	use standard laboratory equipments, modern instrumentation and classical techniques to carry out experiments and develop skills to interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory
PO-5	think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solution to the problems
PO-6	collaborate effectively as part of a team to solve problems, and interact productively with a diverse group of team members

<b>PSO No.</b>	<b>Upon completion of these courses the student would</b>
PSO-1	acquire the basic principles of research and apply in chemical reactions
PSO-2	obtain knowledge about recent analytical and scientific advancements
PSO-3	envisage the structure of new novel Chemical compounds
PSO-4	investigate and interpret the mechanism for unknown chemical reactions using spectroscopic principles
PSO-5	explore the various teaching methodologies which enhance outcome based learning
PSO-6	contribute to the generation of new scientific insights or to the innovation of new applications of chemical research

For Students admitted from June 2016 onwards  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**CHOICE BASED CREDIT SYSTEM**  
**M.SC. CHEMISTRY COURSE PATTERN**

<b>SEMESTER</b>	<b>COURSE</b>	<b>TITLE OF THE COURSE</b>	<b>CODE</b>	<b>HOURS WK.</b>	<b>CREDITS</b>	<b>TOTAL MARKS</b>
<b>I</b>	I	Major Core 1 Physical Chemistry – I	P16CH1MCT01	6	4	100
	II	Major Core 2 Organic Chemistry – I	P16CH1MCT02	6	4	100
	III	Major Core 3 Inorganic Chemistry-I	P16CH1MCT03	6	4	100
	IV	Major Core 4 Inorganic Chemistry Practical I	P16CH1MCP04	5	5	100
	V	Major Core 5 Inorganic Chemistry Practical II	P16CH1MCP05	5	5	100
		Value Education		1		
		Library		1		
		Total		30	22	500
<b>II</b>	VI	Major Core6 Physical Chemistry – II	P16CH2MCT06	6	5	100
	VII	Major Core 7 Organic Chemistry – II	P16CH2MCT07	5	5	100
	VIII	Major Core 8 Organic Chemistry Practical I	P16CH2MCP08	6	5	100
	IX	Major Core 9 Organic Chemistry Practical II	P16CH2MCP09	6	5	100

		Non- Major Elective 1 Food Science	P16CH2NMT01	5	3	100
		Value Education		1		
		Library		1		
		Total		30	23	500

SEMESTER	COURSE	TITLE OF THE COURSE	CODE	HOURS WK.	CREDITS	TOTAL MARKS
<b>III</b>	X	Major Core10 Inorganic Chemistry – II	P16CH3MCT10	4	4	100
	XI	Major Core 11 Physical Chemistry – III	P16CH3MCT11	4	4	100
	XII	Major Core 12 Physical Chemistry Practical – I	P16CH3MCP12	6	3	100
	XIII	Major Core 13 Physical Chemistry Practical II	P16CH3MCP13	6	3	100
		Major Elective 1 Organic Chemistry	P16CH3MET01	5	5	100
		Non-Major Elective 2 Chemistry In Every Day Life	P16CH3NMT02	5	3	100
		Total		30	22	600
<b>IV</b>	XIV	Major Core14 Inorganic Chemistry- III	P16CH4MCT14	6	6	100
		Major Elective 2 Physical Chemistry	P16CH4MET02	6	6	100
		Major Elective 3 Green And Nano Chemistry	P16CH4MET03	6	6	100
		Self Study Paper- Applied Chemistry	P17CH4SST01	-	2	100

	Project Work	P16CH4DIS01	10	5	100
	Library		2	-	
	Total		30	23	400
	Grand Total		120	92	2000

(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – I**

<b>Course Title</b>	<b>MAJOR CORE 1- PHYSICAL CHEMISTRY-I</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH1MCT01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVES:**

To learn quantum mechanics and group theory. To understand the theory of IR, Raman, Electronic, Photoelectron, NMR and ESR spectroscopies

**Course Objectives:**

The learner will be able to

CO No.	Course Objectives
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CO-1	understand the elementary principles, postulates of quantum mechanics and perform quantum mechanics common problems such as particles in 1D and 3D bo
CO-2	understand necessary mathematical basics needed for group theory and apply it for HMO calculations, derive hybridization schemes and explain the vibrational, raman and electronic spectra of different compounds based on it.
CO-3	understand and analyse the spectroscopic techniques of IR and Raman
CO-4	explain electronic spectra of diatomics, photoelectron spectroscopy and its application in the study of complexes
CO-5	understand the basic principle of NMR and ESR and infer structural information from it

### UNIT: I

18Hrs

#### Quantum Mechanics

- 1.1 Fundamental principles of quantum mechanics – wave particle duality of particles, deBroglie hypothesis, Uncertainty principle . The Schrodinger equation for particle wave – the wave function and its physical significance , conditions for acceptable wave functions, normalization of wave function and orthogonality – ortho normal set.
- 1.2 Basic postulates of quantum mechanics – Eigen values, Eigen functions, Hermitian operator, Linear momentum operator, Hamiltonian operator and Angular momentum operator, commutation of operators, expectation values (postulates) and Stationary state.
- 1.3 Applications to simple systems – particle in a box ,one dimensional box , normalization of the wave function , orthogonality of the wave function, forms of wave function, one dimensional box with origin at the centre , utility of the particle in a box model.Three dimensional box, cubical box , distortion of the cubical box and lifting of degeneracy.

**Extra readi ng/keywords:** *Application to simple physical models*

### UNIT: II

18Hrs

#### Group Theory

- 2.1 Properties of a group – sub groups and classes, symmetry elements and operations, product of symmetry operations, point groups , some properties of matrices and vectors and representation of group. Great orthogonality theorem and its consequences – Character table, Reducible and irreducible representations.
- 2.2 Direct products and Correlation tables, Application of group theory to IR (non linear molecules), Raman and electronic spectra, Projection operators ,SALC Procedure – Variation theorem – Variation method.

- 2.3 Huckel MO calculations – Huckel MO method , Bond order and charge density , Evaluation of Energies and MO's for systems like ethylene, butadiene and planar monocyclic aromatic compounds. Hybridisation schemes – central atom in a molecule of definite geometry (non linear molecules).

**Extra reading/keywords:***Symmetric properties of extended arrays (crystals)*

### **UNIT: III**

**18Hrs**

#### **Rotational, Vibrational and Raman Spectroscopy**

- 3.1 Rotational Spectroscopy: Basic principles - Classification of Molecules – Rigid and Non- rigid rotator.
- 3.2 Infrared Spectroscopy: Vibrating diatomic molecules – Harmonic and Anharmonic oscillators – Diatomic vibrating rotator – vibration-rotation spectrum of Carbon monoxide. Vibrations of Polyatomic molecules –overtones, combination frequencies and Fermi resonance, influence of rotation on the spectra of polyatomic molecules- Linear molecules, influence of nuclear spin and perpendicular vibrations. Analysis by infrared techniques –skeletal vibrations, group frequencies. Techniques and instrumentation-outline. Fourier transform spectroscopy.
- 3.3 Raman Spectroscopy - Raman Effect , Quantum and Classical theory of Raman effect ,Pure rotational Raman Spectra , Vibrational Raman Spectra , Polarization of light and the Raman effect – vibrations of spherical Top molecules. Structure determination from Raman and IR spectroscopy. Laser Raman spectroscopy.

**Extra reading/keywords:***Vibrational spectra of metal carbonyls, Resonance Raman spectroscopy*

### **UNIT: IV**

**18Hrs**

#### **Electronic Spectra and Photo Electron Spectroscopy**

- 4.1 Electronic spectra of diatomic molecules, Born Oppenheimer approximation, Vibrational coarse structure, Franck Condon principle, Dissociation energy.
- 4.2 Rotational fine structure of electronic vibration transitions. The Fortrat diagram, Predissociation.
- 4.3 Photoelectron Spectroscopy-Introduction, Chemical information from photoelectron spectroscopy. X-ray photoelectron spectra – chemical shifts in XPS and applications of XPS in the study of complexes.

**Extra reading/keywords:***Electronic spectra of different spin states*

**UNIT: V****18Hrs****NMR and ESR Spectroscopy**

5.1 NMR Spectroscopy - spin and applied magnetic field, Larmor precession, relaxation processes. Chemical shift, Spin-Spin interaction. FT NMR, Multiple pulse NMR,  $C^{13}$  NMR – Chemical exchange.

5.2 ESR Spectroscopy- Basic principles, Presentation of the spectrum, Factors affecting 'g' value, unpaired electron density on an atom in a delocalized system – McConnell relation. Structure and

other useful information about simple systems, Zero field splitting, Kramer's degeneracy.

**Extra reading/keywords:** 2D NMR techniques, NMR of different nuclei ( $H^1$ ,  $F^{19}$ ,  $P^{31}$ ) applications of ESR to biological molecules containing  $Cu(II)$  and  $Fe(III)$  ions.

Course Outcomes:

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Solve the Schrödinger equation for one and three dimensional box	PSO 1	U
CO-2	Classify the molecules into point groups and apply group theory in studying vibrational spectra of different inorganic compounds	PSO 1	U
CO-3	Construct the hybridization scheme for non linear molecule using group theory	PSO 2	Ana
CO-4	Generate the structure using IR and Raman spectroscopy	PSO 3	App
CO-5	Compare and contrast IR and RAMAN spectroscopy	PSO 3	App
CO-6	Explain the application of XPS in the study of complexes	PSO 4	App
CO-7	Discuss the theory and interpret the structure using $C^{13}$ NMR spectra	PSO 5	App
CO-8	Explain the ESR spectra of simple systems	PSO 5	Ana
CO-9	Gain knowledge to explain Group theory	PSO 5	App

**BOOKS FOR REFERENCE**

1. Colin Bannwell N and Elaine McCash M (1994), Fundamentals of molecular spectroscopy, 4<sup>th</sup> edition, McGraw hill Publishing company limited.
2. Barrow, G.M. (1992). Introduction to Molecular Spectroscopy (5<sup>th</sup> Ed.). New Delhi: Mc Graw Hill.
3. Levitt, M.H. (2008). Spin Dynamics: Basics of Nuclear Magnetic Resonance (2<sup>nd</sup> Ed.). Wiley
4. Straughan, B.P. & Walker, S. (1976). Spectroscopy, Vol. 1, 2 & 3. London: Chapman & Hall.



5. Atkins, P., & Paula, J. (2002). Physical Chemistry ( 7<sup>th</sup> Ed.). Oxford University Press.
6. Prasad, R.K. (1993). Quantum chemistry.(1<sup>st</sup> Ed.). New Delhi: Wiley Eastern Limited.
7. Raman, K. (1990). Group theory and its application to Chemistry. New Delhi: Tata McGraw -Hill.
8. Levine, I.N (2000) “Molecular spectroscopy”, John Wiley and Sons.
9. McHale, J.L (1999) “Molecular spectroscopy” , Prentice Hall Publishers.

(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – I**

<b>Course Title</b>	<b>MAJOR CORE 2: ORGANIC CHEMISTRY –I</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH1MCT02</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To enable the students to learn the mechanism of different organic reactions, analyzing the products based on stereochemical approach.

**COURSE OBJECTIVES:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the different reactive intermediates of organic reactions and analyze the methods involved in the determination of reaction mechanism.
CO-2	recall and understand the free radical substitution reactions and apply the mechanism for various naming reactions
CO-3	apply the knowledge of reaction mechanism to aliphatic substitution and elimination reactions
CO-4	understand the terms involved in stereochemistry and evaluate the conformational analysis of cyclocompounds
CO-5	understand and apply the concepts of stereochemistry in stereo selective and stereospecific reactions and analyze the asymmetric synthesis using chiral catalyst and reagent

**UNIT: I****18 Hrs****Methods of Determining Reaction Mechanism and reactive intermediates**

- 1.1 Methods of determining reaction mechanism- identification of products, study of catalysis, spectroscopic studies, isotopic effects. Energy profile diagrams- intermediate vs transition state, cross over experiment, kinetic and thermodynamic control of chemical reactions, Hammond's postulate.
- 1.2 Stereochemical studies, substituent effects- Application of Hammett equation and Taft equation.
- 1.3 Reactive Intermediates: Classical and non-classical carbocation, radical cation, radical anion, Carbenes, arynes, nitrenes, and ylides - General methods of generation, detection and reactivity of these intermediates. Singlet oxygen, its generation and reactions with organic substances.

*Extra Reading/ Keywords :Kinetic and non- kinetic reaction mechanism*

**UNIT: II****18 Hrs****Free Radical Reactions**

- 2.1 Free Radical Reactions: Free radical substitution reactions- Mechanisms in aliphatic and aromatic substrates
- 2.2 Neighbouring group assistance - Orientation and reactivity, Reactivity of free radicals for aliphatic, aromatic substrates and at bridge head. Effect of solvent on reactivity.
- 2.3 Some selected reaction – Oxidation of aldehydes to carboxylic acids, Auto oxidation and formation of cyclic ethers. Name reactions - Sandmeyer, Gomberg – Beckman, Ullmann, Pschorr and Hunsdiecker reactions, Kolbe, Meerweinylation and Hofmann- Loffier-Fetag.

*Extra Reading/ Keywords: Anchimeric Assistance*

**UNIT: III****18 Hrs****Aliphatic Nucleophilic Substitution and Elimination Reactions**

- 3.1 Aliphatic Nucleophilic Substitution:  $SN_1$ ,  $SN_2$  and  $SN_i$  mechanism – Stereo chemical factors – Reactivity of substrates structure, attacking nucleophile, leaving group and reaction medium. Neighbouring group participation- substitution at allylic and vinyl carbons, correlation of structure with reactivity.
- 3.2. Aliphatic Electrophilic Substitution:  $SE_1$ ,  $SE_2$  mechanism, reactivity in SE reactions. Typical electrophilic substitution reactions -halogenation of carbonyl compounds, Friedel-Crafts acylation at olefinic carbon, Stark- enamine reaction.
- 3.3 Elimination Reactions:  $E_1$ ,  $E_2$  and  $E_1CB$  mechanism - Stereo chemical factors, Orientation of the double bond, Hoffman and Saytzeff rules. Competition Between elimination and substitution. Typical eliminations reactions - dehydration, dehydrohalogenation and dehalogenation. Mechanism of pyrolytic eliminations–Chugaev and Cope eliminations.

*Extra Reading/ Keywords: Aromatic Nucleophilic Substitution Reactions and Aromatic electrophilic Substitution Reactions*

**UNIT: IV****18 Hrs****Stereochemistry and Conformational Analysis**

- 4.1 Optical activity and chirality- Classification of chiral molecules as asymmetric and dissymmetric. Inter conversion of Sawhorse, Newmann and Fischer projections. D-L, erythro– threo, R-S, E-Z nomenclature. Chirality in molecules with non carbon stereocenters (N, S and P).
- 4.2 A brief study of dissymmetry of allenes, biphenyls, spiro compounds. Methods of determining configuration – Separation of enantiomeric mixtures.
- 4.3 Geometrical isomerism in acyclic, cyclic and bridged systems. Conformational analysis of cyclopentane, cyclohexane, 1,2 – 1,3 and 1,4 disubstitution cyclohexanes and decalins.
- Extra Reading/ Keywords :Stereochemistry of Drugs**

**UNIT: V**

**18 Hrs**

**Prochiral relationships and Asymmetric synthesis**

- 5.1 Prochirality and topicity -enantiotopic and diastereotopic ligands and faces. Basic principles of asymmetric synthesis - stereoselective and stereospecific reactions- methods for determining enantiomeric excess.
- 5.2 Asymmetric synthesis on Chiral substrate :Nucleophilic addition to  $\alpha$ - chiral carbonyl compounds; Prediction of Stereochemistry -Cram's rule, Prelog's rule.
- 5.3 Asymmetric synthesis using chiral reagent – BINAL-H, Asymmetric synthesis using chiral auxiliary derived from camphor, Asymmetric synthesis using chiral catalyst – Noyori's BINAP and Jacobson catalyst.
- Extra Reading/ Keywords: New Synthetic Chiral reagents and Chiral Catalysts**

**COURSE OUTCOMES:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discuss the stability of reactive intermediates	PSO 1	U
CO-2	Predict the mechanism for free radical substitution reaction	PSO 2	Ana
CO-3	Differentiate the aliphatic nucleophilic substitution and elimination reaction	PSO 3	App
CO-4	Identify the optical activity of organic molecules	PSO 4	App
CO-5	Discuss the asymmetric synthesis using chiral catalysts and chiral reagents	PSO 5	App
CO-6	Obtain knowledge about various chemical reactions and stereochemistry	PSO 5	App

### BOOKS FOR REFERENCE

1. March, J. (1999). *Advanced Organic Chemistry*. (4<sup>th</sup> Ed.). New York: Wiley Eastern Ltd.
2. Mukherji, S.M and Singh. S.P., (1978). *Reaction mechanism in Organic Chemistry*. (3<sup>rd</sup> Ed.). New Delhi: McMillan.
3. Sykes, P. (1997). *Guide Book to Mechanism in Organic Chemistry*. (6<sup>th</sup> Ed.). New Delhi: ELBS and Longmann Ltd.
4. Francis A. Carey and Richard J. Sundberg, *Advanced Organic Chemistry: Part-A, Structure and Mechanisms*. (4<sup>th</sup> Edition), Kluwer Academic Publications, New York.
5. Eliel, E.L. (2004). *Stereo Chemistry of Carbon Compound*. New Delhi: Tata McGraw Hill
6. Patapov, V.M. (1979). *Stereo Chemistry*. Moscow: Mir publishers.
7. Cahn, R.S. and Dermer, O.C. (1979). *Introduction to Chemical Nomenclature*. (5<sup>th</sup> Ed.). London: Butterworths.
8. Finar, I.L. (1997). *Organic Chemistry, Vol II*. (6<sup>th</sup> Ed.). New Delhi: ELBS and Longmann Ltd.
9. Nasipuri, D. (1994). *Stereochemistry of Organic Compounds*. (2<sup>nd</sup> Ed.). New Delhi: New Age International (P). Ltd

(For Students admitted from June 2016 onwards)  
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2  
PG & RESEARCH DEPARTMENT OF CHEMISTRY  
First Year - Semester – I

<b>Course Title</b>	<b>MAJOR CORE 3 - INORGANIC CHEMISTRY-I</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>

<b>Code</b>	<b>P16CH1MCT03</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To learn about covalent bond and ionic bond, structure of cages, clusters and inorganic polymers, acid – base concepts, various concepts behind magnetic properties of lanthanides and actinides

**Course Objectives:**

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	analyse the different theories of covalent and ionic bonds.
CO-2	understand the periodicity, halogen and behaviors of noble gases and its bonding
CO-3	understand the chemistry of some solvents and various acid base concepts
CO-4	apply Wades rules and STYX notation to boranes and carbonanes, di and polynuclear clusters
CO-5	understand, analyse and apply magnetic properties & properties of lanthanides and actinides

**UNIT : I**

**18 Hrs**

**Covalent Bond and Ionic Bond**

- 1.1 Introduction – Lewis theory, Sidgwick – Powell theory, VBT- Hybridization – the extent of d – orbital participation in molecular bonding – concepts of resonance and hybridization – application to simple molecules. Lattice energy – Born Lande equation and its derivation – Kapustinskii equation – Born-Haber cycle – applications.
- 1.2 MOT-LCAO method – Geometry of orbitals – Symmetry and overlap, symmetry of molecular orbitals – construction of molecular orbitals in diatomic molecules – Molecular orbital in molecules like CO, NO, HCl & HF – molecular orbital equivalence of hybridization– comparison of VB & MO methods.
- 1.3 VSEPR theory – methane, ethylene, acetylene, ammonia, water,  $\text{PCl}_3\text{F}_2$  (Bent's rule),  $\text{SF}_4$ ,  $\text{BrF}_3$ ,  $\text{TeF}_5^-$ ,  $\text{ICl}_2^-$ ,  $\text{ICl}_4^-$ ,  $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{XeF}_6$ ,  $\text{XeO}_3$ ,  $\text{XeO}_4$ , phosphorus trihalides, bond angle -  $\text{NH}_3$  and  $\text{NF}_3$ , Dipole moments-  $\text{H}_2\text{O}$ ,  $\text{OF}_2$

*Extra reading/keywords: Derivation of Kapustinskii equation*

**Unit II****18 Hrs****Periodicity, Halogens and Noble Gases**

- 4.1 Periodicity - The use of  $p$ -orbitals in  $\pi$ -bonding –  $p\pi - p\pi$  bonding in heavier non-metals – the use of  $d$  orbitals by non-metals – experimental evidence of  $p\pi - d\pi$  bonding.
- 4.2 Comparison of  $p\pi$  bonding in phosphine complexes and oxides – experimental evidences for  $d$ -orbital contraction and participation
- 4.3 Chemistry of halogens and noble gases - polyhalide ions – oxyacids of heavier halogens – anomalous behaviour of fluorine – bonding in noble gas fluorides and their reactivity

*Extra reading/keywords: Application on  $d$  &  $f$  block elements bonding*

**UNIT: III****18 Hrs****Acid – Base Concepts and Applications of Redox Potential**

- 3.1 Acid base concepts. Bronsted, Lowry, Lux-Flood, Usanovich, Lewis, solvent system and generalised acid base concepts - Measures of acid - base strength - steric effect and solvation effects
- 3.2 Hard and soft acids and bases (HSAB)- acid base strength and hardness and softness – symbiosis. Types of solvents, Liq.  $\text{NH}_3$ ,  $\text{SO}_2$ ,  $\text{HF}$  and  $\text{H}_2\text{SO}_4$  as solvents.
- 3.3 Variable valency and Oxidation states - standard electron potential and electrochemical series – relationships of free energy change and equilibrium constants. Oxidation-reduction reactions – Oxidation states of transition metals in aqueous media. Use of reduction potential – Potential diagrams – stabilization of electrode potentials – factors determining the magnitude of reduction potentials.

*Extra reading/keywords: Latimer diagram of some redox systems*

**UNIT: IV****18 Hrs****Cages, clusters and Inorganic polymers**

- 2.1 Structure and bonding in polyhedral boranes and carboranes; STYX notation, Wade's rule-Classification of Closo, Nido, Arachno types, Synthesis and structure of polyhedral boranes.
- 2.2 Dinuclear clusters- Preparation, Structure & Bonding  $[\text{Re}_2\text{Cl}_8]^{2-}$ ,  $[\text{MoCl}_8]^{2-}$  Poly nuclear clusters:  $[\text{Re}_3\text{X}_{12}]^{3-}$ ,  $[\text{W}_4(\text{OR})_{16}]$ , and quintuple bond Cryptands and crown ethers.
- 2.3 Silanes, Silicone halides, Silicates, Silicones, Silenes, gerenes, Stannenes and phosphazenes.

*Extra reading/keywords: Reactivity of polyhedral boranes*

**UNIT: V****18 Hrs****Magnetic properties, Lanthanides and Actinides**

- 5.1 **Magnetic properties:** Paramagnetism – calculation of magnetic moments – spin only value - magnetic susceptibility – spin orbit coupling – variation of magnetic moments with temperature – Curie-Weiss Law – ferromagnetism and antiferromagnetism.

- 5.2 **Lanthanides:** Position in the periodic table - electronic configuration – oxidation states – size relationships – lanthanide contraction, gadolinium break – spectral and magnetic properties – coordination compounds - lanthanide shift reagents in NMR – MRI contrasting agents.
- 5.3 **Actinides:** Electronic configuration - oxidation states of actinides – spectral and magnetic properties – comparative account of lanthanides and actinides

*Extra reading/keywords: Special properties of radioactive elements*

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Outline the concepts of VBT, MOT and VSEPR theories	PSO 1	R, U
CO-2	Examine the different types of $\pi$ bonding and its uses in p and d-block elements.	PSO 2	R
CO-3	Explain the various types of acid and bases	PSO 2	U
CO-4	Describe the chemistry of few aqueous and non aqueous solvents	PSO 3	R
CO-5	Summarises the concepts and applications of redox potential	PSO 4	An
CO-6	Sketch the structure and bonding of Dinuclear clusters, polyhedral boranes and carboranes.	PSO 4	U
CO-7	Compare the properties of Lanthanides and Actinides.	PSO 5	R, An
CO-8	Discuss the magnetic properties of inner transition elements.	PSO 5	U
CO-9	Gain knowledge to teach various Concepts of inorganic chemistry	PSO 5	Ap

**. BOOKS FOR REFERENCE**

- Huheey, J.E., Ellen. A. Keiter & Richard .L. Keiter. (2003). *Inorganic Chemistry* (4<sup>th</sup> Ed.). London: Addison & Wesley.
- Lee, J.D. (1995). *A New Concise Inorganic Chemistry* (4th Ed.). London:ELBS.

3. Miessler Paul .J, Fischer, Donald A. Tarr. Inorganic Chemistry, fifth edition
4. Cotton F.A and Wilkinson, G. (1985). *Advanced Inorganic Chemistry* (6<sup>th</sup> Ed.). New Delhi: East West student.
5. Day, M.C. & Selbin. (1972). *Theoretical Inorganic Chemistry* (3<sup>rd</sup> Ed.) . London: Butterworth.
6. Friedlander, G. (1990). *Nuclear and Radiochemistry* (3<sup>rd</sup> Ed.). London: John Wiley & Sons.
7. H. J. Arnikar Essentials of *Nuclear Chemistry*,. Second Edition.. Wiley: New York. NY. 1987.
8. Singh, A.& Singh, R. (2006). *Text book of nuclear Chemistry* (1<sup>st</sup> Ed.). London: Campus Books

(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – I**

<b>Course Title</b>	<b>MAJOR CORE 4 - INORGANIC CHEMISTRY PRACTICALS –I</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5</b>
<b>Code</b>	<b>P16CH1MCP04</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVES:**

To acquire the practical skills in the qualitative and quantitative analysis of metal ions.

**Course Objectives:**

**The learner will be able to**



CO No.	Course Objectives
CO-1	Understand the principle of colorimetric estimation
CO-2	Fine the measurement of change in absorbance of the solution colorimetrically
CO- 3	Identify the common and rare radicals in the given mixture systematically
CO-4	Prepare standard solution and different concentrations from given concentration
CO-5	Calibrate the colorimetric instrument

### I COLORIMETRIC ESTIMATION:

Estimation of Chromium.  
 Estimation of Copper.  
 Estimation of Nickel.  
 Estimation of Ferric ion.  
 Estimation of Manganese.

### II SEMI MICRO QUALITATIVE ANALYSIS:

Mixture analysis of common and rare cations such as lead, copper, bismuth, cadmium, nickel, cobalt calcium, strontium, magnesium, ammonium, molybdenum, selenium, tungsten, zirconium, cerium, vanadium, thorium, lithium.

### Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Estimate the amount of metal ions present in the given sample photolorimetrically	PSO3	Ap
CO-2	Identify the common and rare radicals present in the given inorganic salt mixture	PSO2	U
CO-3	Separate the radicals into groups	PSO1	U
CO-4	Prepare stock solution in ppm units	PSO1	U

CO-5	Draw the standard calibration graph	PSO4	An
CO-5	Acquire skill to analyze the given sample qualitatively and quantitatively.	PSO3	Ap

**TEXT BOOKS:**

1. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.
2. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 2<sup>nd</sup> edn, Sultan Chand & Sons, 1997.

**BOOKS FOR REFERENCE:**

1. Svehla G. *Vogel's Qualitative Inorganic Analysis*. US: 7<sup>th</sup> Edition, Prentice Hall, 1996.
2. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Prescribed Book of Qualitative Chemical Analysis*, US: 6<sup>th</sup> Edition, Prentice Hall, 2000.

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**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – I**

<b>Course Title</b>	<b>CHEMISTRY MAJOR CORE 5 - INORGANIC CHEMISTRY PRACTICALS –II</b>
<b>Total Hours</b>	<b>75</b>

<b>Hours/Week</b>	<b>5</b>
<b>Code</b>	<b>P16CH1MCP05</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVES:**

To acquire the practical skills in the quantitative estimation of metal ions.

**Course Objectives:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Understand the principle of quantitative analysis.
CO-2	Demonstrate the laboratory techniques applied for gravimetric analysis.
CO-3	Apply the precipitation and filtration techniques involved in gravimetric estimation.
CO-4	Learn the method of preparation of Inorganic complexes.
CO-5	Understand the chemistry behind the formation of Inorganic complexes.

**INORGANIC ESTIMATION:**

ESTIMATION OF COPPER AND NICKEL

ESTIMATION OF COPPER AND ZINC

ESTIMATION OF CALCIUM AND MAGNESIUM

ESTIMATION OF HARDNESS OF WATER

**PREPARATION:**

PREPARATION OF TRIS THIOUREA COPPER (I) CHLORIDE

PREPARATION OF POTASSIUM TRIS OXALATO CHROMATE (III)

PREPARATION OF PRUSSIAN BLUE

PREPARATION OF TETRAMMINE COPPER (II) SULPHATE

PREPARATION OF POTASSIUM TRIS OXALATO ALUMINATE (III)

PREPARATION OF TRIS THIOUREA COPPER (II) SULPHATE

PREPARATION OF HEXAMINE COBALT (III) CHLORIDE

PREPARATION OF CHROME ALUM

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Estimate the amount of ions present in the given solution.	PSO3	Ap
CO-2	Estimate the hardness of water	PSO3	Ap
CO-3	Separate the ions through proper techniques	PSO1	U
CO-4	Prepare the Inorganic complexes	PSO4	Ap
CO-5	Understand the method of preparation of complexes	PSO1	U
CO-6	Gain analytical skill to analyse the sample using quantitative methods.	PSO3	Ap

**TEXT BOOKS:**

1. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.
2. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 2<sup>nd</sup> edn, Sultan Chand & Sons, 1997.

**BOOKS FOR REFERENCE:**

1. Svehla G. *Vogel's Qualitative Inorganic Analysis*. US: 7<sup>th</sup> Edition, Prentice Hall, 1996.
2. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Prescribed Book of Qualitative Chemical Analysis*, US: 6<sup>th</sup> Edition, Prentice Hall, 2000.

(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – II**

<b>Course Title</b>	<b>MAJOR CORE : 6 - PHYSICAL CHEMISTRY – II</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH2MCT06</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVES:**

To understand quantum applications. To know classical thermodynamics, chemical and solution kinetics.

**Course Objectives:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	think critically about, explain, integrate, and apply physical models to describe wave function and energy levels associated with atoms
CO-2	identify the applications of quantum chemistry in explaining MO, VB and HMO theories and construct hybridization schemes
CO-3	calculate partial molar quantities from experimental data, understand thermodynamic properties of real gases and explain the application of phase rule to three component systems
CO-4	recalls the concepts of kinetics and explain the theories of unimolecular and bimolecular reactions
CO-5	appraise the effects of few variable of solution kinetics

**UNIT: I**

**18Hrs**

## Quantum Chemistry – II

- 1.1 Rigid rotator, Harmonic Oscillator – occurrences of rotational and vibrational quantum numbers and selection rule for rotational and vibrational transitions, Bohr's Correspondence principle, Hydrogen atom – Method of solution, Shapes and properties of hydrogenic orbitals, hydrogen like system, Electron spin.
- 1.2 Exactly solvable nature of systems – Approximation methods, Many electron atoms wave function, One electron orbitals, Pauli's principle and Slater determinant, Application of Variation method to hydrogen and helium atom, atomic spectra of helium and sodium – Zeeman effect.
- 1.3 Perturbation method to non – degenerate systems – Application of perturbation method to helium atom. Hartree – Fock self consistent field methods. Spin orbit interactions – L.S. and J.J. Coupling schemes, Vector model of the atom, term symbols.

**Extra reading/keywords:** *Application of variation method to lithium*

### UNIT: II

18Hrs

#### Applications of Quantum Chemistry II

- 2.1 The Born – Oppenheimer approximation. MO and VB theories as applied to hydrogen molecular ion ( $H_2^+$ ) and hydrogen molecule – coulomb integral and exchange integral and an overlap integral. Construction of  $sp$ ,  $sp^2$  and  $sp^3$  hybrid orbitals.
- 2.2 Huckel molecular orbital theory – principles and applications to ethylene, butadiene and benzene. Huckel calculation of pi- electron energies.

**Extra reading/keywords:** *HMO of allylic system*

### UNIT: III

18Hrs

#### Thermodynamics and Phase equilibria

- 3.1 Thermodynamics of systems of variable composition – partial molar properties, physical significance of partial molar properties, Chemical potential, Relationship between partial molar quantities – Gibbs – Duhem equation, Variation of chemical potential with temperature and pressure – Calculation of partial molar quantities from experimental data.
- 3.2 Thermodynamic properties of real gases – Fugacity concept, Calculation of fugacity of real gas, Activity and activity coefficient concept, Standard states, Experimental determination of activity coefficients of non- electrolytes.
- 3.3 Phase rule to three component systems – systems of three liquids, solids – Liquid systems (Eutectic systems, two salts and water).

**Extra reading/keywords:** *Phase rule to liquid-liquid system*

### UNIT: IV

18Hrs

#### Chemical Kinetics

- 4.1 Theories of reaction rates –Molecular activation, activated complex, theoretical calculation of activation energy-potential energy surface, Simple collision theory, Absolute Reaction Rate theory (ARRT), comparison of collision and Absolute Reaction Rate theories, physical

significance of probability factor, calculation of thermodynamic parameters, Kinetic isotopic effect, theory of termolecular reaction.

4.2 Theory of Unimolecular reactions – Lindemann’s theory, Hinshelwood theory, Treatment of RRK theory (Kassel, Rice and Ramsperger), the Slater’s treatment.

4.3 Principle of microscopic reversibility, Chain reactions – Steady state approximation, Thermal reactions between hydrogen and halogens, Gas phase auto oxidations, Explosions – Hydrogen-oxygen reaction.

**Extra reading/keyworkds:** *RRKM model and diffusion controlled reactions.*

**UNIT: V**

**18Hrs**

**Solution Kinetics**

5.1 Factors determining reaction rates in solution – collisions in solution, Transition state theory, influence of internal pressure and activation.

5.2. Reactions between ions- influence of solvent dielectric constant, pre-exponential factor, single –sphere activated complex and influence of ionic strength.

5.3 Ion-dipole and dipole-dipole reactions- pre-exponential factors, influence of ionic strength. Influence of external pressure-Van’t Hoff equation, Volume of activation.

**Extra reading/ keyworkds:** *Substituent and correlation effects*

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identify, describe and explain the quantum mechanical behavior of simple systems, such as the harmonic oscillator and the rigid rotor	PSO 1	U
CO-2	Discuss LS and J.J coupling scheme and derive ground state term symbol for various atoms	PSO 2	U
CO-3	Explain HMO theory and apply it in the calculation of pi – electron energies for simple conjugated systems	PSO 3	App
CO-4	Construct the phase diagram for three component systems	PSO 4	Ana
CO-5	Compare and contrast simple collision theory and ARRT	PSO 1	U
CO-6	Describe the influence of solvent, ionic strength and pressure on the rate of the reaction in solution	PSO 1	U

CO-7	Gain knowledge to teach physical chemistry	PSO 3	App
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(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – II**

<b>Course Title</b>	<b>Major Core 7 – ORGANIC CHEMISTRY-II</b>
<b>Total Hours</b>	<b>75</b>



<b>Hours/Week</b>	<b>5</b>
<b>Code</b>	<b>P16CH2MCT07</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To enable the students to understand the concepts of aromaticity, substitution reactions, retrosynthesis, rearrangements, redox reactions and the chemistry of heterocyclic compounds, proteins and carbohydrates.

**Course Objectives:**

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Understand the criteria for aromaticity and differentiate the aromatic electrophilic and nucleophilic substitution reactions.
CO-2	Interpret the reaction mechanism for electrophilic, nucleophilic and free radical additions to carbon-carbon multiple bonds.
CO-3	Design a detailed mechanism for rearrangement reactions, identify the oxidation and reduction reactions in the organic compounds.
CO-4	Apply the basic principles of retrosynthetic analysis to work out synthetic strategies for organic molecules, discuss the important modern synthetic reactions.
CO-5	Apply the IUPAC nomenclature for naming alicyclic, bicyclic, spiro and heterocyclic compounds and understand the chemistry of carbohydrates and proteins

**UNIT 1 –AROMATICITY AND SUBSTITUTION REACTIONS**

**15 Hrs**

- 1.1 Aromaticity – Concept of Aromaticity, non-aromaticity and antiaromaticity. Huckel's rule and Craig's rule. Effect of aromaticity on bond lengths, resonance energies and induced ring current. Aromaticity in non-benzenoid compounds – Annulenes, Azulenes, Sydnones and Fullerenes.
- 1.2 Aromatic Nucleophilic substitution - S<sub>N</sub>Ar, S<sub>RN</sub>1 and benzyne mechanisms. Reactivity – effect of structure of substrate, leaving group, attacking nucleophile and solvent.
- 1.3 Aromatic Electrophilic Substitution – The Arenium ion mechanism, orientation and reactivity in monosubstituted benzene rings, The effect of the leaving group, Effect of Electrophiles – Hydrogen, Nitrogen, Sulfur and Halogen. Ipso substitution.

**Extra reading/ Key words: Problems related to aromaticity and reaction mechanisms.**

**UNIT II –ADDITIONS TO CARBON-CARBON MULTIPLE BONDS** **15 Hrs**

- 2.1 Additions to carbon-carbon multiple bonds- addition reactions involving electrophiles- (Addition of H<sub>2</sub>, X<sub>2</sub>, HX, H<sub>2</sub>O, oxymercuration, epoxidation, ozonolysis), nucleophiles and free radicals. Cyclic mechanism, orientation and stereochemistry.
- 2.2 Addition to conjugated system – orientation and reactivity. Hydration of triple bonds. Addition of alcohols and phenols.
- 2.3 Birch reduction, Michael addition, Diels Alder reaction. Carbenes and their addition to double bonds, addition of O<sub>2</sub> across double bonds. Mannich, Stobbe, Darzen, Thrope, Wittig, Tollen's reactions, Benzoin condensation.

*Extra reading/ Key words: Stereo chemistry, Internal and terminal alkynes*

**UNIT III – REARRANGEMENTS AND REDOX REACTIONS** **15 Hrs**

- 3.1 Molecular Rearrangements: Mechanism of the following rearrangements – Wagner-Meerwin, Dienone- o Phenol, Demjanov ring expansion, Wolff, Beckmann , Baeyer-Villiger, Dakins, Favorski, Neber , Stevens, Wittig rearrangements. Stereochemical control of reaction products.
- 3.2. Oxidation: alkenes to epoxides (per acids based), Sharpless asymmetric epoxidation, alkenes to diols (Manganese and Osmium based), Sharpless asymmetric dihydroxylation, SeO<sub>2</sub>, PCC.
- 3.3 Reduction: Catalytic hydrogenation (Heterogeneous: palladium/Platinum/Rhodium/Nickel etc; Homogeneous: Wilkinson), LiAlH<sub>4</sub>, DIBAL.

*Extra reading/ Key words: Redox reactions in organometallic compounds*

**UNIT IV – RETROSYNTHETIC ANALYSIS** **15 Hrs**

- 4.1 Retrosynthetic Analysis – Basic principles and terminology of retrosynthesis, synthesis of aromatic compounds, one group and two group C-X disconnections (1, 2 difunctionalized disconnections – alcohols and carbonyl compounds) and C-C disconnection of 1, 3 difunctionalized compounds (dicarbonyl and  $\alpha$ ,  $\beta$  – unsaturated carbonyl compounds).
- 4.2 Protecting groups – Protection and deprotection of alcohols, aldehydes, ketones, phenols, amines in organic synthesis.
- 4.3 Modern Synthetic Methods: Nef reaction, Ritter reaction, Heck reaction, Stille, Suzuki, Negishi and Sonogashira coupling reactions.

*Extra reading/ Key words: Disconnection of 1,4 and 1,5 difunctionalized compounds.*

**UNIT V –HETEROCYCLICS, CARBOHYDRATES AND PROTEINS** **15 Hrs**

- 5.1 Nomenclature of alicyclic, bicyclic, spirocyclic compounds. Nomenclature of heterocyclic compounds. Chemistry of heterocyclic compounds – pyrimidine, purine, oxazine, imidazole, oxazole and thiazole.
- 5.2 Carbohydrates: disaccharides– Structure and synthesis of disaccharides-maltose, lactose. Polysaccharides-structure and synthesis of starch and cellulose.

5.3 Proteins: Synthesis and properties of peptides – primary, secondary and tertiary structure of proteins. Terminal analysis. Nucleic acids: Structure of DNA and RNA and their importance. Coding and Decoding.

*Extra reading/ Key words: Docking of proteins.*

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identify the aromaticity in organic compound and discuss the mechanism of substitution reactions in aromatic compounds.	3	Ap
CO-2	Explain the addition mechanism of reagents across carbon-carbon multiple bond.	2	Ap
CO-3	Illustrate the mechanism of the various rearrangement reactions	3	Ap
CO-4	Outline the applications of reducing and oxidizing reagents	1	An
CO-5	Design the target molecule based on retrosynthetic analysis	5	ap
CO-6	Compare ,contrast the structure of nucleic acids and Discuss the structure of proteins and carbohydrates	2	U
CO-7	Gain knowledge to teach important concepts in stereochemistry.	3	App

**BOOKS FOR REFERENCE**

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**(For Students admitted from June 2016 onwards)**  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – II**

<b>Course Title</b>	<b>MAIN CORE 8 - ORGANIC CHEMISTRY PRACTICALS –I</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH2MCP08</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVES:**

To acquire the practical skills in the qualitative analysis of organic mixture and to synthesize organic compounds.

**Course Objectives (CO):**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Identify the separation technique for the given organic mixture through pilot separation

CO-2	Isolate the components present in the given organic mixture
CO-3	Analyze the functional groups present in the components
CO-4	Understand the reactions mechanism of the organic complexes
CO-5	Synthesize and recrystallizes the organic complexes.

### I SINGLE STAGE PREPARATION:

- Microwave assisted synthesis of aspirin.
- Nitro salicylic acid from salicylic acid (nitration)
- Phenyl-azo-2-naphthol from aniline (diazotization)
- Preparation of Benzilic acid from benzyl
- Preparation of Xanthene compounds
- Hantz pyridine Synthesis

### II ORGANIC MIXTURE ANALYSIS

#### Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Diagnose the suitable separation technique	PSO4	An
CO-2	Analyze the given organic mixture	PSO5	An
CO-3	Identify the functional groups and elements present in the organic components	PSO3	U
CO-4	Synthesize the derivatives obtained from the pure organic component	PSO6	C
CO-5	Explain the principles of organic preparation	PSO2	U
CO-6	Acquire analytical skill to analyse the given organic compound qualitatively.	PSO3	Ap

**(For Students admitted from June 2016 onwards)**  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year – Semester II**

<b>Course Title</b>	<b>MAIN CORE 9 - ORGANIC CHEMISTRY PRACTICALS –II</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH2MCP09</b>

<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVES:**

To acquire the practical skills in the quantitative organic analysis and preparation.

**Course Objectives:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Prepare the organic compound through double stage
CO-2	Determine the amount of yield obtained
CO-3	Carryout crystallization and recrystallization
CO-4	Detect the melting point of the product obtained
CO-5	Estimate the given organic compound quantitatively

**ORGANIC ESTIMATION:**

1. Estimation of Glucose (Bertrand's Method)
2. Estimation of Phenol
3. Estimation of Aniline
4. Estimation of Acetone
5. Estimation of Glucose (Lane and Eynon Method)

**DOUBLE STAGE PREPARATION:**

1. Preparation of Acetylsalicylic Acid From Methylsalicylate (hydrolysis and acetylation)
2. Preparation of p-Bromoaniline From Acetanilide (acetylation and bromination)
3. Preparation of p-Acetanilide From Aniline ( nitration and hydrolysis)
4. Preparation of m-Nitroaniline From Nitrobenzene (nitration and reduction)
5. Preparation of p-Nitroaniline From Acetanilide (nitration and hydrolysis)
6. p-bromoaniline from acetanilide (bromination and hydrolysis)

**Course Outcomes:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	Characterize the products by physical means including melting point	PSO1	U
CO-2	Perform common laboratory techniques including preparation, crystallization and recrystallization	PSO2	An
CO-3	Critically evaluate data collected to determine the purity and yield of products	PSO2	An
CO-4	Predict the outcome of organic reactions using a basic understanding of the general reactivity	PSO3	An
CO-5	Describe the significance of organic quantitative analysis in organic estimation	PSO1	U
CO-6	Acquire skill to analyse organic compound quantitatively.	PSO3	Ap



(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**First Year - Semester – III**

<b>Course Title</b>	<b>Major Core 10–INORGANIC CHEMISTRY-II</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4</b>
<b>Code</b>	<b>P16CH3MCT10</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To learn about coordination chemistry, chemistry of organo-metallic compound, the photochemical reactions of transition complexes and to understand the applications of spectroscopic techniques in complexes.

**Course Objectives:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Understand and summarise the stability of complexes. Spectral and magnetic properties of complexes and nature of bonding in terms of VBT and MOT
CO-2	Analyse the electron transfer reactions of complex and macrocyclic ligands
CO-3	Understand the role of metal clusters in catalysis and categories the bonding in organometallic compounds
CO-4	Interpret the various spectroscopic techniques such as electronic absorption, NMR and IR spectroscopy.
CO-5	Apply the laws of photochemistry to transition metal complexes, organometallic compounds containing chromium and ruthenium

**UNIT: I****12 Hrs****CO-ORDINATION CHEMISTRY I**

- 1.1 Studies of coordination compounds in solution – detection of complex formation in solution - Stability constants, stepwise and over-all formation constants, simple methods (Potentiometric, pH metric and photometric methods) of determining the formation constants. Factors affecting stability, statistical and chelate effects, Forced configurations.
- 1.2 Crystal field theory - splitting of d-orbitals under various geometries, Factors affecting splitting, CFSE and evidences for CFSE (Structural and thermodynamic effects). Spectrochemical series, Jahn-Teller distortion, Spectral and magnetic properties of complexes, site preferences, limitations of CFT.
- 1.3 Ligand field theory, MO theory, sigma and pi-bonding in complexes, Nephelauxetic effect, the angular overlap model.

*Extra reading/Keywords: Application of complexes in electroplating, textile, dyeing and medicine*

**UNIT: II****12 Hrs****CO-ORDINATION CHEMISTRY II**

- 2.1 Kinetics and mechanism of reactions in solution – labile and inert complexes. Ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions, trans effect – theory and applications.
- 2.2 Electron transfer reactions – electron exchange reactions, complementary and non-complementary types, inner sphere and outer sphere processes. Application of Electron transfer reactions in inorganic - isomerisation and racemisation reactions of complexes
- 2.3 Molecular rearrangement – Reactions of four and six-coordinate complexes, Interconversion between stereoisomers. Reactions of coordinated ligands – Template effect and its application for the synthesis of Macrocyclic ligands, Unique properties.\

*Extra reading/Keywords: Synthesis of new complexes containing macrocyclic ligands*

**UNIT: III****12 Hrs****CHEMISTRY OF ORGANOMETALLIC COMPOUNDS**

- 3.1 Organometallic Compounds of Transition Metals-The 16 and 18 electron rule, Nomenclature of organometallic compounds, sandwich bonded complexes, I-cyclopentadiene metal complexes, bonding in organometallic compounds.
- 3.2 Heterocyclic sandwich complexes – Olefin complexes – preparation, structure and bonding in cyclic unsaturated compounds. Acetylene complexes, allyl metal complexes.
- 3.2 Catalysis by Organometallic Compounds - Catalysis involving organometallic compounds – olefin hydrogenation, the oxo process, polymerization, cyclooligomerisation, olefin isomerisation, Metathesis - metal clusters in catalysis.

*Extra reading/Keywords: Synthesis of new organo metallic compounds*

**UNIT : IV****12 Hrs****APPLICATIONS OF SPECTROSCOPIC TECHNIQUES IN COMPLEXES**

- 4.1 Electronic absorption spectroscopy – electronic states and spectra of octahedral and tetrahedral complexes of d-block metal ions, Orgel and Tanabe-Sugano diagrams, ligand field parameters from electronic spectra and the effect of distortion on the electronic states – spectra of Rubidium complex.
- 4.2 NMR spectroscopy – NMR of complexes and application of spin – spin coupling to structural elucidation, variable temperature, behaviour of fluxional molecules – NMR spectra of

quadrupole nuclei and paramagnetic complexes - contact and pseudo contact shifts and the applications.

- 4.3 IR spectroscopy - Differentiation of linkage isomers, changes in the spectra of donor molecules upon coordination of metal ions in inorganic complexes.

*Extra reading/Keywords: Structural elucidation of new compounds*

UNIT: V

12 Hrs

## PHOTOCHEMISTRY

- 5.1 Basic laws of Photochemistry- Photo physical processes, Photo chemical primary processes, rate constant and life time of reactive energy states, types of photochemical reactions, photo chemistry of transition metal complexes.
- 5.2 Photo redox, substitution and exchange reactions, light induced isomerisation, dissociation and linkage isomerisation reactions.
- 5.3 Photochemistry of organometallic compounds and Cr and Ru complexes.

*Extra reading/Keywords: Jablonski Diagram*

### Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recall the crystal field and molecular orbital theories.	PSO1	R&U
CO-2	Compare and contrast the inner and outer sphere mechanism of complexes.	PSO2	U
CO-3	Analyze the catalytic applications of organometallic compounds.	PSO4	An
CO-4	Interpret the structure of complexes using spectroscopic techniques.	PSO5	Ap
CO-5	Discuss the photochemistry of organometallic compounds.	PSO6	U&Ap
CO-5	Gain knowledge to teach about various Concepts of inorganic chemistry	PSO5	Ap

### BOOKS FOR REFERENCE

1. Cotton F.A. and Wilkinson. G. (1999). *Advanced Inorganic Chemistry*, (4<sup>th</sup> Ed.). London: John Wiley and Sons Inc.
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5. Drago, R.S. (1978). *Physical Methods in Inorganic Chemistry* ( 2<sup>nd</sup> ed.). New Delhi: East West student.
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(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second Year – Semester- III**

<b>Course Title</b>	<b>Chemistry Main Core Paper 11 - Physical Chemistry – III</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>4</b>
<b>Code</b>	<b>P16CH3MCT11</b>

<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>4</b>
<b>Marks</b>	<b>100</b>

**General Objectives:**

To learn ionics and electrode kinetics, understand the electroanalytical methods and statistical thermodynamics (both classical and quantum).

**Course Outcomes (CO):**

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	apply the theories in ionic, implement the concepts of solubility products and common ion effects, relate electrode-electrolyte equilibrium, concentration cells and explain electrochemical energy storage systems.
CO-2	execute the theories of electrode-electrolyte interfaces and kinetics of electrochemical reactions and implements the significance of over voltage and corrosion
CO-3	implement the principles, experimental set up and applications of electro analytical techniques.
CO-4	analyse and evaluate the possible states and particles and theories of heat capacity of solids
CO-5	analyse and evaluate the partition function, bosons, fermions and steady state conditions.

**UNIT: I**

**12 Hrs**

**IONICS**

- 1.1 Debye Huckel theory - Radius of ionic atmosphere, Calculations of thickness of ionic atmosphere, Evidences of ionic atmosphere. Asymmetry effect, Electrophoretic effect. DebyeFalkenhagen effect, Wien effect, Debye - Huckel Onsager equation – Modification and verification of the equation.
- 1.2 Debye - Huckel limiting law - Modification and verification. Finite ion size model, Huckel - Bronsted equation, Calculation of activity coefficient. Determination of ion size parameter, Solubility - solubility product of sparingly soluble salt, common ion effect, neutral salt effect and solubility.
- 1.3 Electrode – electrolyte equilibrium, electrode potential, Applications of concentration cells – liquid Junction potentials. Electrochemical energy storage systems – Primary and secondary batteries, Fuel cells.

*Extra reading/keywords: Experimental determination of solubility products, verifying Nernst equation*

**UNIT: II**

**12 Hrs**

**ELECTRODE KINETICS**

- 2.1 Theories of electrical double layer - Electric double layer at the electrode -electrolyte interface - Helmholtz model of double layer, Law of electro neutrality, Gouy-Chapman diffused charged model, Adsorption theory of double layer, Stern's model, triple-layer theory.
- 2.2 Electro kinetic phenomena – Classification - Electro osmosis, electrophoresis, streaming potential and sedimentation potential, Kinetics of electrode process - Equilibrium and non-equilibrium process, Concentration and activation polarization, Theory of electrochemical over potential - Derivation and verification of Butler - Volmer equation.
- 2.3 Tafel equation – Application of Tafel equation in corrosion process and Pourbaix diagram, Evans diagram. Hydrogen over potential - Mechanism of hydrogen evolution reactions, pH and metal deposition, Application of hydrogen over potential.  
*Extra reading/keywords: Bioelectrochemistry applying electrode-electrolyte interface*

### UNIT: III

12 Hrs

#### ELECTRO ANALYTICAL TECHNIQUES

- 3.1 Polarography - Experimental set up, Advantages of dropping mercury electrode Supporting electrolyte, Maxima suppressor, Residual current, Migration current, Diffusion current, Polarogram, half wave potential, Ilkovic equation (derivation is not required). Outline of applications (Polarogram of  $Zn^{2+}$  and  $Cd^{2+}$ )
- 3.2 Cyclic voltammetry - Principle, Experimental set up, Cyclic voltammogram of  $Fe^{2+}$  in  $H_2SO_4$ , Anodic peak current, Cathodic peak current, Electrochemically reversible couple, Cathodic and anodic peak potential, Electrochemically irreversible couple. Outline of applications
- 3.3 Amperometry - Principle of amperometric titration, Different types of current - voltage curves. Amperometric titration between  $Pb^{2+}$  and  $K_2Cr_2O_7$ -Electrogravimetry - Principle, Experimental set up, Separation of Cu and Ni  
*Extra reading/keywords: Hands - on training on instrumentations*

### UNIT: IV

12 Hrs

#### STATISTICAL THERMODYNAMICS

- 4.1 Statistical mechanics – Calculation of thermodynamic probability of a system Phase space, Ergodic hypothesis, Definition of micro and macro states – Different methods of counting macrostates. Distinguishable and indistinguishable particles .
- 4.2 Classical statistics – Derivation of Maxwell – Boltzmann distribution law, Relationship between entropy and probability
- 4.3 Limitations of classical statistics, Heat capacities of solids – Einstein and Debye's treatments.  
*Extra reading/keywords: Applications of Maxwell-Boltzmann distribution law*

### UNIT: V

12 Hrs

#### QUANTUM STATISTICS

- 5.1 Definition and calculation of partition functions – Partition function and thermodynamic properties. Applications of partition functions in calculating equilibrium constant, free energy functions, Sackur-Tetrode equation.
- 5.2 Bose-Einstein and Fermi-Dirac statistics – Comparison of them with Boltzmann statistics  
– Application of BE statistics to photon gas and super fluidity of liquid helium  
– Application of FD statistics to electron gas and thermionic emission.

5.3 Non-equilibrium thermodynamics of irreversible processes-Onsagar's reciprocal relations – Steady state conditions.

*Extra reading/keywords: Problems based on Bose-Einstein and Fermi-Dirac statistics*

### Course Outcomes

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	construct the fuel cells	PSO6	C
CO-2	Classify and explain the electrokinetic phenomenon	PSO2	U
Co-3	Apply Tafel equation in corrosion process	PSO4	Ap
CO-3	Sketch and interpret the cyclic voltagrams of redox systems	PSO3	Ap
CO-4	Illustrate the various methods for counting macro states.	PSO5	An
CO-5	Compare and contrast the Bose-Einstein and Fermi-Dirac statistics.	PSO2	U
CO-6	Explain Onsagar's reciprocal relations.	PSO1	U
CO-7	gain skill to interpret cyclic voltagrams	PSO4	Ap

### BOOKS FOR REFERENCE

- A.S. Negi & S.C. Anand (1994) "A Text book of Physical Chemistry", 3<sup>rd</sup> edition, Wiley Eastern Ltd.
- Samuel Glasstone, (2015) "An Introduction to Electrochemistry" McMillan India Ltd.,
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- Rajaram, J and Kuriacose, J.C. (2013). "Chemical Thermodynamics", Pearson
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- Crow, D.R. (1991) "Principles And Applications To Electrochemistry", Chapman And Hall.
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(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
Second year- III Semester

<b>Course Title</b>	<b>MAJOR ELECTIVE 1 - ORGANIC CHEMISTRY</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5</b>
<b>Code</b>	<b>P16CH3MET01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**General Objective:** To learn the different spectroscopic techniques - UV,IR, NMR and Mass spectrometry and organic photochemistry, pericyclic reactions and natural products.

**Course Objectives (CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	identify the basic principle and applications of UV and IR spectroscopic techniques.
CO-2	apply H <sup>1</sup> and C <sup>13</sup> NMR techniques to identify the structure of organic compounds.



CO-3	explain mass spectrometry, ORD and CD curves.
CO-4	elucidate the structure of alkaloids and terpenes and learn the synthesis of flavonoids
CO-5	describe the various types of photo chemical reactions and predict the type of pericyclic reactions.

### UNIT I -UV AND IR SPECTROSCOPY

15 Hrs

- 1.1 UV Spectroscopy: Introduction, Instrumentation-sampling techniques, factors affecting the position of UV bands. Woodward – Fieser rules – Alkenes, Conjugated Ketones, Esters, Carboxylic acids, Mono and Di substituted benzene derivatives. Study of Steric effects in Aromaticity.
- 1.2 Steric inhibition of resonance, differentiation of geometrical isomers and positional isomers. Conformational aspects in cyclic 1, 2 and 1, 3 – diols .Trans annular reactions in UV. Determination of reaction rates and mechanisms employing UV.
- 1.3 IR Spectroscopy: Instrumentation- Sample preparation, Interpretation of functional groups, Factors influencing group frequencies – both Internal and external, Study of Inter and Intra molecular hydrogen bonding, quantitative studies .Determination of reaction rates and mechanism IR.

*Extra reading/keywords: Spectral interpretation of unknown molecules using UV and IR.*

### UNIT II - NMR SPECTROSCOPY

15 Hrs

- 2.1  $H^1$ NMR Spectroscopy – Coupling Constant – First order and Second order splitting, spin – Spin splitting, dependence of 'j' on dihedral angle – vicinal and geminal coupling constant – Karplus equation, long range coupling constants, influence of Stereochemical factors on chemical shift of protons, chemical spin decoupling of rapidly exchangeable protons.
- 2.2 Simplification of complex spectra – deuteration, basification and acidification, solvent effects, trifluoro acetylation, Shift reagents, spin decoupling (homonuclear, heteronuclear, broad band off-resonance decoupling), spin tickling. 2D techniques (NOESY, COSY, ROSY).
- 2.3  $C^{13}$  NMR spectroscopy – Basic theory of FT-NMR – Relaxation times broad band coupling, off resonance decoupling, calculation of chemical shift and correlations. Applications of all the above techniques to structural elucidation of simple organic compounds.

*Extra reading/keywords: DEPT,  $N^{15}$ ,  $F^{19}$  and  $P^{31}$  NMR,*

### UNIT II - MASS SPECTROSCOPY, ORD AND CD

15 Hrs

- 3.1 Instrumentation-EI and CI methods and Resolution. Base peak, Parent peak, Fragment peak, Isotopic Peak Meta stable Peak- Uses of metastable peaks. Recognition of parent peak, Determination and use of molecular formula- index of hydrogen deficiency, Nitrogen rule, rule of 13.
- 3.2 Fragmentation – General rules- McLafferty rearrangement, Retro Diels-Alder reactions – factors governing the fragmentation of various classes of organic compounds – saturated hydrocarbons, unsaturated hydrocarbons, Halogen compounds, Hydroxy compounds, Ethers,

Thioethers, Aldehydes and Ketones, Carboxylic acids, esters, lactones, Amides, Amines and Nitro compounds.

- 3.3 Optical rotatory dispersion- Introduction, Plain curves, Rotatory Dispersion of Ketones – Axial haloketone rule, Octant rule and their applications to simple decalin system

*Extra reading/keywords: GC-MS, LC-MS, ICP-MS and ESI*

#### UNIT IV - CHEMISTRY OF NATURAL PRODUCTS

15 Hrs

- 4.1 Alkaloids : Introduction, structural elucidation of quinine, reserpene and morphine. Steroids – structural elucidation of cholesterol, esterone, progesterone.
- 4.2 Flavonoids: Synthesis of flavones, flavonal. Isoflavone- Synthesis of diadzein. Anthocyanidin-chemistry of cyanidine.
- 4.3 Terpenes : Introduction, structural elucidation of  $\alpha$  - pinene, camphor, and zingiberene.

*Extra reading/keywords: Phytochemical Analysis of natural products*

#### UNIT V -ORGANIC PHOTOCHEMISTRY AND PERICYCLIC REACTIONS

15 Hrs

- 5.1 Organic Photo Chemistry: Photochemical energy – Jablonski diagram – Singlet and triplet states, dissipation of photochemical energy. Photosensitization- quenching, quantum efficiency and quantum yield. Photochemistry of carbonyl compounds –  $n-\pi^*$  and  $\pi-\pi^*$  transitions.
- 5.2 Norrish type I and type II cleavages – Photolysis of ketones- Paterno - Buchi reactions, photo oxidation, photo reduction, photocycloaddition reaction, rearrangements of alpha, beta unsaturated ketones and cyclohexadienones. Photochemistry of olefins- photoisomerization. Photochemistry of compounds containing nitrogen – Barton reaction.
- 5.3 Pericyclic Reactions: Molecular orbital symmetry – Frontier orbital of ethylene, 1,3-butadiene, 1,3,5 – hexatriene system. FMO approach, Woodward Hoffmann correlation diagram, PMO approach for explaining thermal and photo chemical reaction. Electrocyclic reactions – Conrotatory and disrotatory motions ( $4n$ ) and ( $4n+2$ ) systems. cyclo addition reactions - notation of cyclo addition ( $4n$ ) and ( $4n+2$ ) additions - 1, 3 – dipolar cyclo – additions and cheletropic reactions . Sigmatropic rearrangements – Cope and Claisen rearrangements.

*Extra reading/keywords: Problems in photochemistry and pericyclic reactions.*

#### Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Interpret the given UV and IR spectra and deduce the structure of the compound.	PSO 2	An

CO-2	Discuss the factors affecting the chemical shift.	PSO 1	K
CO-3	Explain the 2D techniques in NMR.	PSO 1	U
CO-4	Outline the fragmentation patterns for organic compounds using mass spectrometry.	PSO 2	Ap
CO-5	Generate the structure of alkaloids.	PSO 2	Ap
CO-6	Distinguish Norrish type I and type II reactions.	PSO 3	U
CO-7	Discuss the FMO approach for dienes and trienes.	PSO 1	U
CO-8	Acquire skill to interpret all spectroscopic data.	PSO 2	Ap

### BOOKS FOR REFERENCE

1. Gurdeep Chatwal, (1996). *Chemistry of Natural Products Vol. I & II*. (1<sup>st</sup> Ed.). Bombay: Himalaya.
2. Sharma, Y.R. (2007). *Elementary Organic Spectroscopy*. (4<sup>th</sup> Ed.). New Delhi: S.Chand.
3. Bassler, Morrill and Silver Stein, (1981). *Spectrometric Identification of Organic Compounds*. (4<sup>th</sup> Ed.). New York: John Wiley.
4. Cotton and Halton, (1974). *Organic Photochemistry*. U.K: Cambridge University Press.
5. Gurdeep R. Chatwal (2004). *Organic Chemistry of Natural Products, Vol.I & II*. Meerut: Goel Publications.
6. William Kemp, (1987). *Organic Spectroscopy*. (2<sup>nd</sup> Ed.). New Delhi: ELBS.
7. Agarwal, O.P. (1997). *Chemistry of Organic natural products, Vol.I & II*. Meerut: Goel Publications.
8. Jag Mohan (2005). *Organic spectroscopy- Principles and Applications*, 2<sup>nd</sup> Edn., Narosa publishing house Pvt. Ltd., New Delhi.
9. Ahluwalia -V. K. (2005), *Organic Reaction Mechanisms*, 4<sup>th</sup> Edn., Narosa publishing house Pvt. Ltd., New Delhi.
10. Fleming, *Pericyclic Reactions*, Oxford University Press, Oxford, 1999.

(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second Year – Semester- III**

<b>Course Title</b>	<b>NON-MAJOR ELECTIVE – 1: FOOD SCIENCE</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5</b>
<b>Code</b>	<b>P16CH2NMT01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To learn about functions of food, therapeutic nutrition, food additives, various cooking methods, food preservations, adulterations and food sanitation.

**Course Objectives:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	appraise the functions, sources, deficiency diseases, daily allowances of major nutrients and summarize the various techniques of food preparation and recommend steps to retain the nutritive value
CO-2	understand and analyse the nutritive value of food , meal planning and nutritive value
CO-3	understand the effects of the natural and metallic food toxicants and food toxicants
CO-4	understand, apply and analyse the food preservation and adulteration techniques.
CO-5	understand the poisoning of food by microbes, insects rodents , various modern food technologies such as biofortication, nutraceuticals and food packing

**UNIT: I**

**15Hrs**

**FOOD SCIENCE**

- 1.1 Terminology, Food groups, Functions of Food, Food in relation to health.
- 1.2 Cooking – Objectives of Cooking, Preliminary preparations and cooking methods – Moist heat methods, dry heat methods, Microwave cooking and solar cooking-Puffing and germination .

- 1.3 Effect of different methods of cooking on nutritive value - Carbohydrates, proteins, fats, minerals, vitamins pigments, flavour components, Retention of nutritive value during preparation.

*Extra reading/Keywords: Harmful effects of junk foods*

**UNIT: II**

**15Hrs**

**NUTRITIVE VALUES OF FOOD GROUPS AND MEAL PLANNING**

- 2.1 Nutritive values of food: Cereals and cereal product, pulses, nuts and oilseeds, milk and milk products, flesh foods, vegetables and fruits, sugar products and fats and oils.
- 2.2 Meal planning: Meal planning for various age groups – Infant nutrition, Nutrition of weaned infants, pre-school children, school children, adolescents, expectant and nursing mothers, geriatric nutrition and obesity.
- 2.3 Therapeutic nutrition- special feeding methods, Diets during anaemia, blood pressure, diabetes, fever and jaundice.

*Extra reading/Keywords: Nutrition and Dietetics followed by heart patients*

**UNIT: III**

**15Hrs**

**CHEMICAL POISONS IN FOOD**

- 3.1 Sources of Chemical poisons in food, Natural Organic Toxicants in foods, Toxic factors present in food stuffs – Kesari dhal, mushroom, drumsticks, soybeans, fish, Spices and condiments, cabbage, tea leaves. Toxic minerals and metals —lead, mercury and cadmium.
- 3.2 Food additives – classification of food additives- functions and uses of food additives.

*Extra reading/Keywords: Carcinogenic effects of food additives*

**UNIT: IV**

**15Hrs**

**FOOD PRESERVATION AND ADULTERATION:**

- 4.1 Food preservation - Principles and methods, importance of food preservation, Various methods of food preservation- Use of high temperature, low temperature, drying, radiation, Browning reactions – Reasons and preventions.
- 4.2 Food adulteration – Definition, Common adulterants in food and their ill-effects, Intentional adulterants and incidental adulterants. Simple physical and chemical tests for detection of food adulterants.

*Extra reading/Keywords: Detection of adulterants in food*

**UNIT: V**

**15Hrs**

**FOOD SANITATION AND FOOD TECHNOLOGY:**

- 5.1 Practical rules for good sanitation of food.
- 5.2 Food poisoning by micro organisms, insects and rodents- prevention and its Control.
- 5.3 Food technology- Bio-technology in food, Biofortification, Nutraceuticals, low cost nutrient supplements, packaging of foods.

*Extra reading/Keywords: Phytonutrients present in Herbal drinks*

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Summarize the various cooking methods and its effects.	PSO 1	U
CO-2	List the important nutrients of healthy diet	PSO 3	U
CO-3	Outline the meal planning for various age groups	PSO 1	An
CO-4	Prepare a diet chart for hypertension and diabetes	PSO 2	Ap
CO-5	Categorize the various food additives and its functions	PSO 3	Ap
CO-6	Explain the different food preservation techniques	PSO 4	U
CO-7	Evaluate the adulterants present in food	PSO 5	An
CO-8	Discuss the modern concepts of biofortification and nutraceuticals	PSO 5	U
CO-9	Gain knowledge to give awareness about food and nutrition.	PSO 3	Ap

### BOOKS FOR REFERENCE

1. Thankamma Jacob, (1979) A Text Book of Applied Chemistry for Home science and Allied Science, 1st edn., Macmillan company of India Limited.
2. Srilakshmi .B (2003) Reprint "Food Science" 3<sup>rd</sup> edition New Age Internation (P) Ltd., New Delhi.
3. Lillian Hoagland Meyer, (2004) Food Chemistry, 1st edn., CBS Publishers, New Delhi.
4. Mahindru S. N. (2004), Food Safety – Concept and Reality, 1st edn., APH Publishers.
5. Sumathi R, Mudambi, M.V, Rajagopal M.V, Fundamentals of Food and Nutrition 3rd edn., Wiley Eastern Ltd.
6. Swaminathan M., (1982), Handbook of Food and Nutrition, 2nd edition, Bappco Publications.
7. Andrew Schloss and David Joachim with A. Philip Handel,(2009).The Science of Good Food (Paper Back). Oriented Paper Backs.
8. Sharma Avantina, (2010) A Text book of Food Science and Technology, International Book Distribution Company.

**(For Students admitted from June 2016 onwards)**  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>Major Core 13 - Physical Chemistry Practical– II</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH3MCP13</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>3</b>

<b>Marks</b>	<b>100</b>
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**GENERAL OBJECTIVES:**

To acquire the practical skills in handling the instruments like conductometry and potentiometry.

**Course Objectives (CO):**

CO No.	Course Objectives
CO-1	State the principles of conductometry and potentiometry
CO-2	Relate the theoretical and experimental aspects of conductometry and potentiometry
CO-3	Demonstrate the experimental procedures.
CO-4	Analyze the conductance and potential for the given unknown solution
CO-5	Evaluate the conductance and potential graphically.

**CONDUCTIVITY METHOD**

1. Precipitation titration
2. Mixture of acids against alkali
3. Strength of Buffer mixture
4. Mixture of halides against silver nitrate

**POTENTIOMETRIC METHOD**

1. Mixture of halides against silver nitrate
- 2a. Standard single electrode potential of copper and zinc
- 2b. Solubility product of silver chloride
3. Mixture of acids against alkali

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level



CO-1	Understand the theoretical concepts of physical experiments	PSO1	U
CO-2	Execute the conductometric and potentiometric titration.	PSO4	Ap
CO-3	Predict the end point through volumetric method	PSO3	E
CO-4	Draw and relate the end point through graphical method	PSO4	An
CO-5	Evaluate the solubility product of silver chloride	PSO5	E
CO-6	Gain knowledge to analyse the given sample.	PSO5	Ap

(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>Major Core 12 - Physical Chemistry Practical - I</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH3MCP12</b>
<b>Course Type</b>	<b>Practical</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

**GENERAL OBJECTIVES:**

To provide the knowledge and acquire the practical skills on non- electricals experiments

**Course Objectives (CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	List the principles of kinetics and phase diagram.
CO-2	Relate the theoretical and experimental aspects of kinetics experiments
CO-3	Demonstrate the experimental procedures.
CO-4	Identify the end points at constant time intervals
CO-5	Evaluate the data graphically.

1. Verification of Freundlich isotherm
2. Comparison of acid strengths – ester hydrolysis
3. Phase diagram of one component system
4. Phase diagram of three component system
5. Association factor of benzoic acid

6. Determination of Arrhenius parameters
7. Iodination of acetone
8. Study of reaction between KI and  $K_2S_2O_8$

**Course Outcomes:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Outcomes</b>	<b>PSOs Addressed</b>	<b>Cognitive Level</b>
CO-1	Understand the theoretical concepts of non- electrical experiments	PSO1	U
CO-2	Construct the phase diagram for one component and three component systems	PSO5	C
CO-3	Predict the end point through volumetric method	PSO3	E
CO-4	Determine the Arrhenius parameters.	PSO5	An
CO-5	Draw and relate the end point through graphical method	PSO4	An
CO-6	Acquire the practical skills to analyse the given sample using non electrical practical techniques.	PSO5	Ap

**(For Students admitted from June 2016 onwards)**  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second Year - Semester – III**

<b>Course Title</b>	<b>Non-Major Elective 2 – Chemistry In Everyday Life</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>5</b>
<b>Code</b>	<b>P16CH3NMT02</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>3</b>
<b>Marks</b>	<b>100</b>

**General objective:**

To enable the students to learn about common drugs, drug Preparation, metals, corrosion of metals, polymers, rubber and chemical food poisons.

**Course Objectives:**

The learner will be able to

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Classify the different types of drugs, understand the reactivity of analgesics and analyse the adverse reaction of drugs.

CO-2	Summarize the properties, behaviour and application of various metals.
CO-3	Discuss the prevention and Control of Corrosion
CO-4	Classify and elaborates the preparation, properties and uses of natural and synthetic polymers.
CO-5	Identify the sources of Chemical poisons in food; classify the toxic minerals and metals in food and Food Standard.

**Unit-I: 15 hrs**

**COMMON DRUGS AND MEDICINES**

Drug-classification, antibiotics - Applications of Penicillin, streptomycin, chloramphenicol, tetracyclins. Analgesics – Types, narcotic analgesic – morphine, apomorphine –Structure and uses. non-narcotic analgesics – aspirin, paracetamol, analgin–Structure and uses. Burn Preparation- Chemical burn, Sun burn. Drugs in Combination, Prevention and Control of adverse reaction from drugs.

*Extra reading/keywords: Pharmaceutical Industrial Applications*

**Unit-II: 15 hrs**

**METALS IN THE SERVICE OF MAN**

Metals: properties – physical, mechanical, metal structure and properties. corrosion of metals- atmospheric corrosion, electrochemical corrosion. Metals commonly used in homes- iron, copper, aluminium, nickel, tin, lead, titanium, zinc and their alloys. Metals for electronics - tungsten, selenium and germanium. Precious metals - silver, gold and platinum.

*Extra reading/keywords: Metals used in Industries*

**Unit-III: 15 hrs**

**CORROSION PREVENTION AND CARE OF METALS**

Prevention and control of corrosion- material selection, use of corrosion resistant alloys, use of protective coatings and linings, cathodic protection, elimination of corrosive agents. Care of household metals. Metal polishes – functions, composition and mode of action of polish, general rules for cleaning and polishes. Cleaning of aluminium metals, silverware, gold, copper and brasswares.

*Extra reading/keywords: Applications of metals in day today life.*

**Unit-IV: 15 hrs**

**POLYMERS AND RUBBER**

Polymers - General properties and classification. Preparation, properties and uses of PVC, Teflon and polythene. Rubber - origin and chemical nature of natural rubber, vulcanized rubber and its properties. Synthetic rubbers - neoprene rubber, Styrene Butadiene rubber [SBR] and polyurethane – structure, properties and uses.

*Extra reading/keywords: Prepare a chart of polymers used in our daily life*

**Unit-V: 15 hrs**

**CHEMICAL POISONS IN FOOD**

Sources of chemical poisons in food, toxic minerals and metals- fluoride, nitrate and selenium, natural organic toxicant in food- solanine, gossypol, oxalic acid and erucic acid, toxins in soyabean, spices , flavouring agents and fish, toxins in food from other sources, mercury, cadmium, tin and pesticide residues, food additives(polychlorinated biphenyls, N-nitroso compounds), contaminants of fats and oils. Food standards.

**Extra reading/keywords:Methods of Detecting Food Poison**

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discuss the applications of antibiotics and analgesics	PSO1	R&U
CO-2	Describe the physical,chemical properties of metals and the applications of metals used in homes	PSO2	Ap
CO-3	Narrate the steps involved in prevention of corrosion in metals.	PSO4	An
CO-4	Distinguish natural and synthetic rubber.	PSO2	R&U
CO-5	Identify the chemical poisons present in flavouring agents and food additives	PSO6	U&Ap
CO-6	Gain knowledge to teach safety measures in daily life	PSO6	U&Ap

**BOOKS FOR REFERENCE**

1. A Thankamma Jacob (1979), '*A text book of applied chemistry*, 1<sup>st</sup> edition, McMillan India Ltd.,
2. Jayashree Gosh (2006), '*Fundamental concept of applied chemistry*' 1<sup>st</sup> edition, S. Chand Company Ltd.,  
New Delhi.
3. B.K. Sharma (1995) '*Industrial Chemistry*'Goel Publishing House, Meerut.

**(For Students admitted from June 2016 onwards)**  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**

<b>Course Title</b>	<b>Major Core Paper 14 - Inorganic Chemistry- III</b>
<b>Total Hours</b>	<b>90</b>

<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH4MCT14</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>6</b>
<b>Marks</b>	<b>100</b>

**Second Year – Semester- IV**

**General Objective:**

To learn the error analysis and chromatography, instrumentation of different Spectroscopic techniques, diffraction techniques and Bio- inorganic Chemistry.

**Course Objectives:**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	Categorize the chromatographic techniques and error analysis
CO-2	demonstrate the instrumentation of spectroscopic techniques and analyze the Mossbauer and ESR spectra.
CO-3	Explain the principle and instrumentation of nephelometry, turbidimetry, fluorometry, XRD and execute their applications
CO-4	Understand and analyse the various nuclear reactions and application of different radioactive elements in medicine
CO-5	Analyze the interaction of metal ions with biological systems and illustrate the structure and functions of electron transfer proteins

**UNIT: I**

**18Hrs**

**ERROR ANALYSIS AND CHROMATOGRAPHIC TECHNIQUES:**

- 1.1 Significant figures and their importance in calculations - precision and accuracy - determinate and indeterminate errors - measures of precision, statistical concepts - standard or normal error curve and its features - reliability of mean values .
- 1.2 Confidence limits -distribution and confidence levels -Regression - distribution of data of a linear curve-method of propagation of errors. t values for various probability levels and varying, degrees of freedom, Rejection of result, F Tests, Regression and correlation.
- 1.3 Principle of chromatography, retardation factor, classification of chromatographic techniques. Partition chromatography and Thin layer chromatography: Principle, advantages, preparation of TLC plates, development of chromatogram. HPLC - instrumentation, procedure and applications, GC-MS – Instrumentation, technique and application.

*Extra reading/keywords: Interpretation of chromatogram*

**UNIT: II**

**18Hrs**

## **INSTRUMENTATION OF SPECTROSCOPIC TECHNIQUES AND MOSSBAUER SPECTROSCOPY:**

- 2.1 Instrumentation of Atomic absorption spectroscopy, Photoelectron spectroscopy, Nuclear Magnetic spectroscopy, Electron spin resonance spectroscopy, Mossbauer spectroscopy, UV visible spectroscopy, Infrared spectroscopy.
- 2.2 Mossbauer spectroscopy: Mossbauer transition, Doppler effect, isomer shifts, Quadrupole interactions, Effect of magnetic field on spectra, Electronic structure and geometry of complexes, Magnetic interaction and its applications.
- 2.3 EPR spectroscopy – Zero field splitting, Kramer's degeneracy, Isotropic and anisotropic g value and the structure. Application of EPR to simple and polymeric inorganic complexes and few biological molecules containing Cu(II) and Fe(III) ions

*Extra reading/keywords: Hands on training on instruments*

### **UNIT: III**

**18Hrs**

#### **OPTICAL METHODS AND DIFFRACTION STUDIES:**

- 3.1 Nephelometric and Turbidimetric methods - Introduction, Principle, Instrumentation, Analytical applications. Fluorometric and Phosphorimetric method of analysis –Introduction, Instrumentation, fluorometry, computation of results, Application Of fluorometry, Instrumentation of phosphorimetry, Application of Phosphorimetry.
- 3.2 X-ray diffraction – crystal structure, Bragg's equation – intensities of reflection, experimental methods, Laue photographic method, rotating crystal method, powder method, identification of powder diffraction pattern – Applications.
- 3.3 Neutron diffraction: Application and comparison with X-ray diffraction. Electron diffraction – Basic principles and application to simple molecules.

*Extra reading/keywords: Interpretation of the structure of new crystalline compounds*

### **UNIT: IV**

**18Hrs**

#### **NUCLEAR CHEMISTRY:**

- 4.1. Nuclear reaction - Q value, Coulomb barrier, nuclear cross section, threshold energy and excitation function. Proportional counters, Geiger-Muller counter. Accelerators - linear, cyclotron, synchrotron, betatron and bevatron.
- 4.2. Applications of isotopes, neutron activation analysis, isotopic dilution analysis, uses of tracers in structural and mechanistic studies, agriculture, medicine and - Dating of objects- hot atom chemistry.
- 4.3 Metals in medicine- therapeutic applications of cis-platin, radio-isotopes (E.g.: Tc & I<sub>2</sub>) MRI agents and contrasting agents.

*Extra reading/keywords: Radiopharmaceutical applications*

### **UNIT: V**

**18HRS**

#### **BIO-INORGANIC CHEMISTRY:**

- 5.1 Transition elements in biology- their occurrence and function, active-site structure and function of metalloproteins and metalloenzymes with various transition metal ions and ligand system. O<sub>2</sub> binding properties heme (haemoglobin and myoglobin and non-heme proteins hemocyanin & hemerythrin), their coordination geometry and electronic structure, co-operativity effect, Hill coefficient and Bohr Effect.



- 5.2 Electron transfer proteins - active site structure and functions of ferredoxin, rubridoxin and cytochromes, and their comparisons. Vitamin B<sub>12</sub> and cytochrome P<sub>450</sub> and their mechanisms of action.
- 5.3 Metal ion interaction with nucleic acids, metal ions and DNA functions - replication, transcription and translation. Blue copper proteins. Metal based drugs - Nitrogen Fixation- in vivo & in vitro.

**Extra reading/keywords: Biomineralisation**

**Course Outcomes:**

**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Solve the experiments with precision and accuracy.	PSO5	An
CO-2	Analyze the given unknown sample using HPLC technique	PSO6	An
CO-3	Compare and contrast UV and IR spectroscopic techniques.	PSO2	U
CO-4	Interpret Mossbauer spectra of inorganic complexes	PSO3	Ap
CO-5	Diagnose the structure of given crystal using X-ray diffraction	PSO4	An
CO-6	Categorize the therapeutic applications of radio isotopes	PSO1	U
CO-7	Explain the invivo and invitro process of nitrogen fixation.	PSO1	U
CO-8	Relate the functions of oxy hemoglobin and deoxy hemoglobin	PSO1	U
CO-9	Develop knowledge about various Concepts in inorganic chemistry	PSO3	Ap

**BOOKS FOR REFERENCE**

1. Kudesia Sawhney, (2009). *Instrumental Methods of Chemical Analysis*. (1<sup>st</sup> Ed.). New Delhi: Gyan Books Pvt Ltd.
2. Srivastava .A.K & P.C. Jain. (1997). *Chemical Analysis - An instrumental approach*. (2<sup>nd</sup> Ed.). New Delhi: S. Chand and Company.
3. Eichron, G.L. (1975). *Inorganic Biochemistry*. (5<sup>th</sup> Ed.). New York: Elsevier Publications.
4. Addison, W.E. (1961). *Structural Principles of inorganic compounds*. (2<sup>nd</sup> Ed.). London: Longmans

Publications.

5. Huheey, J.E. (1972). *Inorganic Chemistry*. (2<sup>nd</sup> Ed.). New York: Harper & Row publishers, Lee J. D.  
(1998). *Concise Inorganic Chemistry* (6<sup>th</sup> Ed.). London: ELBS.
6. Huheey, J.H. (2002). *Inorganic Chemistry*, (4<sup>th</sup> Ed.). London : Pearson Education Pvt., Ltd.
7. D.F. Shriver, P.W. Atkins, C.H. Langford, 3<sup>rd</sup> Edn. *Inorganic Chemistry*, ELBS. 1999.
8. Glasstone, *Source book of Atomic Energy*, 3<sup>rd</sup> Edn., ELBS, 1986.

**(For Students admitted from June 2016 onwards)**  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second year- IV Semester**

<b>Course Title</b>	<b>MAJOR ELECTIVE 2 - Physical Chemistry</b>
<b>Total Hours</b>	<b>90</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH3MET02</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**General Objective:** To understand the concepts of photochemistry and radiation chemistry, homogeneous catalysis, surface chemistry and polymer chemistry .

**Course Objectives (CO):**

**The learner will be able to**

CO No.	Course Objectives
CO-1	describe photophysical and photochemical processes and mechanisms and execute the established experimental methods for the investigation of these processes.
CO-2	understand the basic concepts of radiation chemistry and explains the interaction of radiation with matter.
CO-3	examine the mechanisms of catalysis and investigates the fast reaction techniques
CO-4	classify adsorption, implement adsorption theories, heterogeneous catalysis.
CO-5	classify the polymers, execute the polymerisation mechanisms and techniques and molecular weights of polymers

### UNIT: I

18 Hrs

#### PHOTOCHEMISTRY

- 1.1 Laws of photochemistry, Photophysical process in electronically excited molecules- Jablonski diagram, Wigner's spin conservation rule, Stern – Volmer equation and its applications , experimental techniques in photochemistry – chemical actinometers
- 1.2 Photochemical Kinetics – Reactions which do not involve chains – Dissociation of HI ,Reactions which involve chains – Distinguishing features,H<sub>2</sub>- Cl<sub>2</sub> reaction, Photolysis of acetaldehyde, Photochemical equilibrium.
- 1.3 Laser and their applications, Elementary aspects of photosynthesis, photochemical conversion and storage of solar energy.

*Extra reading/Keywords:Problems in quantum yields, Photochemical applications in biomedical and industrial fields*

### UNIT: II

18 Hrs

#### RADIATION CHEMISTRY

- 2.1 Difference between radiation chemistry and photochemistry, sources of high energy radiation, interaction of high energy radiation with matter.
- 2.2 Radiolysis of water, Hydrated electrons. Units of radiation energy – G value, Rad, Gray, RBE, Rontgen, Rem and Sievert. Linear energy transfer (LET)- Scavenging techniques , use of dosimetry in radiation chemistry.
- 2.3 Applications of nuclear radiations – radiation sterilization, radiation energy for chemical synthesis, radioisotopes as a source of electricity.

*Extra reading/Keywords:Aqueous radiation chemistry*

### UNIT: III

18 Hrs

## HOMOGENEOUS CATALYSIS

- 3.1 Mechanisms of catalysis, Equilibrium treatment, Steady – State treatment, Activation energies of catalysed reactions, Acid – base catalysis and its Mechanism, rate law derivation. Arrhenius vant'Hoff intertmediate, Hammett's acidity function, Bronsted relation, Salt effects in acid – base catalysis, Enzyme catalysis – Michaelis – Menten law, Lineweaver burk and Eadie Hofs-tee plots, Influence of pH, concentration and temperature.
- 3.2 Fast reaction techniques – introduction, relaxation methods – T and P Jump methods, Large perturbation methods, flash photolysis, Shock wave technique, pulse radiolysis, reactions in Crossed molecular beams.

*Extra reading/Keywords: Application of fast reaction techniques*

## UNIT: IV

18 Hrs

### SURFACE CHEMISTRY AND HETEROGENEOUS CATALYSIS

- 4.1 Surface phenomenon-physical and chemical adsorption, Adsorption and free energy relation at interfaces, Gibbs adsorption Isotherm – Surface excess, Gibbs monolayers Soluble and insoluble Films, solid-liquid interface, Contact angle and wetting, Solid-Gas Interface, physisorption and chemisorptions. Freundlich, Langmuir, BET isotherms, Heats of adsorption.
- 4.2 Heterogeneous catalysis-: Role of surface in catalysis, Kinetics and Mechanism of heterogenous catalysis, Langmuir-Hinselwood, Langmuir-Rideal model.
- 4.3 Eletrophoresis, Electro-osmosis – principles and applications, micelle and reverse micelle, micro emulsions.

*Extra reading/Keywords: Experimental verification of adsorption isotherms*

## UNIT: V

18 Hrs

### POLYMER CHEMISTRY

- 5.1 Introduction, classification, structure-size and shape of polymers.
- 5.2 Polymerisation reactions – Kinetic aspects of ionic and free radical chain Reactions, Copolymerisation, polymerization methods-Bulk, solution, suspension and emulsion.
- 5.3 Determination of molecular weight-Number average molecular weight of Polymers, molecular weight by cryoscopy, ebullioscopy, osmotic pressure Method. Average molecular weight determination-Light scattering method- using ultracentrifugation by sedimentation equipment, sedimentation velocity.

*Extra reading/Keywords: Polymer synthesis and characterization, thermal and visco-elastic properties of polymers*

## Course Outcomes

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Evaluate the significance of LASER	PSO4	An
CO-2	Compare and contrast photochemistry and radiation chemistry	PSO4	An
CO-3	Interpret the applications nuclear radiations	PSO2	U
CO-4	Describe the fast reaction techniques	PSO1	Ap
CO-5	Discuss the applications of electrophoresis and electroosmosis	PSO2	An
CO-6	Determine the molecular weights of polymers using number average and weight average methods.	PSO4	An
CO-6	Develop knowledge to explain some important topics in physical chemistry	PSO4	Ap

#### BOOKS FOR REFERENCE

1. Atkins, P.W., and J.de Paula and James Keeler (2014), "Physical Chemistry", 10<sup>th</sup> edn., Oxford University Press.
2. Gordon M Barrow (2007 ) "Physical Chemistry" , 5<sup>th</sup> edn., Tata Mc Graw Hil Publishing Ltd.,
3. Rohatgi Mukherjee, (1986). Fundamentals of Photo chemistry, Wiley Eastern Ltd.
4. Samuel Glasstone D.Sc., Ph.D., (1974) "Text Book of physical Chemistry", 2<sup>nd</sup> edition.
5. Bhajpai, D.N., (2001).Advanced Physical Chemistry (2<sup>nd</sup> Ed.) S. Chand Ltd.,
6. Bond, G.C., (1987). Heterogenous catalysis – Principles and Applications. Oxford: Oxford Science Publications, Clarendon Press.
7. Billmeyer F.W., (1984). A Text Book of polymer Science, 3<sup>rd</sup> Ed.. London: John Wiley
8. Prasad P.N., (1994), "Frontiers of Polymers and Advanced Materials", Plenum

(For Students admitted from June 2016 onwards)  
**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second Year- IV Semester**

<b>Course Title</b>	<b>MAJOR ELECTIVE-3 - Green and Nano Chemistry</b>
<b>Total Hours</b>	<b>75</b>
<b>Hours/Week</b>	<b>6</b>
<b>Code</b>	<b>P16CH4MET03</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>5</b>
<b>Marks</b>	<b>100</b>

**General Objective:**

To learn the basic principles of green chemistry, microwave induced reactions and reactions carried out by ionic liquids. To know about nanoparticles, Fullerenes, Carbon nanotubes and colloidal gold.

**Course Objectives (CO):**

**The learner will be able to**

<b>CO No.</b>	<b>Course Objectives</b>
CO-1	understand the principles of green chemistry and apply the different green chemistry constituents in organic synthesis.
CO-2	understand the microwave and ultrasound mediated synthesis and applies them to various organic reactions.
CO-3	apply and analyse the green techniques in various organic synthesis.
CO-4	understand the synthesis of nanoparticles and analyze the various characterization techniques involved in nanotechnology.
CO-5	understand and apply the concepts of carbon nanotubes and colloidal gold and analyze their applications in structural, electromagnetic, chemical and mechanical aspects.

**UNIT: I**  
**GREEN CHEMISTRY**

**15 Hrs**

Introduction to green chemistry, Green chemistry - relevance and goals, Anasta's twelve principles of green chemistry, tools of green chemistry, alternative starting materials. Reagents - dimethyl carbonate, polymer supported reagents, polymer supported peracids, PNBS. Catalysts-acid, oxidation, basic, polymer supported phase transfer catalyst. Solvents and processes with suitable examples - aqueous phase reactions, reactions in ionic liquid, organic synthesis in solid state, solid supported organic synthesis.

**Extra Reading/ Keywords:** *Applications of green chemistry principles*

**UNIT: II** **15 Hrs**

**MICROWAVE MEDIATED AND ULTRASOUND ASSISTED ORGANIC SYNTHESSES**

Microwave activation – advantage of microwave exposure, specific effects of microwave. Neat reactions – Solid supports reactions - deacetylation, deprotection, saponification of ester, reduction, functional group transformations, condensations reactions, oxidations-reduction reactions, Multi-component reactions.

Ultrasound Assisted Green Synthesis– Introduction, Applications of Ultra Sound- Esterification, Saponification, Substitution and Addition reactions.

**Extra Reading/ Keywords:** *Comparison of Microwave synthesis Vs sonochemical synthesis*

**UNIT: III** **15 Hrs**

**IONIC LIQUIDS AND PTC**

Synthesis of ionic liquids, physical properties, applications in alkylation, hydroformylations, epoxidations, synthesis of ethers, Friedel-Crafts reactions, Diels-Alder reactions, Knoevenagel condensations, Wittig reactions. Phase transfer catalyst - Synthesis and applications.

**Extra Reading/ Keywords:** *Alternative green methods*

**UNIT: IV** **15 Hrs**

**NANO CHEMISTRY**

Introduction, Nano particles – Classification of nano particles, Properties- Melting point, electrical, mechanical and optical properties. Production - Inert Gas Condensation (IGC), Physical Vapour Deposition (PVD), Chemical Vapour Deposition (CVD), Sol-Gel Process, Ball-milling. Characterization - XRD, SEM, TEM and AFM. Safety issues. Fullerenes – variations, properties of fullerenes.

**Extra Reading/ Keywords:** *Characterization techniques of nanoparticles using STM, FE-SEM, AAS and XPS*

**UNIT: V** **15 Hrs**

**CARBON NANOTUBES AND COLLOIDAL GOLD**

Carbon nanotube – Types and related structures, Properties, Synthesis of nanotubes - Arc discharge method, Laser ablation and CVD method. Defects of nanotubes, Applications of carbon nanotubes - Structural, Electromagnetic, Chemical and Mechanical applications. Colloidal gold– synthesis and applications

**Extra Reading/ Keywords:** *Synthesis of Boron Nitride Nanotube*

**Course Outcomes (CO):**

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level

CO-1	Enumerate the Green Chemistry Principles.	PSO 1	U
CO-2	Distinguish microwave and ultrasound green synthesis.	PSO 1	U
CO-3	Elucidate the various mechanisms using ionic liquids and PTC.	PSO 2	Ana
CO-4	Discuss the properties and synthesis of nanoparticles.	PSO 5	U
CO-5	Summarizes the applications of carbon nanotubes and colloidal gold.	PSO 6	App
CO-6	Gain knowledge about Green chemistry and Nano technology	PSO 6	App

### BOOKS FOR REFERENCE

1. Ahluwalia V. K. (2006) Green Chemistry - Environmentally benign reactions, Ane Books India.
2. T. Pradeep, (2007) Nano : The essentials-Understanding Nanoscience and Nanotechnology- Tata McGraw Hill Education Pvt. Ltd.
3. M. S. RamachandraRao and Shubra Singh (2013) Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley India Pvt. Ltd.
4. Paul T. Anastas & Tracy C. Williamson (1998). Green Chemistry – Designing Chemistry for the Environment (2<sup>nd</sup> ed.).
5. Rashmi Sanghi and Srivastava M.M. (2003). Green Chemistry – Environment friendly Alternatives. Narora Publishing House.
6. Rao C.N.R., Muller A and Cheetam A.K. (2004). The Chemistry of Nanomaterials, Vol.1, 2. Wiley – VCH, Weinheim.
7. Lakshman Desai, (2007). Nanotechnology. Paragon International Publishers.
8. Charles Jr. and Frank J. Owen, (2008). Introduction to nanotechnology. London: John Wiley & Sons.



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**HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2**  
**PG & RESEARCH DEPARTMENT OF CHEMISTRY**  
**Second Year - Semester – IV**

<b>Course Title</b>	<b>SELF STUDY PAPER – APPLIED CHEMISTRY</b>
<b>Total Hours</b>	<b>60</b>
<b>Hours/Week</b>	<b>-</b>
<b>Code</b>	<b>P17CH4SST01</b>
<b>Course Type</b>	<b>Theory</b>
<b>Credits</b>	<b>2</b>
<b>Marks</b>	<b>100</b>

### General Objectives:

To know about the basics of Crystal Studies, Nuclear Chemistry, Polymer Chemistry, Soil Chemistry and Environmental Chemistry

### Course Objectives (CO):

#### The learner will be able to

CO No.	Course Objectives
CO-1	Understand the fundamental concepts in solid state and to predict the structure of ionic crystals
CO-2	Apply the principles of nuclear chemistry in various nuclear reactions and understand the applications of radioactive isotopes.
CO-3	Discuss the different properties of inorganic polymers.
CO-4	Explain the components of soil, soil microorganism and soil reactions
CO-5	Determine the sources, causes and effects of air pollution, water pollution and solid waste management

### Unit I: SOLID STATE CHEMISTRY

- 1.1 Introduction – Crystalline solids, amorphous solids, symmetry operations. Basic crystal system – space lattice, unit cell, Bravais lattice.
- 1.2 Lattice energy – Born Lande equation, Derivations of Born Haber cycle and applications. Radius ratio rules
- 1.3 Structure of ionic crystals –  $\text{TiO}_2$ ,  $\text{CaC}_2$ ,  $\text{CdI}_2$ , Silicates – Structures and classification.

### Unit II: NUCLEAR CHEMISTRY

- 2.1 Introduction – Composition, properties of nuclei, nuclear stability, nuclear stability, artificial radioactivity and Nuclear cross sections
- 2.2 Characteristics of fission reaction, product distribution, Theories of fission, fissile and fertile isotopes, nuclear fusion and stellar energy.
- 2.3 Synthetic elements, nuclear wastes, nuclear reprocessing. Radiation hazards and Prevention. Various atomic power projects in India.

### Unit III : INORGANIC POLYMERS.

- 3.1 General properties Glass Transition Temperature, phosphorous based polymers.
- 3.2 Sulphur based polymers, Boron based polymers and silicon based polymers.

3.3 Natural co-ordination polymers, 2-Dimensional polymers , 3- Dimensional network, synthetic co-ordination polymers.

#### Unit IV: SOIL CHEMISTRY

- 4.1 Soil Chemistry – Definition, Components of soil and Classification of soil. Physical properties of soil – soil texture, soil structure, porosity, consistence, colour and temperature.
- 4.2 Soil microorganism – Classification of soil microorganism and its functions . Nitrogen Cycle.
- 4.3 Soil reaction . soil pH, factors controlling soil reaction. Acid soil - Nature of acidity development, formation and effects of acid soils.

#### Unit V: ENVIRONMENTAL CHEMISTRY

- 5.1 Environmental pollution – Air pollution – air pollutants – CO<sub>2</sub>, CO, O<sub>3</sub> and photochemical smog.
- 5.2 Water pollution – Sewage and other oxygen demanding waste, Domestic water treatment, Industrial waste water and its treatment – Primary and secondary treatment.
- 5.3 Solid waste management – plastic and solid nuclear waste disposal , separation and recycling of plastics. Biodegradable plastics.

#### Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the fundamental concepts in solid state and to predict the structure of ionic crystals	PSO 1	U
CO-2	Apply the principles of nuclear chemistry in various nuclear reactions and understand the applications of radioactive isotopes.	PSO 1	Ap
CO-3	Predict the different properties of inorganic polymers.	PSO 2	An
CO-4	Explain the components of soil, soil microorganism and soil reactions	PSO 3	U
CO-5	Identify the sources , causes and effects of air pollution, water pollution and solid waste management	PSO 5	Ap
CO-6	Develop the knowledge on soil and environmental chemistry	PSO 5	Ap

**BOOKS FOR REFERENCE:**

1. Lee J.D (1995) A new concise Inorganic Chemistry (4<sup>th</sup> edition) , London ELBS
2. Samuel Glasstone (1967) Sourcebook on Atomic Energy (3<sup>rd</sup> Edition) Devan and nostrand.
3. Cotton F.A and Wilkinson G (1985) Advanced Inorganic Chemistry (1985) New Delhi
4. Sashai V.N. (1993) Fundamental of soil 2nd Edition kalyani publishers.
5. Nyle C. Brady (1996), The nature and properties of soil 10<sup>th</sup> editon, Mcmillian Publishing company.
6. Sharma B.K (2005) Environmental Chemistry 8<sup>th</sup> Edition, Goel Publishing house.
7. V.P. Gowariker and N.V. Viswanathan- “ Polymer Science”, 1<sup>st</sup> Ed., Wiley Easter Pvt. Ltd., New Delhi.