(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

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

Programme Specific Outcomes (PSOs)

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

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PG AND RESEARCH DEPARTMENT OF CHEMISTRY

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK (LOCF)

UG COURSE PATTERN

B.Sc CHEMISTRY

Semester	Part	Course	Title of the Course	Course Code	Hrs./wk.	Credits	Marks
I	I	Language	General Tamil I/ Hindi paper I/ French paper I	**U22TL1GEN01/ U22HN1HIN01/ U22FR1FRE01**	3	3	100
	II	English	General English I	**U22EL1GEN01**	3	3	100
	III	Major Core – 1	Fundamental concepts of chemistry	**U22CH1MCT01**	5	4	100
		Major Core – 2	Volumetric Analysis (Lab cum theory)	**U22CH1MCP02**	4	3	100
		Major Core -3	Analytical Chemistry	**U22CH1MCT03**	4	4	100
		Allied – 1	Basic Physics I	**U22PH1ALT01**	4	2	100
		Allied – 2	Basic Physics Practicals	**U22PH1ALT02**	4	2	100
	IV	Environmental Studies	Environmental Studies	**U22RE1EST01**	2	1	100
		Value Education	Ethics-I/ Bible Studies-I/ Catechism-I	**U22VE2LVE01/ U22VE2LVB01/ U22VE2LVC01**	1	-	-
		Service oriented course			-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22EX1INT01**		2(EC)	
		Total			30	22	800
II	I	Language	General Tamil II/ Hindi paper II/ French paper II	**U22TL2GEN02/ U22HN2HIN02/ U22FR2FRE02**	3	3	100
	II	English	General English I	**U22EL2GEN02**	3	3	100
	III	Major Core –4	Organic and Physical Chemistry	**U22CH2MCT04**	6	4	100
		Major Core –5	Semi micro Analysis (Lab cum Theory)	**U22CH2MCP05**	4	3	100
		Major Core - 6	Major Core - 6	**U22CH2MCT06**	4	4	100

		Allied – 3	Basic Physics II	**U22PH1ALT03**	4	2	100
	IV	Skill-based Course– 1	Soft Skill Development	**U22SS2SBC01**	2	1	100
		Skill-based Elective – 2	Rural Enrichment and Sustainable Development	**U22RE2SBC02**	2	1	100
			Industrial Chemistry	**U22CH2IRT01**	1	1	
		Value Education	Ethics I/ Bible Studies I/ Catechism I	**U22VE2LVE01/ U22VE2LVB01/ U22VE2LVC01**	1	1	100
		Service Oriented Course			-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22EX2INT02**		2(E.C)	100
		Online course		**U22EX2ONC01**		1(E.C)	
		RESCAPES		**U22EX2RES01**		1(E.C)	
		Total			**30**	**23**	**900**

Semester	Part	Course	Title of the Course	**Course Code**	Hrs./ wk	Credits	Marks
III	I	Language	General Tamil III/ Hindi paper III/ French paper III	**U22TL3GEN03/ U22HN3HIN03/ U22FR3FRE03**	3	3	100
	II	English	General English III	**U22EL3GEN03**	3	3	100
	III	Major Core –7	Inorganic and Organic Chemistry	**U22CH3MCT07**	6	5	100
		Major Core –8	Physical Experiments and Computer Aided Molecular Calculations	**U22CH3MCP08**	4	3	100
		Major Elective	Major Elective		4	3	100
		Allied – 4	Differential Calculus and Trigonometry	**U22MA3ALT15**	4	2	100
	IV	Major Skill-based Elective– 1	Major skill based Elective paper		2	1	100
		Non Major elective - 1	Non Major elective paper		2	2	100
		Value Education	Ethics-II/ Bible Studies-II/ Catechism -II	**U22VE4LVE02/ U22VE4LVB02/ U22VE4LVC02**	1	-	-

		Gender studies	Gender studies	**U22WS3GST01**	1	1	100
		Service Oriented Course			-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22EX2INT04**		2(E. C)	100
		Online course		**U22EX2ONC02**		1(E.C)	
		Total			**30**	**23**	**900**
IV	I	Language	General Tamil IV/ Hindi paper IV/ French paper IV	**U22TL4GEN04/ U22HN4HIN04/ U22FR4FRE04**	3	3	100
	II	English	General English IV	**U22EL4GEN04**	3	3	100
	III	Major Core –9	Inorganic and Physical Chemistry	**U22CH4MCT09**	6	5	100
		Major Core -10	Applied Chemistry Practical	**U22CH4MCP10**	3	3	100
		Major Elective	Major Elective		4	3	100
		Allied – 5	Algebra and Integral Calculus	**U22MA4ALT17**	4	2	100
		Allied – 6	Analytical Geometry of three Dimensions, Vector calculus and Differential Equations	**U22MA4ALT18**	4	2	100
		Non-Major Elective - 2	Non-Major Elective paper		2	2	100
	IV	Value Education	Ethics II/ Bible Studies II/ Catechism II	**U22VE4LVE02/ U22VE4LVB02/ U22VE4LVC02**	1	1	100
			Service Oriented Course		-	2 (E.C)	
		Service Oriented Course		**U22EX4SOC01**	-	2 (E.C)	
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22EX2INT04**		2(E.C)	100
			RESCAPES	**U22EX2RES02**		1(E.C)	
		Total			**30**	**24**	**900**
Semester	**Part**	**Course**	**Title of the Course**		**Hrs./wk.**	**Credits**	**Marks**

V	III	Major Core –11	Inorganic Chemistry - I	**U22CH5MCT11**	4	4	100
		Major Core –12	Organic Chemistry - I	**U22CH5MCT12**	5	4	100
		Major Core -13	Physical Chemistry - I	**U22CH5MCT13**	4	4	100
		Major Core -14	Gravimetric analysis and preparation of inorganic complexes	**U22CH5MCP14**	4	3	100
		Major Core -15	Physical Chemistry Practical - I	**U22CH5MCP15**	4	3	100
		Major Elective	Food Chemistry/ Smart Waste Management for Environmental Sustainability	**U22CH5MET05/ U22CH5MET06**	4	3	100
		Major Skill based Elective – 2	Cosmetology/ Micro Enterprises[For Chemistry students]	**U22CH5SBT03/ U22CH5SBT04**	2	1	100
	IV	Non Major Elective – 3			2	2	100
		Value Education	Ethics III/ Bible Studies III/ Catechism III	**U22VE6LVE03/ U22VE6LVB03/ U22VE6LVC03**	1	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22EX2INT05**		2(E. C)	100
		Online course		**U22EX2ONC03**		1(E.C)	
		Total			**30**	**24**	**800**
VI	III	Major Core –15	Inorganic Chemistry -II	**U22CH6MCT15**	4	4	100
		Major Core –16	Organic Chemistry II	**U22CH6MCT16**	4	4	100
		Major Core – 17	Physical Chemistry– II	**U22CH6MCT17**	5	4	100
		Major Core – 18	Organic analysis and Organic Preparation	**U22CH6MCP18**	4	3	100
		Major Core – 19	Physical Chemistry Practical - II	**U22CH6MCP19**	4	3	100
		Major Elective	Polymer Chemistry / Chemistry of biomolecules /	**U22CH5MET07/ U22CH5MET08**	4	3	100
	IV	Non Major Elective	Non Major Elective		2	2	100
		SBC – 3	Research Methodology	**U22DS6SBT03**	2	1	100
		Value Education	Ethics III/	**U22VE6LVE03/ U22VE6LVB03/**	1	-	-

			Bible Studies III/ Catechism III	**U22VE6LVC03**			
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22EX2INT06**		2(E. C)	100
		RESCAPES		**U22EX6RES03**		1(E.C)	100
			Total		**30**	**24**	**800**
			Grand Total		**180**	**140**	**5100**
			Grand Total – 140 + 20(E.C) = 160				

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

Sem.	Part	Course	Title of the Course	Course Code	Hrs. /wk.	Credits	Marks
I	III	Allied – 1	Chemistry Paper I (For Botany/Zoology)	**U22CH1ALT01**	4	2	100
		Allied – 2	Chemistry Paper II (For Botany/ Zoology)	**U22CH1AL P02**	4	2	100
II	III	Allied – 3	Chemistry Paper III (For Bot/ Zoology)	**U22CH2ALT03**	4	2	100
III	III	Major Elective	Nutraceuticals and Health care/ Renewable Energy Resources	**U22CH3MET01/ U22CH3MET02**	4	3	100
		Allied – 4	Chemistry Paper-I (For Biochemistry Physics)	**U22CH3ALT04/ U22CH3ALT05**	4	2	100
	IV	Major Skill-based Elective–1	Dairy Entrepreneurship	**U22CH3MSBT01**	2	1	100
		Non Major elective - 1	Food and Nutrition	**U22CH3NMT01**	2	2	100
IV	III	Major Elective	Phytochemistry/Chemistry for Biologist- Lab cum theory (For Biotech)	**U22CH4MEP03/ U22CH4MEP04**	4	3	100
		Allied – 5	Chemistry paper –II (For Biochemistry Physics)	**U22CH4ALT06/ U22CH4ALT07**	4	2	100
		Allied – 6	Chemistry paper III (For Biochemistry/ Physics)	**U22CH4ALP08/ U22CH4ALP09**	4	2	100
	IV	Non Major Elective - 2	Home Care	**U22CH4NMT02**	2	2	100
V	IV	Non Major Elective – 3	Beauty Care	**U22CH5NMT03**	2	2	100
VI	IV	Non Major Elective – 4	Cosmetology	**U22CH6NMT04**	2	2	100

Course Title	**Major Core 1 – FUNDAMENTAL CONCEPTS OF CHEMISTRY**
Code	**U22CH1MCT01**
Course type	**Theory**
Semester	**I**
Hours/Week	**5**
Credits	**4**
Marks	**100**

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 ψ and ψ^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 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, CaC_2, $CaCN_2$, 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 CH_4, H_2O, NH_3, SF_4, XeF_2, 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 H_2, He_2, N_2, O_2, and CO, bond order and stability of molecules.

Extra reading/Keywords: *MO configuration of Li_2, Be_2, F_2 and NO*

UNIT- IV FIRST LAW OF THERMODYNAMICS AND THERMOCHEMISTRY **12Hrs**

4.1 Importance and Limitations of Thermodynamics. Terms and definitions – system, acroscopic 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 Cp and Cv, 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 – σ,π 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* 35thedn)., New Delhi:Shoban Lal Nagin chand and Co, 2013.
2. Soni P.L. and Chawla H.M, *Text Book of Organic Chemistry,* 26thedn., New Delhi: Sultan Chand and sons, 2014.

3. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Inorganic Chemistry* 35thedn., New Delhi:Shoban Lal Nagin chand and Co, 2013.
4. Samuel Glasstone, *Thermodynamics for Chemists* 3rd printing., East-West edn.,1974.
5. Lee, J.D., *Concise Inorganic Chemistry*, 5th edn., Blackwell Science, 1996.
6. Jain M.K. *Organic Chemsitry*, 12thedn.,, New Delhi: Shoban Lal Nagin Chand and Co, 2003.

SUGGESTED READINGS

1. Raj K. Bansal, *A Text Book of Organic Chemistry*, 5thedn., 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*, 20th 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.

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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
6. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Fundamentals/Nomenclature
7. https://youtu.be/xkNw2t3sNpI

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	K3

	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.	
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

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

PSO-CO Mapping

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

Course Title	**Major Core – 2: VOLUMETRIC ANALYSIS – Lab cum Theory**
Code	**U22CH1MCP02**
Course type	**Lab cum Theory**
Semester	**I**
Hours/Week	**4**
Credits	**3**
Marks	**100**

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 Na_2CO_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 $KMnO_4$, oxalic acid against $KMnO_4$, $FeSO_4$ against $K_2Cr_2O_7$, 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*

<u>VOLUMETRIC ANALYSIS:</u>

1. Acidimetry
   Estimation of Oxalic acid.
2. Permanganometry:
   i. Estimation of $FeSO_4$.
   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* 35thedn., 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: 2ndedn, 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: 6thedn., Pearson Education, 2006.
2. Soni P.L. and Mohankatyal ,*Text book of Inorganic Chemistry*, 20th revised edn., New Delhi: Sultan Chand and sons, 2013.

WEB REFERENCES

1. https://youtu.be/HVjvFydMOc8
2. https://youtu.be/ci4cHGLVZQY
3. https://youtu.be/Z2a5Owqr30A
4. https://youtu.be/7i6sGH5Me6g
5. https://youtu.be/85tMHHOj7PU

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
CO-4	find the risks and hazards in the lab and adopt techniques for lab safety and sustainable development	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	-	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

Course Title	Major Core 3:ANALYTICAL CHEMISTRY
Code	U22CH1MCT03
Course Type	Theory
Semester	I
Hours/Week	4
Credits	4
Marks	100

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, Rf value and its significance, factors affecting Rf 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 chromatograph*y

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: 35thedn, 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*, 6th 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

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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**
CO4	**H**	**H**	**H**

Course Title	Allied – 1: CHEMISTRY PAPER I [For Bioinformatics, Botany and Zoology]
Code	U22CH1ALT01
Course Type	Theory
Semester	I
Hours/Week	4
Credits	2
Marks	100

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 α- 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(*26thedn). New Delhi: Sultan Chand and sons., 2014.
2. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Physical Chemistry (*35thedn) New Delhi: Shoban Lal Nagin chand and Co, 2013.
3. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Inorganic Chemistry, (*35thedn). New Delhi:Shoban Lal Nagin chand and Co,. 2013.

SUGGESTED READINGS

:

1. Soni P.L. and Mohankatyal, *Text book of Inorganic Chemistry*, 20th 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* (7th Edition), Chennai: Pearson Education India, 2011.
4. Jain M.K, Sharma S.C, *Modern Organic Chemistry*, Vishal Publishing Co, 2007

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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	K1

	intermediates, reagents, electronic effects and hybridization, electrophoresis and osmotic pressure.	
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 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.	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	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

Course Title	Allied 2: CHEMISTRY PAPER II (For Bioinformatics, Botany and Zoology)
Code	U22CH1ALP02
Course Type	Lab cum Theory
Semester	I
Hours/Week	4
Credits	2
Marks	100

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 theequivalence point
3. To determine the concentration of solution in various units and prepare standard solution and dilute solution
4. To explainthe 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_3COOH against NaOH, Na_2CO_3 with HCl. Acid-Base indicators – Ostwald's theory and quinonoid theory.

1.4 Redox titrations – Mohr salt against $KMnO_4$, Oxalic acid with $KMnO_4$, $FeSO_4$ against $K_2Cr_2O_7$. 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: 2nd edn, Sultan Chand & Sons, 1997.

SUGGESTED READINGS:

1. Svehla G. *Vogel's Qualitative Inorganic Analysis.* US: 7th 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: 6th 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*, 1st Edition, ISBN: 1849739145

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COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	define and recall the terms of volumetric analysis	K1
CO-2	explain and describetheknowledge 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
Code	U22CH2MCT04
Semester	II
Total Hours	90
Hours/Week	6
Course Type	Theory
Credits	4
Marks	100

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 KMnO4, 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 ΔA and ΔG 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	ognitive 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 pertrol, 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 ΔA and ΔG 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.

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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

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

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

Course Title	Major Core 5- SEMI-MICRO QUALITATIVE ANALYSIS
Code	**U22CH2MCP05**
Semester	**II**
Total Hours	**45**
Hours/Week	**3**
Course type	**Practical**
Credits	**3**
Marks	**100**

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 interferring radicals.	K2
CO-3	apply the concepts of qualitative analysis in confirmatory tests and	K3

	separation of the cations into groups.	
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* 35th 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: 2nd 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: 6th edn., Pearson Education, 2006.

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

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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**

Course Title	**Major Core 6 – BASICS OF ANALYTICAL AND PHYSICAL METHODS**
Code	**U22CH2MCT06**
Semester	**II**
Total Hours	**75**
Hours/Week	**5**
Course type	**Theory**
Credits	**4**
Marks	**100**

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 Na_2CO_3 with HCl.

2.3 Redox titration – theory – titration of Mohr salt against $KMnO_4$, oxalic acid against $KMnO_4$, $FeSO_4$ against $K_2Cr_2O_7$, 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 equlibria.	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*, (6th edn). Pearson Education.
2. Puri B.R., Sharma L.R. and Madan S. Pathania, (2013). *Principles of Physical Chemistry (*35th 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'*, (2nd Edn). Sultan Chand & Sons.
5. Walter J Moore 'Physical *Chemistry'*, (5th Edn)., Prentice-Hall, 1999

SUGGESTED READINGS:

5. P. W. Atkins, (2009) "*Physical Chemistry*", (7th 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
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_mm20_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**

Course Title	Allied – 3: CHEMISTRY PAPER III [For Botany/ Zoology]
Code	U22CH2ALT03
Semester	II
Total Hours	60
Hours/Week	4
Course Type	Theory
Credits	2
Marks	100

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 Λo of a weak electrolyte, Conductometric titrations – HCl Vs NaOH, KCl Vs $AgNO_3$, CH_3COOH 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(*26th 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 (*35th 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 (*35th 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*, 20th 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,	K2

	fertilizers and cleansing agents.	
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 Λo, 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, relationship between specific and equivalent conductance, advantages of gaseous fuel, role of micronutrients, macro nutrients and cleansing action of soaps and detergents.	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	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**

Course Title	SBC-2 - INDUSTRIAL CHEMISTRY
Code	U22CH2IRT01
Semester	II
Total Hours	15
Hours/Week	1
Course Type	Theory
Credits	1
Marks	50

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', 6th 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 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

Semester	Part	Course	Title of the Course	Course Code	Hrs./wk.	Credits	Marks
I	I	Language	General Tamil I/ General Hindi I/ General French I	**U21TL1TAM01/ U21HN1HIN01/ U21FR1FRE01**	3	3	100
	II	English	General English I	**U21EL1GEN01**	3	3	100
	III	Major Core – 1	Fundamental concepts of chemistry	**U21CH1MCT01**	5	4	100
		Major Core – 2	Volumetric Analysis (Lab cum theory)	**U21CH1MCP02**	4	3	100
		Major Core -3	Analytical Chemistry	**U21CH1MCT03**	4	4	100
		Allied – 1	Differential Calculus and Trigonometry/ Biomolecular Chemistry	**U21MA1ALT02/ U21BC1ALT01**	4	2	100
		Allied – 2	Algebra and Integral Calculus/ Practical	**U21MA1ALT07/ U21BC1ALP02**	4	2	100
	IV	Environmental Studies	Environmental Studies	**U21RE1EST01**	2	1	100
		Value Education	Ethics-I/ Bible Studies-I/ Catechism-I	**U21VE2LVE01/ U21VE2LVB01/ U21VE2LVC01**	1	-	-
		Service oriented course			-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U21SP1ECC01**		2(E.C)	
		Total			**30**	**22**	**800**
II	I	Language	General Tamil II/ General Hindi II/ General French II	**U21TL2TAM02/ U21HN2HIN02/ U21FR2FRE02**	3	3	100
	II	English	English Paper II	**U21EL2GEN02**	3	3	100
	III	Major Core –4	Organic and Physical Chemistry	**U21CH2MCT04**	5	5	100
		Major Core –5	Semi micro Analysis (Lab cum Theory)	**U21CH2MCP05**	4	3	100
		Major Elective - 1			5	3	100
		Allied – 3	Analytical geometry of three dimensions, vector calculus and differential equations /	**U21MA2ALT09/ U21BC2ALT03**	4	2	100

			Enzymes and Enzyme Technology				
	IV	Skill-based Course– 1	Soft Skill Development	**U21SS2SBC01**	2	1	100
		Skill-based Elective – 2	Rural Enrichment and Sustainable Development	**U21RE2SBC02**	2	1	100
			Industrial Chemistry	**U21CH2IRT01**	1	1	
		Value Education	Ethics I/ Bible Studies I/ Catechism I	**U21VE2LVE01/ U21VE2LVB01/ U21VE2LVC01**	1	1	100
		Service Oriented Course			-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U21SP2ECC02**		2(E C)	**100**
		Total			**30**	**23**	**900**

Semester	**Part**	**Course**	**Title of the Course**	**Course Code**	**Hrs./wk**	**Credits**	**Marks**
III	I	Language	General Tamil III/ General Hindi III/ General French III	**U21TL3TAM03/ U21HN3HIN03/ U21FR3FRE03**	3	3	100
	II	English	English Paper III	**U21EL3GEN03**	3	3	100
	III	Major Core –6	Inorganic and Organic Chemistry	**U21CH3MCT06**	5	4	100
		Major Core –7	Physical Experiments and Computer Aided Molecular Calculations	**U21CH3MCP07**	4	3	100
		Major Elective - 2	Nutraceuticals and Health care/ Renewable Energy Resources	**U21CH3MET03/ U21CH3MET04**	4	3	100
		Allied – 4	Basic Physics I	**U21PH3ALT05**	4	2	100
	IV	Major Skill-based Elective–1	Biological Techniques for Chemistry/ Basic Skills in Biological Science	**U21BO3SBP03/ U21ZO3SBP02**	2	1	100
		Non Major elective - 1			3	3	100
		Value Education	Ethics-II/ Bible Studies-II/ Catechism -II	**U21VE4LVE02/ U21VE4LVB02/ U21VE4LVC02**	1	-	-
		Gender studies	Gender studies	U21WS3GST01	1	1	100
		Service Oriented Course					

		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U21SP3ECC03**		2(EC)	100
		Total			**30**	**23**	**900**
IV	I	Language	General Tamil IV/ General Hindi IV/ General French IV	**U21TL4TAM04/ U21HN4HIN04/ U21FR4FRE04**	3	3	100
	II	English	English Paper – IV	**U21EL4GEN04**	3	3	100
	III	Major Core –8	Inorganic and Physical Chemistry	**U21CH4MCT08**	5	4	100
		Major Core -9	Applied Chemistry Practical	**U21CH4MCP09**	3	3	100
		Major Elective - 3	Phytochemistry/Chemistry for Biologist- Lab cum theory (For Biotech)	**U21CH4MEP05/ U21CH4MEP06**	4	3	100
		Allied – 5	Basic Physics II	**U21PH3ALT06**	4	2	100
		Allied – 6	Basic Physics Practicals	**U21PH3ALP07**	4	2	100
		Non Major Elective - 2			3	3	100
	IV	Value Education	Ethics II/ Bible Studies II/ Catechism II	**U21VE4LVE02/ U21VE4LVB02/ U21VE4LVC02**	1	1	100
		Service Oriented Course				2(EC)	
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U21SP4ECC04**		2(E.C)	100
		Total			**30**	**24**	**900**
Semester	**Part**	**Course**	**Title of the Course**		**Hrs. /wk.**	**Credits**	**Marks**
V	III	Major Core – 10	Inorganic Chemistry - I	**U21CH5MCT10**	4	4	100
		Major Core – 11	Organic Chemistry - I	**U21CH5MCT11**	4	3	100
		Major Core -12	Physical Chemistry -I	**U21CH5MCT12**	4	4	100
		Major Core -13	Gravimetric analysis and preparation of inorganic complexes	**U21CH5MCP13**	4	3	100
		Major Core -14	Physical Chemistry Practical - I	**U21CH5MCP14**	4	3	100
		Major Elective - 4	Food Chemistry/ Smart Waste Management for	**U21CH5MET07/ U21CH5MET08**	4	3	100

			Environmental Sustainability				
		Major Skill based Elective – 2	Cosmetology/ Micro Enterprises [For Chemistry students]	**U21CH5SBT03/ U21CH5SBT04**	2	1	100
	IV	Non Major Elective – 3			3	3	100
		Value Education	Ethics III/ Bible Studies III/ Catechism III	**U21VE6LVE03/ U21VE6LVB03/ U21VE6LVC03**	1	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U21SP5ECC05**		2(E C)	100
		Total			**30**	**24**	**800**
VI	III	Major Core – 15	Inorganic Chemistry - II	**U21CH6MCT15**	4	3	100
		Major Core – 16	Organic Chemistry II	**U21CH6MCT16**	4	4	100
		Major Core – 17	Physical Chemistry– II	**U21CH6MCT17**	4	4	100
		Major Core – 18	Organic analysis and Organic Preparation	**U21CH6MCP18**	4	3	100
		Major Core – 19	Physical Chemistry Practical - II	**U21CH6MCP19**	4	3	100
		Major Core- for Physics	Spectroscopy	**U21CH6MCT20**	4	3	100
	IV	Non Major Elective - 4	Cosmetology	**U21CH6NMT04**	3	3	100
		SBC – 3	Research Methodology	**U21DS6SBC03**	2	1	100
		Value Education	Ethics III/ Bible Studies III/ Catechism III	**U21VE6LVE03/ U21VE6LVB03/ U21VE6LVC03**	1	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U21SP6ECC06**		2(E C)	100
		Online Course		**U21OC5ECT01**		2(E C)	
		RESCAPES				4(E C)	
			Total		**30**	**24**	**800**
			Grant Total		**180**	**140**	**5100**
		Grant Total – 140+ 20(EC) = 160					

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

Semester	**Part**	**Course**	**Title of the Course**	**Course Code**	**Hrs. /wk.**	**Credits**	**Marks**
I	III	Allied – 1	Chemistry Paper I (For Botany/Zoology)	**U21CH1ALT01**	4	2	100

		Allied – 2	Chemistry Paper II (For Botany/ Zoology)	**U21CH1AL P02**	4	2	100
II		Major Elective - 1	Nano technology and Crystal growth techniques/ Chemistry of materials(For Physics)	**U21CH2MET01/ U21CH2MET02**	5	3	100
		Allied – 3	Chemistry Paper III (For Bot/ Zoology)	**U21CH2ALT03**	4	2	100
			Industrial Chemistry	**U21CH2IRT01**			
III	III	Major Elective - 2	Nutraceuticals and Health care/ Renewable Energy Resources	**U21CH3MET03/ U21CH3MET04**	4	3	100
		Allied – 4	Chemistry Paper-I (For Biochemistry Physics)	**U21CH3ALT04/ U21CH3ALT05**	4	2	100
	IV	Major Skill-based Elective–1	Dairy Entrepreneurship	**U21CH3MSBT01**	2	1	100
		Non Major elective - 1	Food and Nutrition	**U21CH3NMT01**	3	3	100
IV	III	Major Elective - 3	Phytochemistry/Chemistry for Biologist- Lab cum theory (For Biotech)	**U21CH4MEP05/ U21CH4MEP06**	4	3	100
		Allied – 5	Chemistry paper –II (For Biochemistry Physics)	**U21CH4ALT06/ U21CH4ALT07**	4	2	100
		Allied – 6	Chemistry paper III (For Biochemistry/ Physics)	**U21CH4ALP08/ U21CH4ALP09**	4	2	100
	IV	Non Major Elective - 2	Home Care	**U21CH4NMT02**	3	3	100
V	III	Major Elective - 4	Food Chemistry/ Solid Waste Management	**U21CH5MET07/ U21CH5MET08**	4	3	100
	IV	Non Major Elective – 3	Beauty care	**U21CH5NMT03**	3	3	100
VI	IV	Non Major Elective - 4	Cosmetology	**U21CH6NMT04**	3	3	100

Course Title	**MAJOR CORE: 6 - INORGANIC AND ORGANIC CHEMISTRY**
Code	**U21CH3MCT06**
Course type	**Theory**
Semester	**III**
Hours/Week	**5**
Credits	**4**
Marks	**100**

CONSPECTUS

This course will enable the students to learn about the techniques of metallurgy, types of interactions in biological molecules, theories of acids & bases, organo halogen compounds and also about alcohols, phenols and ether.

COURSE OBJECTIVES

1. To illustrate the techniques used in the purification of metals and enumerate the influence of hydrogen bonding on the physical properties of molecules.
2. To classify hard and soft acids, bases and non-aqueous solvents.
3. To propose the mechanism for electrophilic substitution reactions to predict the formation of products and give a reason for the orientation.
4. To enumerate the preparation and properties of organohalogen compounds and list out their applications.
5. To summarize the preparation, properties and applications of alcohols, phenols, and ethers.

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 Non-covalent interactions - Vander Waals forces, ion dipole-dipole interactions. Hydrogen bonding- intra and intermolecular hydrogen bonding, influence the physical properties of molecules

1.4 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.

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 NH_3 as a solvent – chemical reactions in liquid NH_3.

2.4 Anhydrous hydrogen fluoride as a solvent – chemical reactions in anhydrous hydrogen fluoride. Liquid SO_2 as a solvent – chemical reactions in Liquid SO_2.

Extra reading/ keywords: *Cady – Esley Concept*

UNIT – III: AROMATICITY AND AROMATIC HYDROCARBONS 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 halogenation, 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 ORGANOHALOGEN COMPOUNDS 15Hrs.

4.1 Alkyl halides – classification, vicinal and germinal dihalides. General methods of 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- SN_1, SN_2, SN_i, 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 CFC's on the 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.

Extra reading/keywords*: Synthesis and chemical properties of epoxides.*

COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive Level
CO1	Definition of metallurgy, metallic bond, Hydrogen bonding, non- covalent interactions, an acid and a base, aqueous and non-aqueous solvent, amphoterism, ammonolysis, ammonation, aromaticity, electrophilic and nucleophilic substitution reaction, activating and deactivating groups, Huckel's rule, classification and general methods of preparation of alkyl halides, poly halogenated alkanes, aromatic halogen compounds, alcohol, mono and dihydric phenol, allyl alcohol , glycol, glycerol and ethers, hard and soft acids and bases, describe the methods used in a concentration of the ore, to list the uses of DDT, fluoro and chlorofluorohydrocarbons	**K1**
CO 2	Discuss the techniques used in the purification of metals, stoichiometric and non-stoichiometric defects, crystalline hydrates and clathrates, theories of acids and bases, chemical reactions of liq. Ammonia, anhydrous HF and liquid SO_2, Structure, reactions and stability of benzene, synthesis of naphthalene, anthracene and phenanthrene, chemical reactions of alkyl, vinyl and aryl halides, classification and reactions of alcohols and poly hydric phenols.	**K2**
CO-3	Apply band theory to study the crystal structure of metals, illustrate the bonding in ethanol and acetic acid, the relative strength of acids and bases, liq. Ammonia as solvent, illustrates the mechanism of aliphatic and aromatic nucleophilic substitution reactions and aromatic electrophilic substitution reactions, to apply IUPAC nomenclature to name the alcohols and phenols and ethers.	**K3**
CO-4	Explain the application of HSAB principle to complexes, to compare and contrast the properties of solvents based on various factors, infer the formation of products and to give reasons for orientation in aromatic electrophilic and nucleophilic substitution reaction, benzyne mechanism, synthetic applications of Grignard reagents, acidic character and isomerism in phenol.	**K4**
CO-5	Compare inter and intra molecular H-bonding, mechanism of aliphatic and aromatic nucleophilic substitution reactions in alkyl halides , evaluate bonding hard-hard and soft-soft combinations and assess the molecules based on Huckel's rule to aromatic, non-aromatic and anti-aromatic compounds	**K5**

RBT Levels

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

TEXTBOOKS

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. P.L. Soni and H.M. Chawla (2014). *'Textbook of Organic Chemistry' (*26th edn).: Sultan Chand and sons, New Delhi.
6. John Mc Murray, (2012). '*Organic chemistry'*, 8th Edition, International Edition.
7. Paula Yurkanis Bruice, (2016). *'Organic chemistry'*, 8th Edition, Pearson Education Ltd.

SUGGESTED READINGS

1. J. E. Huheey, E. A. Kieter 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 Textbook of Organic Chemistry'*, New Delhi, Sultan Chand and Sons, New Delhi.

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1. https://archive.nptel.ac.in/courses/113/105/113105024/
2. https://nptel.ac.in/courses/104103069
3. https://www.sydney.edu.au/science/chemistry/~george/alcohols.html
4. https://www.britannica.com/science/organohalogen-compound
5. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Wade)/17%3A_Aromatic_Compounds/17.05%3A_Aromaticity_and_Huckel's_Rule

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	H	H
CO-2	H	H	M	M	M	M	H	H	M
CO-3	H	M	M	M	M	M	H	M	M
CO-4	H	H	L	M	M	M	H	M	M
CO-5	H	H	M	M	M	H	H	H	M

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	H	M	H
CO3	H	M	H
CO4	M	M	H
CO5	H	H	H

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

Course Title	MAJOR CORE 7- PHYSICAL EXPERIMENTS AND COMPUTER AIDED MOLECULAR CALCULATIONS
Code	U21CH3MCP07
Course type	Lab cum Theory
Semester	III
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS

To expose the students to various concepts in Phase Rule and Solutions, to gain skill in Physical experiments through virtual lab, draw the structures, relate their properties using ARGUS LAB Software thereby enhancing the skill and competency of students in research and development.

COURSE OBJECTIVES:

11. To understand the principles involved in phase rule and solutions.
12. To describe the concepts of colligative properties and phase equilibria.
13. To determine the molecular weight, eutectic temperature and transition temperature by adopting physical methods.
14. To determine the boiling point, freezing point of a solution and viscosity of solvents through virtual lab experiments.
15. To visualize the chemical structure and calculate the bond length, bond order and bond energies using ARGUS 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.

***Extra Reading / key words**: Partially miscible liquids*

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 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.

2.3 Elevation in boiling point and depression in freezing point by a nonvolatile solute – thermodynamic derivation and experimental determination

2.4 Abnormal molecular weights – Van't Hoff factor, association and dissociation. Nernst distribution law & its applications.

***Extra reading/ Keywords* :** *Fractional distillation of binary liquid solutions*

PRACTICALS **(3hrs External)**

1. Determination of Molecular Weight by Rast method
2. Phase diagram of a Simple eutectic system: Naphthalene – Biphenyl.
3. Determination of transition temperature of a salt hydrate

VIRTUAL LAB EXPERIMENTS

4. Determination of boiling point elevation of a solution.
5. Determination of freezing point depression of a solution.
6. Determination of viscosity of organic solvents.

ARGUS LAB Practicals

7. Calculate the Heat of formation of conformers using ARGUS Lab Software.
8. Calculate the Strain energies of alicyclic rings using ARGUS Lab Software.
9. Visualize the Molecular orbitals and their lone pairs of simple molecules using ARGUS Lab Software.
10. Calculate the bond energies, bond orders and bond lengths of delocalized and resonance stabilized bonds.

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	Apply the principle of phase rule and identify the colligative properties of solutions.	K1
CO-2	Calculate the molecular weight, transition temperature and eutectic temperature through physical experiments	K2
CO-3	Illustrate the Calculation of bond order, bond length and bond energies using ARGUS LAB	K3
CO-4	Analyze the colligative properties through virtual lab experiments.	K4
CO-5	Predict the Bond order and Bond length for the simple molecules.	K5

TEXT BOOKS

6. Puri B.R., Sharma L.R. and Madan S. Pathania, (2013).*Principles of Physical Chemistry (*35th 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.
8. Jan H.Jenwsen, " Molecular Modelling Basics", CRC Press, 2017.

SUGGESTED READINGS:

1. Venkateswaran V., Veeraswamy R., Kulandaivelu A.R., (1997), '*Basic Principles of Practical Chemistry'*, Second edition, Sultan Chand & Sons.
2. Donald A. McQuarrie, John D. Simon, Physical Chemistry: A Molecular Approach, University Science books, 2005.
3. Christopher J.Cramer, "Essentials of Computational Chemsitry: Theories and Models", Wiley, 2004.

WEB REFERENCES

6. http://www.arguslab.com/arguslab.com/ArgusLab.html
7. https://nptel.ac.in/courses/112104248
8. https://vlab.amrita.edu/?sub=2&brch=190&sim=337&cnt=1
9. https://vlab.amrita.edu/index.php?sub=2&brch=190&sim=1545&cnt=1
10. https://vlab.amrita.edu/index.php?sub=2&brch=190&sim=339&cnt=1

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	M	M	M	H	M	M
CO-2	H	H	H	H	M	M	H	H	M
CO-3	H	H	H	H	M	H	H	H	H
CO-4	H	H	H	H	M	H	H	H	H
CO-5	H	H	H	H	M	H	H	H	H

CO-PSO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	H	M	H
CO3	H	H	H
CO4	H	H	H
CO5	H	H	H

Course Title	MAJOR ELECTIVE 2: NUTRACEUTICALS AND HEALTH CARE WITH DATA ANALYSIS
Code	U21CH3MET03
Semester	3
Course Type	Theory
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS

To make the students to teach basic concept of nutraceutical and functional food, their use for managing chronic diseases and to gain knowledge for the diet plan of each stage of life and the fundamental concepts of Bigdata.

COURSE OBJECTIVES

1. To relate the nutraceuticals with food and medicine.
2. To provide the knowledge about nutraceutical rich supplements.
3. To impart the knowledge of prebiotics, probiotics and synbiotics.
4. To analyze the relationships between nutritional health and food selection through diet.
5. Understand the fundamental concepts of Big data, the usage and extraction techniques of Big data Analytical framework

UNIT I: NUTRACEUTICALS- INTRODUCTION 12Hrs.

1.1 Historical perspective; definition, nature, nutraceutical compounds and their classification based on chemical/biochemical nature with suitable and relevant descriptions; scope and future prospects.

1.2 Nutraceuticals Foods as remedy medicines, Nutraceuticals for Mental Health - Acetyl-L-Carnitine, Phosphatidylserine, Docosahexaenoic Acid (DHA), Soy Isoflavones, Other Nutraceuticals and Treatments for Depression. Synergism, beneficial interactions and combination products

1.3 Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers.

Extra Reading/keywords: *Relation of Nutraceutical Science with other Sciences*

UNIT II: PHYTONUTRIENTS 12Hrs.

2.1 Sources and role of Terpenoids, Alkaloids, Carotenoids, Tocopherols, Anthocyanin, Phenol and Polyunsaturated fatty acids.

2.2 Nutraceutical Rich Supplements – Caffeine, Green Tea, Mushroom, Chlorophyll and Spirulina-Health effects of common Beans, Capsicum, Mustards, Ginseng, Garlic, Grapes, Citrus Fruits, Fish Oil and Spices.

2.3 Concept of free radicals and antioxidants- Functional foods of Wheat and Rice and their health effects. Role of Nuts in cardiovascular disease prevention and Dietary fibers in disease prevention.

Extra Reading/keywords: *Phytonutrients as therapeutic agents*

UNIT III: MICROBIAL AND ALGAL NUTRACEUTICALS 12Hrs.

3.1 Prebiotics - Definition, Sources, Bioavailability, Effects on Human Health and Applications- Non-Digestible (Carbohydrates/Oligosaccharides), Dietary Fibre and Resistant Starch.

3.2 Probiotics - Probiotic Microorganisms, Foods - Fermented Milk Products, Non-Milk Products, Quality Assurance of Probiotics and Safety

3.3 Synbiotics for maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment.

Extra Reading/keywords: *Biotechnology in Phyto nutraceuticals*

UNIT IV: NUTRITION FOR HEALTHY LIFE 12Hrs.

4.1 Nutritional requirements for different types of physical activities and sports, Special needs before and after certain intensive and prolonged sports (Pre-game and Post-game meals).

4.2 Nutritional requirements of vulnerable sections such as infants, pregnant and lactating women, elderly and the dietary management.

4.3 Popular Diets- GM Diet, DASH Diet, Gluten-Free Diet, Low-Carb Diets, The Macrobiotic Diet, the Mediterranean Diet, Vegetarian and Vegan Diets

Extra Reading/keywords: *Nutrition related diseases and disorders*

UNIT- V: DATA ANALYSIS 12Hrs

5.1 Fundamentals of Big Data: The Evolution of Data Management – Understanding the Waves of Managing Data – Defining Big Data – Applications and Benefits.

5.2 Examining Big Data Types Defining Structured Data – Defining Unstructured Data – Looking at Real time and Non-Real time Requirements – Putting Big Data together.

5.3. Digging into Big Data Technology Components: Exploring the Big Data, Stack – Layer 0: Redundant Physical Infrastructure – Layer 1: Security Infrastructure – Interfaces and Feeds to and from Applications and the Internet – Layer 2: Operational Databases – Layer 3: Organizing Data Services and Tools – Layer 4: Analytical Data Warehouses – Big Data Analytics – Big Data Applications.

Extra Reading/keywords: *Big data & Importance, examples of Real, non-real time requirements and Importance of Distributed system in Big Data and its components*

COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive level
CO1	Recognize nutraceutical compounds and their classification based on chemical/biochemical nature, Sources and role of phytonutrients and recall the fundamental concepts of Big data.	K1
CO2	Understand dietary supplements, fortified foods and Phyto nutraceuticals, Nutraceutical Rich Supplements, Recommendations for Weight Management, Prebiotics, Probiotics, Synbiotics and Nutritional requirements and explain the categorizes of Big Data and its importance	K2
CO3	Predict the special nutrition needs before and after certain intensive and prolonged sports and illustrate the role of nuts in cardiovascular disease prevention and identifies the distributed Computing with Big Data and the various layers of the Stack.	K3
CO4	Examine nutraceutical remedies for common disorders, role of Dietary fibres in disease prevention, Health Risk, Nutritional Care for Weight Management and Popular Diets and analyze the usage and extraction techniques of Big data Analytical framework.	K4
CO5	Evaluate the nutraceutical remedies, nutraceutical rich supplements, popular diets and its role in weight management and examine the data gathering of large data from a range of data sources.	K5

TEXT BOOKS:

1. Robert E.C. Wildman, Robert Wildman, Taylor C. Wallace. Handbook of Nutraceuticals and Functional Foods. Boca Raton: CRC, 2012.
2. Maureen Zimmerman and Beth Snow. An introduction to Nutrition. Creative Commons, 2012.
3. Srilakshmi, B. Nutrition Science. New Delhi: New Age International, 2014.
4. Swaminathan, M. Textbook on Food Chemistry. Bangalore: Printing and Publishing, 2006.
5. Swaminathan M., Essentials of Food and Nutrition, 2nd Ed, 1985, Ganesh and Co.
6. Judith Hurwitz, Alan Nugent, Dr. Fern Halper and Marcia Kaufman, "Big Data for Dummies", A Wiley Brand - Wiley Publications, 2013.

SUGGESTED READINGS

1. Aluko, Rotimi E. Functional Foods and Nutraceuticals. Boca Raton: CRC, 2012.
2. William Hogoland Mayer. Food Chemistry. New Delhi: CBS Publishers and Distributors, 2002
3. Owen R. Fennema. Food Chemistry. New York: Marcel Decker Inc, 2000.
4. Krause's Food, Nutrition and Diet Therapy, 10th Edition by Mahan, L.K. & EcottStump, S. (2000), W.B. Saunders Ltd.
5. Functional foods, designer foods, pharma foods, Nutraceuticals, Israel Goldberg (Ed.), Aspen publishers Inc., Gaithersburg, Maryland, USA, 1999.
6. Fereidoon Sahidi, Deepthi K. Weerasinghe; Nutraceutical Beverages, Chemistry, Nutrition and Health Effects; American Chemical Society.
7. Handbook of nutraceuticals Vol I by Yahwant Vishnupant Pathak, CRC press.2009
8. Handbook of nutraceuticals Vol II by Yahwant Vishnupant Pathak, CRC press,2011
9. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012.

10. Chris Eaton and Dirk Deroos , “Understanding Big data”, Indian Edition, McGraw Hill, 2015.

WEB REFERENCES

1. https://onlinecourses.swayam2.ac.in/cec22_ag02/preview
2. https://onlinecourses.swayam2.ac.in/cec20_ag08/preview
3. https://onlinecourses.swayam2.ac.in/cec20_ge06/preview
4. https://nptel.ac.in/courses/126103017
5. https://onlinecourses.nptel.ac.in/noc22_bt01/preview

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	L	M	L	M	M	L	L
CO-2	H	M	L	M	L	M	M	M	L
CO-3	H	H	M	M	L	M	M	M	M
CO-4	H	M	M	M	M	M	M	M	M
CO-5	H	H	M	M	L	M	M	M	M

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	H	M	H
CO3	H	M	H
CO4	H	M	H
CO5	H	M	H

Course Title	MAJOR ELECTIVE : RENEWABLE ENERGY RESOURCES
Code	U21CH3MET04
Semester	3
Course Type	Theory
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS

To make the students identify the new methodologies / technologies for effective utilization of renewable energy sources.

Course Objectives:

1. To understand the need, importance and scope of non-conventional and alternate energy resources
2. To highlight the significance of solar energy and construct the panel.
3. To explain the importance of wind energy conversion Systems
4. To discuss the processing technique of biomass to ethanol.
5. To describe the working of OTEC power generation

UNIT I: INTRODUCTION TO ENERGY STUDIES **12 Hrs.**

1.1 Introduction, Energy science and Technology, Forms of Energy, Importance of Energy Consumption as Measure of Prosperity- Per Capita Energy Consumption.

1.2 Roles and responsibility of Ministry of New and Renewable Energy Sources and Needs of renewable Energy.

1.3 Classification of Energy Resources, Conventional Energy Resources, Non Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.

Extra Reading/keywords: *Energy conservation*

UNIT II: SOLAR ENERGY **12 Hrs.**

2.1 Introduction, Solar Radiation Measurements, Principle of Conversion of Solar Radiation into Heat, Solar energy storage systems.

2.2 Applications of solar energy: Solar Water Heating system, Solar Cookers, Solar driers, Solar distillation, Solar Furnaces, Solar Greenhouse.

2.3 Solar cell: Fundamentals, Classification, Solar cell, module, panel and array construction. Solar PV Systems (stand-alone and grid connected), Solar PV Applications.

Extra Reading/keywords: *Construction of Solar Cell*

UNIT III: WIND ENERGY **12 Hrs.**

3.1 Introduction, History of Wind Energy, Wind Energy Conversion- Power, torque and speed characteristics, Wind Data and energy estimation. Site selection consideration.

3.2 Wind Energy Conversion system (WECS): Basic Components, Classification of WECS, Advantages and disadvantages of WECS.

3.3 Wind Energy Collectors: Wind turbine generators of WECS- Safety systems, Applications of wind energy, Environmental effects, Wind -Energy programme in India.

Extra Reading/keywords: *Procedure for wind energy installation*

UNIT IV: BIOMASS ENERGY **12 Hrs.**

4.1 Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications - Urban waste to Energy Conversion.

4.2 Biomass Gasification, Types and application of gasifier, Biomass to Ethanol Production, Biogas production from waste biomass.

4.3 Types of biogas plants, Factors affecting biogas generation, Energy plantation, Environmental impacts and benefits, Future role of biomass, Biomass programs in India.

Extra Reading/keywords: *Scheme to support promotion of biomass*

UNIT V: GEOTHERMAL, OCEAN AND HYDRO POWER ENERGY **12 Hrs.**

5.1 Geothermal Energy: Origin and distribution of geothermal energy, Types of geothermal resources, Environmental consideration, geothermal energy in India.

5.2 Ocean Energy: Origin and nature of Tidal Energy, Ocean Tidal Energy Conversion. Wave energy, Ocean Thermal Energy, Ocean thermal energy conversion technology, Environmental impacts.

5.3 Hydropower: Classification of Small Hydro power stations, components of a Hydroelectric scheme, present status of hydropower plants.

Extra Reading/keywords: *Hydropower plant in India*

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	Recognize energy science and Technology, Forms of Energy, Principle of Conversion of Solar Radiation into Heat, History of Wind Energy and Biomass energy.	K1
CO2	Understand Importance of Energy, Roles and responsibility of Ministry of Renewable Energy Sources, Wind Energy Conversion and Biomass energy conversion technologies.	K2
CO3	Illustrate the Classification of Energy Resources, Applications of solar energy and wind energy.	K3
CO4	Examine the environmental impacts of wind energy, biomass energy, ocean energy and geothermal energy.	K4
CO5	Evaluate the different energy consumption methods, the various energy programs in India and Biogas plant.	K5

TEXT BOOKS:

1. Sukhatme. S.P., '*Solar Energy'*, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. B. H. Khan, '*Non-Conventional Energy Resources'*, The McGraw Hill
3. Twidell, J.W. & Weir, A. '*Renewable Energy Sources'*, EFN Spon Ltd., UK, 2006.
4. S. P. Sukhatme and J.K. Nayak, '*Solar Energy – Principles of Thermal Collection and Storage'*, Tata McGraw-Hill, New Delhi.
5. Garg, Prakash, '*Solar Energy, Fundamentals and Applications'*, Tata McGraw Hill.

SUGGESTED READINGS

1. G.D. Rai, '*Non-Conventional Energy Sources'*, Khanna Publications, New Delhi, 2011.
2. Godfrey Boyle, *'Renewable Energy, Power for a Sustainable Future*', Oxford University Press, U.K., 1996.
3. Khandelwal, K.C., Mahdi, S.S., '*Biogas Technology – A Practical Handbook'*, Tata McGraw-Hill, 1986.
4. Tiwari. G.N., Solar Energy – *'Fundamentals Design, Modeling & Applications'*, Narosa Publishing House, New Delhi, 2002.
5. Freris. L.L., *'Wind Energy Conversion Systems'*, Prentice Hall, UK, 1990.
6. Frank Krieth and John F Kreider , '*Principles of Solar Energy'*, John Wiley, New York

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2. https://onlinecourses.nptel.ac.in/noc20_ph14/preview
3. https://nptel.ac.in/courses/103103206
4. https://archive.nptel.ac.in/courses/103/103/103103206/
5. https://onlinecourses.nptel.ac.in/noc20_me10/preview

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	L	M	L	M	M	L	L
CO-2	H	M	L	M	L	M	M	M	L
CO-3	H	H	M	M	L	M	M	M	M
CO-4	H	M	M	M	M	M	M	M	M
CO-5	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	M	H
CO4	H	M	H
CO5	H	H	M

Course Title	MAJOR SKILL BASED ELECTIVE–1: DAIRY ENTREPRENEURSHIP
Code	U21CH3MSBT01
Semester	III
Course Type	Theory
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS

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

COURSE OBJECTIVES:

1. To illustrate the composition of milk and the process involved in boiling.
2. To discuss the reactions of milk proteins, milk carbohydrate and milk vitamins
3. To understand the chemistry of the creaming process
4. To explain the manufacture of milk powder and ice cream
5. To analyse the washing procedure using dairy detergents

UNIT I: INTRODUCTION TO MILK **6 Hrs.**

1.1 Milk: General composition of milk, factors affecting the gross composition of milk

1.2 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.**

2.1 Milk proteins - Physical properties of milk Proteins-Electrical properties, hydration and solubility. Reaction of milk proteins with formaldehyde and ninhydrin. 2.2 Milk Carbohydrate-Lactose, Estimation of lactose in milk. Milk vitamins-water and fat soluble vitamins, effect of heat and light on vitamins.

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

UNIT III: MILK CREAMS **6 Hrs.**

3.1 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. 3.2 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**

4.1 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 the quality of milk powder. 4.2 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**

5.1 Dairy Detergents-Definition, characteristics, classification-washing procedure (modern method)

5.2 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	Cognitive level
CO-1	identify the composition of milk, properties of milk, composition of milk cream, butter, ice-cream, need for making milk powder, types of dairy detergents	K1
CO-2	Understand the physiochemical changes of milk during various process, factors affecting the milk composition, reaction of milk proteins, effect of light and heat on vitamins, factors affecting cream separation, Desi butter, characteristics of dairy detergents, manufacture of butter, icecream and milk powder	K2
CO-3	Apply the different sterilization methods for milk, different methods of separation of cream from milk.	K3
CO-4	Estimate the lactose content, fat acidity, salt and moisture content	K4
CO-5	Evaluate the milk quality parameters in various milk samples and compare them with the standard	K5

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

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. Paul L. H. McSweeney and Patrick F. Fox,(2013) "*Advanced Dairy Chemistry*", Springer, 4th Edition.

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 Diary Technology*", Oxford University Press.

WEB REFERENCES

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2. http://milkfacts.info/Milk%20Composition/Protein.html
3. https://www.desidakaar.com/homemade-fresh-cream-recipe/
4. https://www.vegrecipesofindia.com/vanilla-ice-cream-recipe/
5. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=6170

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	H	H	H	H	M	M
CO-3	M	H	M	M	H	H	H	M	M
CO-4	H	M	H	H	H	M	H	M	H
CO-5	H	H	H	H	M	H	H	H	M

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	M	M	M
CO2	M	M	H
CO3	H	H	H
CO4	H	H	H
CO5	H	M	H

Course Title	**ALLIED 4: CHEMISTRY PAPER I (FOR BIOCHEMISTRY MAIN)**
Code	**U21CH3ALT04**
Course type	**Theory**
Semester	**III**
Hours/Week	**4**
Credits	**2**
Marks	**100**

CONSPECTUS

To make the students to understand and apply the basic concepts of co-ordination chemistry, metals and metalloenzymes in biology, water chemistry, electrochemistry and photochemistry.

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 role of metal ions in biological systems.
3. To understand and determine the water quality parameters
4. To understand and apply the basic concepts of conductance in the determination of pH, Kohlrausch law and the conductometric titrations.
5. To recognize and relate the different photochemical laws and photophysical processes.

UNIT-I 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 particular 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-II METALS AND METALLOENZYMES IN BIOLOGY 12Hrs.

2.1 Metal ions in Biology- Essential and trace elements in biological system, role of alkali and alkaline earth metal ions- sodium-potassium pump, calcium pump, biological fixation of nitrogen.

2.2 Biological importance and toxicity of elements such as Fe, Mo, W, V Cr, Cu, Zn, Co and Mn in biological system and their vital role in the active site.

2.3 Metallo enzymes- carbonic anhydrase, carboxy peptidase, peroxidases, catalases and cytochrome-P450.

Extra Reading/Keywords: *vitamin B_{12}*

UNIT-III CHEMISTRY OF WATER **12Hrs.**

3.1. 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.

3.2. Internal and external treatment of hard water – Zeolite process, Ion exchange process, desalination of water.

3.3. 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-IV ELECTROCHEMISTRY – I **12Hrs.**

4.1 Conductance –specific conductance, equivalent conductance, strong and weak electrolytes, variation of equivalent conductance with dilution, factors affecting electrolytic conduction, comparison of electrolytic and metallic conduction, measurement of equivalent conductance, molar conductance, relationship between conductivity and molar conductivity.

4.2 Kohlrausch law and its application to determine Λo of a weak electrolyte, Conductometric titrations – HCl Vs NaOH, KCl Vs $AgNO_3$, CH_3COOH Vs NaOH, differences between conductometric titration and volumetric titrations.

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-V PHOTOCHEMISTRY **12Hrs.**

5.1 Photochemistry – interaction of radiation with matter – differences between thermal and photochemical reaction- laws of photochemistry- Lambert-Beer's law, Grothus-Draper law and Stark-Einstein's law of photochemical equivalence.

5.2 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, photolysis of acetaldehyde, dimerization of anthracene.

5.3 Jablonski diagram, photosensitized reactions, types of luminescence, fluorescence, phosphorescence and chemiluminescence. Applications of fluorescence and phosphorescence.

Extra reading/ Keywords: *Biological applications of chemiluminescence*

COURSE OUTCOMES

CO No.	**COURSE OUTCOMES**	**Cognitive level**
CO1	Define and describe the terms in co-ordination chemistry, metal ions, metallo enzymes, nitrogen fixation, types of water, hardness of water, water quality parameters, boiler feed water, conductance, pH and buffer solution, differences between conductometric titration and volumetric titrations, laws of	K1

	photochemistry, distinguish between thermal and photochemical reactions, photophysical process.	
CO2	Identify and recognize the theories of coordination compounds and role of alkali and alkaline earth metals in biological system, biological importance of metal ions, heamoglobin, myoglobin and chlorophyll, internal and external treatment of hard water, disadvantages of hard water, electrical conductance, relationship between conductivity and molar conductivity, conductometric titration, determination of pH and buffer solutions, explain photochemical reactions, quantum yield, Jablonski diagram.	K2
CO3	Apply the concept of Pauling's theory to determine hybridization and magnetic behavior of coordination complexes, co-ordination chemistry in various fields, metal ions in biological system, toxicity of metal ions, metalloenzymes, quantum yield in chemical reactions, boiler troubles, calculation of water quality parameters, Kohlrausch law in determination of Λo, measurement of conductance, pH and buffer solutions, photo sensitized reactions, illustrate the applications of photophysical process.	K3
CO4	Examine the stability of complexes using EAN, analyze the hybridization and magnetic behavior of coordination complexes, role of metal ions in the active site of biological systems, water quality parameters, preparation of potable water and deionized water, desalination of water, determination of pH by conductivity method, buffer solution in biological system, low and high quantum yield, fluorescence and phosphorescence, analyze the photochemical reactions based on quantum yield.	K4
CO5	Evaluate the toxicity of metal ions in biological systems, water quality parameters for different water samples, pH of buffer solutions in biological systems, quantum yield for HCl, HI, acetic acid and anthracene.	K5

TEXT BOOKS

6. Puri B.R., Sharma L.R. and Madan S. Pathania, (2016-17), *Principles of Physical Chemistry* 47th Edition.. New Delhi:Shoban Lal Nagin chand and Co.
7. Sharma B.K, (2016), *Industrial Chemistry*, Goel Publishing House, Meerut.
8. Puri B.R., Sharma L.R. and Kalia K.C., (2021-22), *Principles of Inorganic Chemistry* 33rd Edition Jalandhar: Vishal Publishing Co.
9. Bahl B.S, Arun Bahl and Tuli G.D, (2014), *Essentials of Physical Chemistry*, New Delhi: Sultan Chand and Sons.

SUGGESTED READINGS

4. Soni P.L. and Mohankatyal , (1992.), *Text book of Inorganic Chemistry*, 20th revised Edition, Sultan Chand and Sons
5. Jain P. C., Jain Monika, (2004.), *Engineering Chemistry*, Dhanpat Rai Publishing Company

WEB REFERENCES

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2. https://www.vedantu.com/chemistry/conductometric-titration
3. https://www.vedantu.com/physics/fluorescence-and-phosphorescence
4. https://ncert.nic.in/textbook/pdf/lech109.pdf
5. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Physical_Properties_of_Matter/All_About_Water

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	H	H	H	H	M	M
CO-3	M	H	M	M	H	H	H	M	M
CO-4	H	M	H	H	H	M	H	M	H
CO-5	H	H	H	H	M	M	H	H	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
CO5	H	M	H

Course Title	ALLIED 4: CHEMISTRY PAPER I (FOR PHYSICS MAIN)
Code	U21CH3ALT05
Course Type	Theory
Semester	III
Hours/Week	4
Credits	2
Marks	100

CONSPECTUS

Allied Chemistry deals with the basic concepts from all the branches of chemistry. This course helps to understand the basic organic reactions, quantum numbers, chemical bonding, energy sources, storage devices, solutions, colligative properties and phase equilibria.

COURSE OBJECTIVES

1. To understand the basic concepts of organic chemistry.
2. To recognize the concept of grouping elements based on their properties in periodic table.
3. To elaborate the basic concepts of ionic and covalent bonding.
4. To explain the working of nuclear reactor and batteries.
5. To differentiate ideal and non-ideal solutions and to sketch the phase diagram of one and two component systems.

UNIT- I INTRODUCTION TO ORGANIC CHEMISTRY 12Hrs.

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 12Hrs.

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 and 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 12Hrs

3.1 Ionic bond – definition, factors influencing the formation of ionic bonding, variable electro valency and properties of ionic compounds.

3.2 Covalent bond - orbital overlap concept for the H_2, F_2, O_2 and HF molecules, Variable covalency and properties of covalent compounds.
3.3 Polarity in covalent bonds, Fajan's rules -polarization of molecules, effects of polarization and 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 and 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_2-O_2 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 and 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_2O).

Extra reading/keywords*:* *Alloy and phase diagrams of three component system*

COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive level
CO1	Recall the types of reagents, field effects, quantum numbers, bonds, batteries, solutions and recognize the periodic properties.	K1
CO2	Explain the different field effects, quantum numbers, nuclear fission and fusion reaction and the various colligative properties.	K2
CO3	Apply the concept of field effects to find the stability, Fajan's rule, illustrate the working of batteries and derive the expression for relative lowering of vapour pressure.	K3
CO4	Sketch the resonating and hyper conjugative structures, examine the periodic trends, calculate the percent ionic character, applications of batteries, and construct phase diagram of water and simple eutectic system.	K4
CO-5	Evaluate the acidic nature of organic compounds based on inductive effect, percentage ionic character of compounds, the mole fraction of a solute in a solution, molecular weight of a compound, osmotic pressure of a solution, degree of freedom, the orbital designation of an element in the periodic table, ionization energy, electronegativity and efficiency of different types of cells.	K5

RBT Levels

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

TEXT BOOKS

1. Puri B.R., 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*, 35th Edition, Shoban Lal Nagin Chand and Co.
3. Parmer V.S. and Chawla B.M., (1973), *Principles of reaction mechanism in Organic Chemistry*, 2nd Edition, Sultan Chand and Co.
4. Ravikrishnan A., (2000), *Engineering Chemistry* – I & II, 14th Edition, Srikrishna Hitech Publishing Company Pvt., Ltd.

SUGGESTED READINGS

1. Huheey, J.E., Ellen. A. Keiter & Richard.L. Keiter. (2003), *Inorganic Chemistry*, 4th Edition, London, Addison & Wesley.
2. Lee, J.D. (1995), *A New Concise Inorganic Chemistry* ,4th Edition, London: ELBS.
3. Morrison, R.T., Boyd. R.N. and Bhattacharjee. S.K. (2011), *Organic Chemistry*, 7th Edition, Pearson Prentice Hall.
4. Moore. W.J (1972), *Physical Chemistry*, 5th Edition, Orient Longman Ltd.

WEB REFERENCES

1. https://www.vedantu.com/chemistry/types-of-organic-reactions
2. https://classnotes.org.in/class11/chemistry/structure-of-atom/quantum-numbers/
3. https://ncert.nic.in/ncerts/l/kech103.pdf
4. https://www.learncbse.in/solutions-cbse-notes-class-12-chemistry/
5. https://colloidmueg.weebly.com/uploads/2/5/7/3/25736627/chapter_19._the_phase_rule.pdf

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	L	M	L	M	M	L	L
CO-2	H	M	L	M	L	M	M	M	L
CO-3	H	H	M	M	L	M	M	M	M
CO-4	H	M	M	M	M	M	M	M	M
CO-5	H	L	M	M	M	M	L	M	L

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	H	M	H
CO3	H	M	H
CO4	H	M	H
CO5	M	M	L

Course Title	**NON-MAJOR ELECTIVE – 1: FOOD AND NUTRITION**
Code	**U21CH3NMT01**
Course type	**Theory**
Semester	**III**
Hours/Week	**3**
Credits	**3**
Marks	**100**

CONSPECTUS

To enable the students to identify the functions of carbohydrates, vitamins and minerals, their sources and their deficiency diseases, the terms involved in the food, different processing techniques, ways to enhance the quality of food free from adulteration, various roles and functions of quality control.

COURSE OBJECTIVES

1. To develop the social thinking and ability in context of balanced diet and its nutrition contents.
2. To understand the nutritive value that influence food quality in the food industry.
3. To learn the knowledge about various techniques used in food processing.
4. To analyse and apply the food adulteration techniques in their daily life.
5. To explain the significance of sensory evaluation and food quality control.

UNIT-I - CONSTITUENTS OF FOODS 9Hrs.

1.1 Introduction, classification, sources of food – (animal and plant sources), functions and uses of food.
1.2 Selection and storage of food. balanced diet, meal planning: objectives, factors affecting meal planning.
1.3 Nutritional value – sources, functions, bioavailability and deficiency diseases of carbohydrates, proteins, lipids, vitamins and minerals.

Extra Reading/keywords: *novel foods and organic foods.*

UNIT-II NUTRITION AND DIET 9Hrs.

2.1 Nutrition – calorific value of food, respiratory quotient of food and recommended Dietary allowances for energy
2.2 Basal metabolic rate. – factors influencing BMR (Basal Metabolic Rate), specific dynamic action (SDA) of food.
2.3 Thermogenic effect – energy requirements of individuals – diet and its components.

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

UNIT-III FOOD PROCESSING **9Hrs.**

3.1 Food spoilage: Definition, sources of contamination and microorganisms involved in food spoilages. Types of food spoilage and deterioration.
3.2 Methods of food preservation and processing (heating, sterilization, deep freezing and pasteurization).
3.3 Definition of sterilization and disinfection. Objectives of cooking and different modes of cooking fruits and vegetables.

Extra Reading/keywords: *Various food processing techniques*

UNIT-IV FOOD ADULTERATION **9Hrs.**

4.1 Food Adulterants - common adulterants in different foods - milk and milk products, vegetable oils and fat, spices, cereals, pulses, sweetening agents and beverages.
4.2 Naturally occurring toxins in foods, chemical toxins (pesticides residues, heavy metals) and microbial toxins (bacterial and fungal) and its effects.
4.3 Contamination with toxic chemicals- pesticides and insecticides. Detection of common food adulterants.

Extra Reading/keywords: *food safety parameters*

UNIT-V FOOD QUALITY CONTROL **9Hrs.**

5.1 Quality control, quality assurance and its importance.
5.2 Role and functions of implementing agencies with references to Indian scenario. Tips to consumers for buying safety food.
5.3 Sensory characteristics of food, factors affecting food acceptance - sensory and psychological factors. objective method of sensory evaluation

Extra Reading/keywords: *Food quality control procedures*

COURSE OUTCOMES

CO No.	Course Outcomes	Cognitive Level
CO-1	Recognise the source, functions and classifications of food, define the calorific value, respiratory quotient, basal metabolic rate and thermogenic effect, identify the food spoilage and food adulteration, define the quality control and quality control methods available in India and international scenario.	K1
CO-2	Explain the sources, functions, bioavailability and deficiency diseases of carbohydrates, proteins, lipids, vitamins and minerals, role and functions of implementing agencies with references to Indian scenario. describe the recommended dietary allowances for energy and factors affecting BMR, food processing methods, summarize the naturally occurring toxins in foods.	K2
CO-3	Apply the balanced diet in their life, different modes of cooking fruits and vegetables, calculate the BMR value, interpret the common adulterants present in the food.	K3
CO-4	Analyse the common food adulterants, sterilization and disinfection present in different types of food, various food processing methods and food	K4

	preservation methods, correlate the sensory and psychological characteristics of food acceptance.	
CO5	Evaluate the BMR values for different age groups and test the food adulterants of various food items.	K5

TEXT BOOKS

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

SUGGESTED READINGS

1. Carl H, Synder, (1992) *The Extraordinary chemistry for ordinary things*, New York, John Wiley & Inc.
2. Alex. 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,
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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2. https://www.medicalnewstoday.com/articles/basal-metabolic-rate#definition
3. https://www.eufic.org/en/food-production/article/processed-food-qa
4. https://www.publichealthnotes.com/food-adulteration-types-of-food-adulteration-and-mitigation-measures/
5. https://www.simplilearn.com/what-is-quality-control-article

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	M	H
CO-2	H	H	M	H	H	H	H	M	H
CO-3	H	H	H	H	H	H	H	M	H
CO-4	H	H	H	H	H	H	H	M	H
CO-5	H	H	H	H	H	M	H	H	H

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	M
CO4	H	H	H
CO5	H	H	H

Course Title	Major Core 8- INORGANIC AND PHYSICAL CHEMISTRY
Code	U21CH4MCT08
Semester	IV
Total Hours	75
Hours/Week	5
Course Type	Theory
Credits	4
Marks	100

CONSPECTUS:

This course will enable the students to learn the general characteristics of p-block elements and their compounds and learn about the kinetics of reaction rate.

COURSE OBJECTIVES

1. To outline the characteristics of p- block elements and find out the anomalous behavior of Carbon.
2. To understand the preparation, properties, structure and compounds of nitrogen group, carbon group, halogens and noble gases.
3. To analyze the characteristics of d-block elements and outline the industrially important compounds of d-block elements.
4. To illustrate the reaction rates in the determination of rate laws.
5. To 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 CO_2 and SiO_2, CCl_4 and $SiCl_4$. 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-XeF_2, XeF_4, XeF_6, 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, TiO_2, V_2O_5, Sodium nitro prusside – preparation, properties and uses, chrome tanning- process and consequences

3.4 Oxidising properties of $KMnO_4$, 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 **15Hrs.**

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 – iodine reaction.*

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 the general characteristics of p-block and d-block elements, terminologies of chemical kinetics and photochemistry.	**K1**

CO 2	Illustrate the preparation, properties and biological functions of p-block and d-block elements, derivation of rate equations, half-life period, kinetics of photo chemical combination of Hydrogen-Bromine reactions, Hydrogen-Chlorine reactions and experimental techniques involved in the determination of rate equations.	**K2**
CO-3	Relate the toxicity of p and d-block elements, calculate the quantum yield, activation energy, order and half-life period,	**K3**
CO-4	Analyse the trends in physical and chemical properties in passing from the first to the second series and to the third series, anomalous behaviour of carbon, oxygen and diagonal relationship between B and Si, analysing the photochemical reactions based on quantum yield.	**K4**
CO-5	Predict the geometries of Xenon fluoride compounds, assess the order of the given reactions and biological effects of d-block metals	**K5**

RBT Levels

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

TEXT BOOKS

1. Puri, B R, Sharma, L R, Kalia, K C (1996), '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*, 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
4. Madan R.D., (1987), '*Modern Inorganic Chemistry*', S. Chand and Company (PVT) limited, New Delhi.

SUGGESTED READINGS

1. Lee. J D, (1995) *A New Concise Inorganic Chemistry* 4th edition Chapman &Hall London
2. Huheey,J E, Ellen. A. Keiter and Richard L. Keiter. (2003) *Inorganic Chemistry*.: 4th edition., Addison & Wesley. London
3. Cotton, F A, Wilkinson G and, Guas, P L,(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*, 20th revised edn., Sultan Chand and sons. New Delhi

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1. https://ncert.nic.in/ncerts/l/lech107.pdf
2. https://archive.nptel.ac.in/courses/104/101/104101090/
3. https://www.askiitians.com/iit-jee-chemistry/chemical-kinetics.aspx
4. https://www.askiitians.com/iit-jee-s-and-p-block-elements/the-p-block-elements/
5. https://onlinecourses.swayam2.ac.in/cec21_ma16/preview

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	H	H
CO-2	H	H	M	M	M	M	H	H	M
CO-3	H	M	M	M	M	M	H	M	M

CO-4	**H**	**H**	**L**	**M**	**M**	**M**	**H**	**M**	**M**
CO-5	**H**	**H**	**M**	**M**	**M**	**H**	**H**	**H**	**M**

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	**H**	**M**	**H**
CO2	**H**	**M**	**H**
CO3	**H**	**M**	**H**
CO4	**M**	**M**	**H**
CO5	**H**	**H**	**H**

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

Course Title	Major Core 9- APPLIED CHEMISTRY PRACTICAL
Code	**U21CH4MCP09**
Semester	**IV**
Total Hours	**45**
Hours/Week	**3**
Course Type	**PRACTICAL**
Credits	**3**
Marks	**100**

CONSPECTUS

To develop practical skills in the separation of solid and liquid mixtures, determine the melting and boiling point and identifies the Rf values using chromatographic techniques.

COURSE OBJECTIVES:

1. To understand the different types of separation techniques for both solid and liquid mixtures.
2. To determine the melting and boiling point of the given mixtures.
3. To determine the R_f values for the separation of dyes and amino acids by chromatographic techniques.
4. To estimate the amount of hardness present in water.
5. To calculate the molecular weight of a polymer by viscometer.

PRACTICALS:

1. Separation of the solid mixtures into its constituents, Purification and determination of Melting point using Bicarbonate separation
   a. Benzoic acid + m-dinitro benzene
   b. Benzoic acid + Biphenyl
2. Separation of the solid mixtures into its constituents, Purification and determination of

Melting point using Sodium hydroxide separation

c. Resorcinol + m-dinitrobenzene

d. Naphthol + m-dinitrobenzene

3. 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.

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	Identify the type of separation of solid mixtures using pilot test.	K1
CO-2	Demonstrate the separation of solid and liquid mixtures into its constituents.	K2
CO-3	Determine the melting and boiling point of the given mixtures, hardness of water and molecular weight of polymers.	K3
CO-4	Analyse the amino acids and dyes using the R_f values.	K4
CO-5	Predict the molecular weight of polymers using Viscometer.	K5

RBT Levels

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

TEXTBOOKS

1. Puri B.R., Sharma L.R. and Madan S. Pathania, (2013).*Principles of Physical Chemistry (*35th edn).New Delhi: Shoban Lal Nagin chand and Co.
2. Gopalan R., Subramanian P.S. and Rengarajan K,(2013) *Elements of Analytical Chemistry.* 3rd edn.,New Delhi: Sultan Chand and sons.

SUGGESTED READINGS:

1. Venkateswaran V., Veeraswamy R., Kulandaivelu A.R., (1997), '*Basic Principles of Practical Chemistry'*, Second edition, Sultan Chand & Sons.
2. Puri B.R., Sharma L.R. and Madan S. Pathania, (2013) *Principles of Inorganic Chemistry,* 35th edn., New Delhi: Shoban Lal Nagin chand and Co.

WEB REFERENCES

1. https://www.youtube.com/watch?v=ZCzgQXGz9Tg
2. https://www.youtube.com/watch?v=gAkf6x2pRoU
3. https://www.youtube.com/watch?v=qdmKGskCyh8
4. https://www.youtube.com/watch?v=rMGQavOMAmc
5. https://www.youtube.com/watch?v=Kn2pcH4ai5g

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	M	H	H	H	H
CO-4	H	H	H	H	M	H	H	H	H
CO-5	H	H	H	H	M	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
CO5	H	H	H

Course Title	Major Elective – CHEMISTRY OF BIOMOLECULES
Code	U21CH4MET05
Semester	IV
Total Hours	60
Hours/Week	4
Course Type	Theory
Credits	3
Marks	100

CONSPECTUS

Chemistry of Biomolecules deals with the basic concepts of biomolecule reactions taking place in our body. This course helps to understand about the carbohydrates, lipids, proteins, enzymes, blood and bile pigments.

Course objectives:

1. To understand the importance and different classes of lipids and functions of lipids.
2. To recognize the concept of carbohydrate digestion, glycolysis, glycogenesis, Glycogenolysis.
3. To elaborate the anabolism and catabolism of proteins, detect the effects of starvation on different metabolism.
4. To explain the properties, mechanism of action metabolic effects of Thyroxine and diseases associated with abnormal metabolism of thyroxine.
5. To understand the properties of blood, Haemoglobin, bile pigments, bile acids and blood groups.

UNIT I: CARBOHYDRATES **12Hrs**

3. 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 II: LIPIDS **12Hrs**

2.1 Introduction, Biological significance of fats, classification, Blood lipids.

2.2 Oxidation of fatty acids –β-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 Hypochlolesterolemia – pathological condition and treatment.

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

UNIT III: PROTEINS **12Hrs**

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 skelton, 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 IV: ENZYMES AND THYROXINE **12Hrs**

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 CH_2O, 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 V: BLOOD, BILE ACIDS AND PIGMENTS **12Hrs**

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 No.	COURSE OUTCOMES	Cognitive level
CO-1	Define and describe the carbohydrates, glycogenesis, glycogenolysis, glycolysis, gluconeogenesis, blood, Diabetics, lipids, Cholesterol, Absorption of proteins, nitrogen metabolism, enzymes and their classifications, Thyroxine, Haemoglobin, Bile pigment and bile acids.	K1
CO-2	Identify and recognize the Chemical and Physical changes of glucose, Oxidation of fatty acids, Catabolism of proteins, diseases due to deficiency of protein,	K2

	Factors influencing enzyme action, enzyme inhibitors, Intestinal fermentation and putrefaction, properties of Hb, Types of Jaundice.	
CO-3	Apply the concept of Regulation of blood sugar, Ketogenesis, Ketosis, effects of starvation on different metabolism, mechanism of enzyme action and enzyme inhibitors, metabolic effects of thyroxine, coagulation of blood mechanism.	K3
CO-4	Analyse the glucose Tolerance Tests, Diabetics pathological condition and treatment, Hyper and Hypochlolesterolemia, Inborn errors of phenylalanine metabolism, function and diseases associated with bile acids.	K4
CO-5	Evaluate the glucose tolerance in Type I and Type II diabetics, Lipid profile, metabolism of proteins, enzymes and haemoglobin.	K5

RBT Levels

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

TEXTBOOKS

1. Ambika Shanmugam, 'Fundamentals of Biochemistry for medical students', July 1982, 4th edn., 1983 Navabharat offset works.
2. U.Satyanarayana and U, Chakrapani, Biochemistry, Fourth Revised Edition, 2013, Elsevier.
3. David L. Nelson, Albert L. Lehninger, Michael M. Cox , Princples of biochemistry Lehninger.fifth edition, 2008, Worth *Publishers*, New York.

SUGGESTED READINGS

1. Dulsy Fatima, L.M.Narayanan and Co-workers – BioChemistry 1993, Saras publication.
2. Richard A. Harvey , Denise R. Ferrier, Biochemistry 4th ed. 2008.Lippincott Williams and Wilkins.

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2. **https://accesspharmacy.mhmedical.com/content.aspx?bookid=1696&sectionid=111398103**
3. **https://content.iospress.com/articles/translational-science-of-rare-diseases/trd200049**
4. **https://www.sciencelearn.org.nz/resources/1840-digestive-enzymes**
5. **https://departments.weber.edu/chpweb/hemophilia/mechanisms_of_blood_coagulation.htm**

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	M	M	M	H	M	M
CO-2	H	H	H	H	M	M	H	H	M
CO-3	H	H	H	H	M	H	H	H	H
CO-4	H	H	H	H	M	H	H	H	H
CO-5	H	H	H	H	M	H	H	H	H

CO-PSO Mapping

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

CO5	**H**	**H**	**H**

Course Title	**Allied 5: CHEMISTRY PAPER II (For Biochemistry Main)**
Code	**U21CH4ALT06**
Semester	**IV**
Total Hours	**60**
Hours/Week	**4**
Course Type	**Theory**
Credits	**2**
Marks	**100**

CONSPECTUS

To make the students to understand and apply the basic concepts in polymers, heterocyclic compounds, stereoisomerism, chemical aspects in industries, electrochemistry, chemical kinetics and catalysis.

COURSE OBJECTIVES

1. To explain the preparation, properties and uses of polymers, heterocyclic compounds and stereoisomerism.
2. To illustrate the various types of fuel gases, fertilizers, cleansing action of soaps.
3. To demonstrate cell reactions of primary, secondary batteries and corrosion.
4. To differentiate order and molecularity of the reaction, determine the order of the reaction.
5. To evaluate 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 Promotors, 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*

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	Cognitive Level

CO1	Define and describe the concepts in polymers, fertilizers, corrosion, order, molecularity ,catalysis and its types.	K1
CO2	Identify and recognize the heterocyclic compounds and its properties, fuel gases, order of the reaction, types of enzymes.	K2
CO3	Examine the different polymers, chemicals in industrially important compounds, electrochemical series, over voltage and heterogenous catalysis in adsorption theory.	K3
CO4	Analyse the cleansing action of soaps, stereoisomerism, fertilizer action, determination of electrode potential, corrosion and its prevention, order of the reaction, various theories of catalysis.	K4
CO5	Evaluate the basicity of pyrrole and pyridine, usage of fuel gases, reference electrodes, second order and zero order reaction, types of catalysis.	K5

RBT Levels

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

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*, 35th edition, shoban Lal Nagin Chand and Co, New Delhi.
3. Soni P.L. and Chawla H.M., (1997), *Text Book of Organic Chemistry*, 27th Edition, Sultan Chand and sons, New Delhi.

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1. Cotton F.A. and Wilkinson. G. (1999). *Advanced Inorganic Chemistry*, 4th Ed.. John Wiley and Sons Inc, London.
2. Huheey, J.H. (2002). *Inorganic Chemistry*, 4th 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.

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2. https://www.mechical.com/2021/03/methods-of-preventing-corrosion.html
3. https://study.com/learn/lesson/what-are-polymers-properties-applications-examples.html
4. https://chemistrypage.in/fuel-gases/

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	H	M	H	H
CO-5	M	H	M	H	H	H	H	H	M

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	M	M	H
CO2	M	L	M
CO3	L	M	L
CO4	M	L	L
CO5	M	M	H

Course Title	**Allied 5: CHEMISTRY PAPER II (For Physics Main)**
Code	**U21CH4ALT07**
Semester	**IV**
Total Hours	**60**
Hours/Week	**4**
Course Type	**Theory**
Credits	**2**
Marks	**100**

CONSPECTUS

Allied Chemistry deals with the basic concepts from all the branches of chemistry. This course helps to learn about the basic concepts in photochemistry, surface chemistry, electrochemistry, data analysis, chemical kinetics and fuels.

COURSE OBJECTIVES

1. To explain the photochemical and photophysical processes and their mechanisms.
2. To illustrate the various types of conductometric titration and corrosion control.
3. To calculate the mean, median, deviations, types of errors and different types of tests
4. To describe the general forms of rate equations and state the Arrhenius equation.
5. To 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_3COOH with NaOH, CH_3COOH with NH_4OH and KCl with $AgNO_3$.

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.*

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
CO-1	Define and describe the laws of photochemistry, emulsions, gels preparation and properties, rate of reaction, order and molecularity, fuels, classification of fuels and calorific values, recall the concept of mean, median, significant numbers, confidence limits, data ethics, precision and accuracy.	K1
CO-2	Explain the photochemical reactions, quantum yield, photo sensitized reactions, electrical conductance, conductometric titrations, types of corrosion, types of errors, order of reaction, combustion of fuels and theoretical calculation of calorific value- ignition temperature.	K2
CO-3	Apply the quantum yield in chemical reactions, conductometric titrations in various types, illustrate the applications of photochemistry and photochemical processes, , determination of order and corrosion control, manufacture of synthetic petrol, diesel oil, compressed natural gas (CNG), liquefied petroleum gases (LPG), producer gas and water gas.	K3
CO-4	Distinguish between thermal and photochemical reaction, fluorescence and phosphorescence, specific and equivalent conductance, analyse the photochemical reactions based on quantum yield, statistical tests of data - F test, t test and Q test, Arrhenius equation, coal, carbonization and manufacture of metallurgical coke.	K4
CO-5	Evaluate the Jablonski diagram, summarize the energy of activation and compare the various types of fuels.	K5

RBT Levels

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

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*, 35th edition, shoban Lal Nagin Chand and Co, New Delhi.
3. Soni P.L. and Chawla H.M., (1997), *Text Book of Organic Chemistry*, 27th Edition, Sultan Chand and sons, New Delhi.
4. Ravikrishnan A., (2000), Engineering Chemistry – I & II, 14th Edition, Srikrishna Hitech Publishing Company Pvt., Ltd Chennai.

SUGGESTED READINGS

1. Cotton F.A. and Wilkinson. G. (1999). *Advanced Inorganic Chemistry*, 4th Edition, John Wiley and Sons Inc. London.
2. Huheey, J.H. (2002). *Inorganic Chemistry*, 4th Edition, 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.

WEB REFERENCES

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2. http://stpius.ac.in/crm/assets/download/Photochemistry.pdf
3. https://www.griet.ac.in/nodes/EC_UNIT_2.pdf
4. http://web.iyte.edu.tr/~serifeyalcin/lectures/chem201/cn_7.pdf
5. https://ncert.nic.in/textbook/pdf/lech104.pdf
6. https://stannescet.ac.in/cms/staff/qbank/CSE/Notes/CY8151-Engineering%20Chemistry-1908708516-unit_4.pdf

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	L	M	L	M	M	L	L
CO-2	H	M	L	M	L	M	M	M	L
CO-3	M	H	M	M	L	M	M	M	M
CO-4	H	M	H	M	M	M	M	M	M
CO-5	L	M	M	M	M	L	M	L	M

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	H	M	H
CO3	H	M	H
CO4	H	M	H
CO5	H	M	H

Course Title	Allied 6: CHEMISTRY PAPER - III (For Biochemistry Main)
Code	U21CH4ALP08
Semester	IV
Total Hours	60
Hours/Week	4
Course Type	Practical
Credits	2
Marks	100

CONSPECTUS

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

COURSE OBJECTIVES

1. To understand the basic terms and the principle involved in volumetric analysis.
2. To categorize the primary standard ,standard solution and their requirements.
3. To illustrate the theories behind the acid-base indicators.
4. To determine the strength of the given solution from different types of titrations like acid base, redox, precipitation and complexometric titration.

5. To analyse the nature of the given organic substance

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.

TEXT BOOKS:

1. Puri B.R., Sharma L.R. and Madan S. Pathania, .*Principles of Inorganic Chemistry* 35thedn., 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: 2ndedn, 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: 6thedn., Pearson Education, 2006.
2. Soni P.L. and Mohankatyal ,*Text book of Inorganic Chemistry*, 20th revised edn., New Delhi: Sultan Chand and sons, 2013.

WEB REFERENCES

1. https://youtu.be/HVjvFydMOc8
2. https://youtu.be/ci4cHGLVZQY
3. https://youtu.be/Z2a5Owqr30A
4. https://youtu.be/7i6sGH5Me6g
5. https://youtu.be/85tMHHOj7PU

COURSE OUTCOMES(CO):

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
CO-4	find the risks and hazards in the lab and adopt techniques for lab safety and sustainable development.	K4
CO-5	evaluate the strength of the given solution	K5

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
CO-5	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
CO5	H	H	H

Course Title	**Allied 6: CHEMISTRY PAPER- III (For Physics Main)**
Code	**U21CH4ALP09**
Semester	**IV**
Total Hours	**60**
Hours/Week	**4**
Course type	**Practical**
Credits	**2**
Marks	**100**

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.

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.

TEXT BOOKS:

1. Puri B.R., Sharma L.R. and Madan S. Pathania, *.Principles of Inorganic Chemistry* 35th 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: 2nd 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: 6th edn., Pearson Education, 2006.
2. Soni P.L. and Mohankatyal ,*Text book of Inorganic Chemistry,* 20th revised edn., New Delhi: Sultan Chand and sons, 2013.

WEB REFERENCES

1. https://youtu.be/HVjvFydMOc8
2. https://youtu.be/ci4cHGLVZQY
3. https://youtu.be/Z2a5Owqr30A
4. https://youtu.be/7i6sGH5Me6g
5. https://youtu.be/85tMHHOj7PU

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
CO-4	find the risks and hazards in the lab and adopt techniques for lab safety and sustainable development.	K4
CO-5	evaluate the strength of the given solution	K5

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**
CO-5	**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**
CO5	**H**	**H**	**H**

Course Title	Non Major Elective-1: PRACTICAL SKILLS ON FOOD ANALYSIS AND SMALL SCALE PRODUCTS
Code	**U21CH4NMP02**
Semester	**IV**
Total Hours	**45**
Hours/Week	**3**
Course Type	**PRACTICAL**
Credits	**3**
Marks	**100**

CONSPECTUS

To explore the students to acquire knowledge about the adulterants in food and to gain practical experience in the preparation of household and personal care products.

COURSE OBJECTIVES:

1. To know about the adulterants present in food samples.
2. To identify the adulterants present in some solid and liquid food samples.
3. To acquire knowledge in the preparation of various household care products.
4. To distinguish between the herbal based and chemical based personal products.
5. To develop the entrepreneurial skill in the preparation of household and personal care products.

PRACTICALS:

1. Chemical analysis of adulterants in
   - (i) Turmeric powder (iii) Chickpea flour
   - (ii) Chilli powder (iv) Sugar
2. Chemical analysis of adulterants in
   - (i) Milk (iii) Honey
   - (ii) Ghee (iv) Oil
3. Preparation of
   - (i) Phenyl (iii) Liquid detergent
   - (ii) Floor cleaners (iv) Hand wash
4. Preparation of
   - (i) Candle (iii) Naphthalene balls
   - (ii) Incense stick (iv) Air freshener
5. Preparation of
   - (i) Herbal soap (iii) Henna based hair dye
   - (ii) Herbal shampoo (iv) Natural face mask
6. Preparation of
   - (i) Lipstick (iii) Moisturizing cream
   - (ii) Face powder (iv) Perfumes

CO No.	COURSE OUTCOMES	Cognitive Level
CO-1	describe the basic adulterants added in the food samples.	**K1**
CO-2	identify the natural and chemical ingredients present in cosmetics.	**K2**
CO-3	apply the practical experience in enhancing their employability.	**K3**
CO-4	analyze the adulterants present in food samples using chemical tests.	**K4**
CO-5	appraise the benefits of homemade herbal products	**K5**

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

TEXT BOOKS

1. B. Srilakshmi, Food Science, Third Edition, New Age International publishers, 2003
2. Parvesh Handa A Complete book on Beauty, Body, Makeup and hair styles, Goodwill publishing house, March 2014.

SUGGESTED READINGS

1. Mudambi, S.R., Rao, S.M. and Rajagopal, M.V.. Food science. 2nd Edition. New Age, 2006.
2. Baki Gabriella and Kenneth S. Alexander Introduction to cosmetic formulation and Technology, May 2015.

WEB REFERENCES

1.https://www.fssai.gov.in/upload/uploadfiles/files/Manual_Testing_Method_Food_Safety_On_Wheels_30_08_2017(2)(1).pdf

2.https://www.dfda.goa.gov.in/images/PDF-DOCUMENTS/quciktestforsomeadullterantsinfood-fssaiinitiative.pdf
3.https://www.turi.org/content/download/7355/134087/file/Vida%20Verde%20recipe%20booklet%20-%20English%20-%202016.pdf
4. https://www.pdfdrive.com/formulation-guide-for-cosmetics-e182935.html

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	H	H	H	H	M	H	H
CO-2	H	H	H	H	H	M	M	H	M
CO-3	H	H	H	H	H	H	M	H	H
CO-4	H	H	H	H	H	M	M	H	H
CO-5	H	H	H	H	H	M	M	H	H

CO-PSO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	M	M
CO2	H	H	M
CO3	H	H	H
CO4	H	M	M
CO5	H	M	H

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

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI-620002

SCHOOL OF PHYSICAL SCIENCES

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

UG COURSE PATTERN

B.Sc CHEMISTRY

Semester	Part	Course	Title of the Course	Course Code	Hrs./wk.	Credits	Marks
I	I	Language	General Tamil I/ General Hindi I/ General French I	**U20TL1GEN01/ U20HN1HIN01/ U20FR1FRE01**	3	3	100
	II	English	General English I	**U20EL1GEN01**	3	3	100
	III	Major Core – 1	Inorganic Organic and Physical Chemistry	**U20CH1MCT01**	5	4	100
		Major Core – 2	Volumetric Analysis (Lab cum theory)	**U20CH1MCP02**	4	3	100
		Major Core -3	Analytical Chemistry	**U20CH1MCT03**	4	4	100
		Allied – 1	Differential Calculus and Trigonometry/ Biomolecular Chemistry	**U20MA1ALT02/ U20BC1ALT01**	4	2	100
		Allied – 2	Algebra and Integral Calculus/ Practical	**U20MA1ALT07/ U20BC1ALP02**	4	2	100
	IV	Environmental Studies	Environmental Studies	**U20RE1EST01**	2	1	100
		Value Education	Ethics-I/ Bible Studies-I/ Catechism-I	**U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01**	1	-	-
		Service oriented course			-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U20SP1ECC01**		2(E C)	
		Total			30	22	800
	I	Language	General Tamil II/ General Hindi II/ General French II	**U20TL2GEN02/ U20HN2HIN02/ U20FR2FRE02**	3	3	100
	II	English	General English II	**U20EL2GEN02**	3	3	100
	III	Major Core –4	Organic and Physical Chemistry	**U20CH2MCT04**	5	5	100
		Major Core –5	Semi micro Analysis (Lab cum Theory)	**U20CH2MCP05**	4	3	100

II		Major Elective - 1	Major Elective – 1 Nanoscience and Nanotechnology for Chemical Sciences	**U20BT2MET01**	5	3	100
		Allied – 3	Analytical geometry of three dimensions, vector calculus and differential equations / Enzymes and Enzyme Technology	**U20MA2ALT09/ U20BC2ALT03**	4	2	100
	IV	Skill-based Course– 1	Soft Skill Development	**U20SS2SBT01**	2	1	100
		Skill-based Elective – 2	Rural Enrichment and Sustainable Development	**U20RE2SBT02**	2	1	100
			Industrial Chemistry	**U20CH2IRT01**	1	1	
		Value Education	Ethics I/ Bible Studies I/ Catechism I	**U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01**	1	1	100
		Service Oriented Course			-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U20SP2ECC02**		2(E C)	100
		Total			**30**	**23**	**900**

Semester	Part	Course	Title of the Course	**Course Code**	Hrs./ wk	Credits	Marks
III	I	Language	General Tamil III/ General Hindi III/ General French III	**U20TL3GEN03/ U20HN3HIN03/ U20FR3FRE03**	3	3	100
	II	English	General English III	**U20EL3GEN03**	3	3	100
	III	Major Core –6	Inorganic and Organic Chemistry	**U20CH3MCT06**	5	4	100
		Major Core –7	Physical Chemistry practical - I	**U20CH3MCP07**	4	3	100
		Major Elective - 2	Basic Programming/ Emerging trends in IT	**U20CS3MET02/ U20CA3MET01**	4	3	100
		Allied – 4	Basic Physics - I	**U20PH3ALT05**	4	2	100
	IV	Major Skill-based Elective– 1	Basic Skills in Biological Science /Botanical Techniques for Chemistry	**U20ZO3SBP03 / U20BO3SBP04**	2	1	100

		Non Major elective - 1	Non Major elective paper		3	3	100
		Value Education	Ethics-II/ Bible Studies-II/ Catechism -II	**U20VE4LVE02/ U20VE4LVB02/ U20VE4LVC02**	1	-	-
		Gender studies	Gender studies	**U20WS3GST01**	1	1	100
		Service Oriented Course					
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U20SP3ECC03**		2(EC)	100
		Total			**30**	**23**	**900**
IV	I	Language	General Tamil IV/ General Hindi IV/ General French IV	**U20TL4GEN04/ U20HN4HIN04/ U20FR4FRE04**	3	3	100
	II	English	General English IV	**U20EL4GEN04**	3	3	100
	III	Major Core –8	Inorganic and Physical Chemistry	**U20CH4MCT08**	5	4	100
		Major Core -9	Applied Chemistry Practical	**U20CH4MCP09**	3	3	100
		Major Elective - 3	Chemistry of Biomolecules	**U20BC4MET05**	4	3	100
		Allied – 5	Basic Physics Practicals - I	**U20PH4ALP07**	4	2	100
		Allied – 6	Basic Physics - II	**U20PH4ALT08**	4	2	100
		Non-Major Elective - 2	Non-Major Elective paper		3	3	100
	IV	Value Education	Ethics II/ Bible Studies II/ Catechism II	**U20VE4LVE02/ U20VE4LVB02/ U20VE4LVC02**	1	1	100
			Service Oriented Course			2(EC)	
			Internship / Field Work / Field Project 30 Hours - Extra Credit	**U20SP4ECC04**		2(EC)	100
		Total			**30**	**24**	**900**
Semester	**Part**	**Course**	**Title of the Course**		**Hrs./wk.**	**Credits**	**Marks**
V		Major Core –10	Inorganic Chemistry - I	**U20CH5MCT10**	4	4	100

	III	Major Core –11	Organic Chemistry - I	**U20CH5MCT11**	4	3	100
		Major Core -12	Physical Chemistry - I	**U20CH5MCT12**	4	4	100
		Major Core -13	Gravimetric analysis and preparation of inorganic complexes	**U20CH5MCP13**	4	3	100
		Major Core -14	Physical Chemistry Practical - II	**U20CH5MCP14**	4	3	100
		Major Elective - 4	Food Chemistry/ / Smart Waste Management for Environmental Sustainability	**U20CH5MET07/ U20CH5MET08**	4	3	100
		Major Skill based Elective – 2	Nutricosmetics (for chemistry students)	**U20CH5SBT03**	2	1	100
	IV	Non Major Elective – 3			3	3	100
		Value Education	Ethics III/ Bible Studies III/ Catechism III	**U20VE6LVE03/ U20VE6LVB03/ U20VE6LVC03**	1	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U20SP5ECC05**		2(EC**)**	100
		Online Course		**U20OC5ECT01**			
		Total			**30**	**24**	**800**
VI	III	Major Core –15	Inorganic Chemistry -II	**U20CH6MCT15**	4	3	100
		Major Core –16	Organic Chemistry II	**U20CH6MCT16**	4	4	100
		Major Core – 17	Physical Chemistry– II	**U20CH6MCT17**	4	4	100
		Major Core – 18	Organic analysis and Preparation of Organic compounds	**U20CH6MCP18**	4	3	100
		Major Core – 19	Physical Chemistry Practical - III	**U20CH6MCP19**	4	3	100
		Major Core- for Physics	Spectroscopy	**U20CH6MCT20**	4	3	100
	IV	Non Major Elective - 4			3	3	100
		SBC – 3	Research Methodology	**U20DS6SBC03**	2	1	100
		Value Education	Ethics III/ Bible Studies III/ Catechism III	**U20VE6LVE03/ U20VE6LVB03/ U20VE6LVC03**	1	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U20SP6ECC06**		2(EC)	100

		RESCAPES				4(EC)	
			Total		**30**	**24**	**800**
			Grant Total		**180**	**140**	**5100**
		Grant Total – 140+ 18(EC) = 158					

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

Semester	**Part**	**Course**	**Title of the Course**	**Course Code**	**Hrs./wk.**	**Credits**	**Marks**
I	III	Allied – 1	Chemistry Paper I (For Bot/Zoology)	**U20CH1ALT01**	4	2	100
		Allied – 2	Chemistry Paper II (For Botany/ Zoology)	**U20CH1AL P02**	4	2	100
II		Major Elective - 1	Nano technology and Crystal growth techniques/ Chemistry of materials(For Physics)	**U20BT2MET01/ U20BT2MET02**	4	3	100
		Allied – 3	Chemistry Paper III (For Bot/ Zoology)	**U20CH2ALT03**	4	2	100
			Industrial Chemistry	**U20CH2IRT01**			
III	III	Major Elective - 2	Bioanalytical Techniques / Forensic science	**U20CH3MET03/ U20CH3MET04**	4	3	100
		Allied – 4	Chemistry Paper-I (For Biochemistry Physics)	**U20CH3ALT04/ U20CH3ALT05**	4	2	100
	IV	Major Skill-based Elective– 1	Dairy Entrepreneurship/ Health Chemistry	**U20CH3MSBT01/ U20CH3MSBT02**	2	1	100
		Non Major elective - 1	Food and Nutrition/ Everyday Chemistry	**U20CH3NMT01/ U20CH3NMT02**	3	3	100
IV	III	Major Elective - 3	Phytochemistry/Chemistry for Biologist-Lab cum theory (For Biotech)	**U20CH4MEP05/ U20CH4MEP06**	4	3	100
		Allied – 5	Chemistry paper –II (For Biochemistry Physics)	**U20CH4ALT06/ U20CH4ALT07**	4	2	100
		Allied – 6	Chemistry paper III (For Biochemistry/ Physics)	**U20CH4ALP08/ U20CH4ALP09**	4	2	100
	IV	Non Major Elective - 2	Home Science / Chemistry for Human Welfare/ small Scale Entrepreneurship	**U20CH4NMT03/ U20CH4NMT04/ U20CH4NMT05**	3	3	100

V	III	Major Elective - 4	Food Chemistry/ Smart Waste Management for Environmental Sustainability	**U20CH5MET07/ U20CH5MET08**	4	3	100
	IV	Non Major Elective – 3	Beauty Care	**U20CH5NMT06**	3	3	100
VI	IV	Non Major Elective - 4	Cosmetology	**U20CH6NMP07**	3	3	100

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year - Semester – V

Course Title	MAJOR CORE 10- INORGANIC CHEMISTRY-I
Total Hours	60
Hours/Week	4
Code	U20CH5MCT10
Course Type	Theory
Credits	4
Marks	100

General Objectives:

To make the students to learn about the nomenclature, isomerism, theories, distortion and stability of coordination complexes and to prepare them to know about the classification, bonding in metal carbonyls, importance of 18 electron rule, role of metal ions in biological systems and the concepts of nuclear chemistry.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO -1	differentiate the types of ligands in coordination compounds
CO -2	describe the theories of coordination complexes and their applications.
CO -3	analyze the principle, methods of gravimetric analysis and describe the types of precipitants and precipitation techniques.
CO -4	explain the classification, nature of bonding, properties and applications of organometallic compounds.
CO -5	apply the principles of nuclear chemistry in various nuclear reactions and understand the applications of radioactive isotopes.

UNIT I - CO-ORDINATION CHEMISTRY I **12Hrs**

1.1 Double salts, co-ordination compounds, co-ordination number, classification of ligands, nomenclature of coordination compounds. Chelation- classification, importance of chelation, factors influencing the stability of metal chelates, Role of metal chelates in living system.

1.2 Werner's theory, electronic interpretation of co-ordination compounds, factors affecting the formation of complex ions, detection of complex ion in solution, 18 electron rule.

1.3 Isomerism: Structural isomerism– hydrate isomerism, co-ordination isomerism, coordination position isomerism, ionization isomerism, ligand isomerism, linkage isomerism and polymerization isomerism.

1.4 Stereoisomerism – Geometrical isomerism in (i) square planar metal complexes (ii) Octahedral metal complexes using suitable examples. Optical isomerism in (i) tetrahedral complexes, (ii) Octahedral complexes using suitable examples.

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

UNIT II -CO-ORDINATION CHEMISTRY II **12Hrs**

2.1 Valence bond theory (VBT) – postulates and application to (a) tetrahedral complexes $Ni(NH_3)_4]^{2+}$, $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ (b) square planar complexes $[Ni(CN)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$, $[PtCl_4]^{2-}$ \(c) octahedral complexes $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$, $[FeF_6]^{4-}$, $[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$, Limitations of VBT.

2.2 Crystal field theory – crystal field splitting of energy levels of d-orbitals, important features of CFT, Crystal field stabilization energy, Factors affecting the magnitude of Δ_o. Application of CFT – color, magnetic properties and spin states of the complexes. limitations of CFT.

2.3 Ligand field theory (LFT) – important features of LFT, Basic principles and importance of Molecular orbital theory (MOT) in metal complexes. Comparison of different theories – VBT vs CFT, CFT vs LFT, VBT vs LFT

2.4 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: *Kinetics and thermodynamic stability of metal complexes.*

UNIT III - GRAVIMETRIC ANALYSIS AND THERMO ANALYTICAL METHODS 12Hrs

3.1 Principles of Gravimetric analysis- Methods of gravimetric analysis – requirements of gravimetric analysis. Precipitation – Theory of precipitation.

3.2 Types of precipitation – 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.

3.3 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 – Applications of TGA.

3.4 Differential thermal analysis - DTA of calcium oxalate monohydrate – thermal analysis of calcium acetate monohydrate. Applications of DTA.

Extra reading/Key words: *Electrogravimetry*

UNIT IV- BASIC ORGANOMETALLIC CHEMISTRY 12Hrs

4.1 Definition, a brief history, classification of organometallic compounds based on metal-carbon bond type, classification of ligands in organometallic compounds, alkene complexes (olefin complexes), Zeise's salt, Structural features of Zeise's salt, rhodium-ethylene complex, other metal-alkene complexes, iron-butadiene complex, bonding in metal-alkene complexes, metal-butadiene complexes.

4.2 The 18-electron rule and the organometallic compounds, metal-allyl complexes, η^3- allylpalladium chloride dimer, metal-acetylene complexes, carbyne complexes (alkylidynes), carbene complexes (alkylidenes), carbido complexes, metal-sandwich complexes.

4.3 Ferrocene- structure of ferrocene, bonding in ferrocene, properties of ferrocene, bis(cyclopentadienyl)beryllium, metallocenes.

4.4 Metal π-complexes – classification, general methods of preparation, general properties, structure of metal carbonyls, applications of 18 electron rule on structural elucidation of mono and poly nuclear metal carbonyls (nuclearity ≤ 4). Importance and applications of organometallic compounds.

Extra reading/Keywords: *Organometallic compounds in green catalysis*

UNIT V -NUCLEAR CHEMISTRY 12Hrs

5.1 Subatomic particles, nuclear size, nuclear forces – Meson theory of nuclear forces. Magic number, nuclear shell structure - Liquid drop model.

5.2 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.

5.3 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.

5.4 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.*

Course Outcomes (CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	recall the basic terms in coordination chemistry and nomenclature.	PSO1	R, An
CO -2	analyze the splitting of energy levels based on CFT and compare the theories of coordination chemistry	PSO1	Ap, An
CO -3	describe the principle, instrumentation and applications of TGA and DTA	PSO2	R,Ap
CO -4	recall the classification of organometallic compounds and understand the bonding in ferrocene and metal carbonyls	PSO4	U,Ap
CO -5	explain the theories of nuclear chemistry, nuclear stability and applications of radioisotopes.	PSO1	U, Ap

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

TEXTBOOKS

1. B.D. Gupta and A.J. Elias, Basic organometallic chemistry, 1st Edition (2010).
2. N.N. Greenwood, chemistry of the elements,2nd Edition (2005), Elsevier Publication
3. Puri B.R., Sharma L.R. and Kalia, *Principles of Inorganic Chemistry,* Vishal Publishing Co., 2021.
4. S. K. Agarwala, Keemti Lal, *Advanced Inorganic Chemistry*, Pragati Prakashan Publishers, 15th Edition, 2015.

BOOKS FOR REFERENCES

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

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

SCHOOL OF PHYSICAL SCIENCES

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

PG & RESEARCH DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year - Semester – V

Course Title	**MAJOR CORE -11 – ORGANIC CHEMISTRY-I**
Total Hours	**60**
Hours/Week	**4**
Code	**U20CH5MCT11**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objectives:

The student learns the preparations and properties of some important organic compounds containing oxygen and nitrogen.

Course Objectives (CO):

The learner will be able to

CO No.	**Course Objectives**
CO-1	understand the preparation, properties of aliphatic and aromatic aldehydes and ketones
CO-2	describe the preparation, properties and strength of aliphatic and aromatic carboxylic, sulphonic acids and their derivatives.
CO-3	appraise and justify the preparation, properties and basicity of nitrogen containing organic compounds.
CO-4	classify, formulate and discuss the concepts of amino acids, proteins and nucleic acids.
CO-5	classify, distinguish and elucidate the structures of few carbohydrates

UNIT I -CARBONYL COMPOUNDS **12Hrs**

1.1 Carbonyl compounds – Introduction, General methods of preparation and properties of aliphatic and aromatic aldehydes and ketones.

1.2 General reactions and mechanisms of Aldol condensation , Claisen reaction , Perkins reaction , Knoevenagel reaction ,Mannich reaction and Benzoin condensation.

1.3 General reactions and mechanisms of Reformatsky, Wittig, Claisen- Schmidt, Cannizzaro and haloform reactions. Mechanism of reduction ($NaBH_4$, Wolff-Kishner and MPV reduction).

1.4 α, β – unsaturated carbonyl compounds – General methods of preparation and properties, Michael addition and its mechanism .

Extra reading/Keywords: *Applications of Carbonyl Compounds*

UNIT II -ORGANIC ACIDS AND DERIVATIVES **12Hrs**

2.1 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.

2.2 Aromatic sulphonic acid – preparation and properties. Aliphatic hydroxy acids – Action of heat on α, β, γ hydroxy acids. Acyl substitution.

2.3 Aliphatic dicarboxylic acid – Blanc's rule.Problems related to mono and dicarboxylic acids.

2.4 Malonic and aceto acetic ester – characteristics and synthetic uses.

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

UNIT III- NITRO COMPOUNDS AND AMINES **12Hrs**

3.1 Aliphatic nitro compounds – comparison between primary, secondary and tertiary Nitro compounds. Conversion of nitrobenzene to o, m and p-dinitrobenzene, reduction of nitrobenzene in neutral, acidic and alkaline media. Trinitrotoluene – preparation and properties and uses.

3.2 Relative basic characters of aliphatic, aromatic amines and guanidine. Separation of aliphatic amines. Phenylene diamines – preparation, properties and uses.

3.3 Diazotisation - Illustration and mechanism. Synthetic applications of diazonium salts.

3.4 Diazomethane and diazo acetic ester – preparations, structure and their synthetic uses.

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

UNIT IV- AMINO ACIDS, PROTEINS AND NUCLEIC ACIDS **12Hrs**

4.1 Amino acids – introduction, classification, zwitter ions, iso electric point, Preparation of amino acids-Gabriel's phthalimide, Strecker's , chemical characteristics (reactions of amino group, carbonyl group and amino-carbonyl groups).

4.2 Peptides and Polypeptides – classification, synthesis (Bergmann's method), characterization of peptides by C- Terminal residue analysis (hydrazinolyis method) and N-termianal analysis (Sanger's, Edman's method)

4.3 Proteins – Introduction, classification based on composition, physical and chemical properties (colour reactions), structural analysis- primary, secondary and tertiary, and functions of proteins.

4.4 Nucleic acids – structure of DNA and its role in heredity, DNA replication, types of RNA, synthesis of m-RNA, t-RNA, biological functions of DNA and RNA.

Extra reading/Keywords: Genetic code and bio synthesis of proteins

UNIT V-CARBOHYDRATES **12Hrs**

5.1 Carbohydrates - Introduction, classification, monosaccharides - preparation, reactions, structural elucidation of glucose and fructose.

5.2 Ring size determination- Haworth's methylation Method, Periodate oxidation method, Mutarotation and Epimerization. Ascending and descending of sugar series - Arabinose to Glucose (Kiliani-Fischer synthesis) and Glucose to Arabinose (Ruff degradation) . Interconversions – conversion of Glucose into Fructose, Fructose into Glucose.

5.3 Disaccharides – preparations, reactions and structure of maltose, lactose and sucrose (Structural elucidation not expected).

5.4 Chemistry of starch and cellulose – properties, structures 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 learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describe the mechanism of various reactions of carbonyl compounds	PSO 1	R, U
CO-2	Formulates and discriminate the preparation, properties and strength of aliphatic, Aromatic carboxylic, sulphonic acids and their derivatives.	PSO 2	R, U
CO-3	Explains the preparation, properties and basicity of nitrogen containing organic compounds.	PSO 2	Ap
CO-4	Illustrate the physiological functions and structures of proteins, amino acids and nucleic acids.	PSO 3	Ap
CO-5	Elucidate 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. S.C. Sharma "Modern Organic Chemistry", Vishal Publishing Co. Golden Jubilee year Edition 2020.
2. Tewari K.S., Vishnoi N.K., Mehrotra S.N., "*A Text Book of Organic Chemistry*", 4th Revised Edition, Vikas Pulbishing House Pvt. Ltd, 2017.

BOOKS FOR REFERENCES

1. Soni P.L. and Chawla H.M, "*Text Book of Organic Chemistry*", 29th Edition, Sultan Chand, 2012.
2. Jerry March, "*Advanced Organic Chemistry*" Reactions, Mechanisms and Structure", 6th Edition,John Wiley and Sons(Asia)Pte. Ltd, New Delhi, 2006.
3. Robert Thornton Morrison, Robert Neilson Boyd , SaibalKanti Bhattacharjee, *Organic Chemistry*, 7th Edition, Pearson Education India, Chennai, 2011.
4. Jonathan Clayden, Nick Geeves, Stuart Warren, '*Organic chemistry'*, 2nd Edition, Oxford University Press, 2012.
5. John McMurray, '*Organic chemistry'*, 8th Edition., International Edition ,MaryFirch, 2011.

(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

B.Sc. CHEMISTRY

Third year - Semester – V

Course Title	**MAJOR CORE : 12 - PHYSICAL CHEMISTRY - I**
Total Hours	**60**
Hours/Week	**4**
Code	**U20CH5MCT12**
Course Type	**THEORY**
Credits	**4**
Marks	**100**

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 the concepts in chemical kinetics, fast reaction techniques and the fundamentals of catalysis and adsorption.

Course Objectives (CO):

The learner will be able to

CO No.	**Course Objectives**
CO-1	understand the concepts and theories of electrolytic conductance.
CO-2	know the electrochemical cells, EMF of the cell and its measurement.
CO-3	explain the concentration cells and the theories of over voltage and corrosion.
CO-4	understand the theories of chemical kinetics, chain reactions and fast reaction techniques.
CO-5	understand the concepts of catalysis, types of adsorption and its theories

UNIT-I: ELECTROLYTIC CONDUCTANCE AND TRANSFERENCE 12 Hrs

1.1. Ohm's law – conductance in metals and electrolytic solution – Specific conductance, equivalent conductance – Effect of dilution on conductance,Ionic mobility-definition, experimental proof for migration of ions.

1.2 Transport number – definition, Hittorf's rule, Determination of transport number by Hittorf's method and moving boundary method, Kohlrausch law and its applications.

1.3 Applications of conductance measurements – determination of degree of dissociation of weak electrolyte, ionic product of water, solubility of sparingly soluble salt and conductometric titrations.

1.4 Arrhenius theory of electrolytic dissociation and its limitations – Weak and strong electrolytes according to Arrhenius theory - Ostwald's diluton law, its uses and its limitations- 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: *Activity co-efficient of electrolytes*

UNIT-II: ELECTROCHEMICAL CELLS – I 12 Hrs

2.1 Galvanic cells, reversible electrodes and their types – metal/metal ion, gas/ion, metal/insoluble salt/anion, oxidation – reduction electrodes.

2.2 Single electrode potential, sign of electrode potential, reference electrodes – hydrogen, calomel and silver/silver chloride electrodes.

2.3 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.

2.4 E.M.F. of a cell and its measurement, Weston standard cell, the electrochemical series and its applications.

Extra reading, keywords: *Electrical double layer*

UNIT-III: ELECTROCHEMICAL CELLS – II 12 Hrs

3.1 Electrolyte concentration cells with and without transference, liquid junction potential.

3.2 Applications of E.M.F. measurements – determination of valency of ions, solubility product and pH – hydrogen electrode, quinhydrone electrode and glass electrode, potentiometric titrations.

3.3 Over Voltage – definition, determination and applications.

3.4 Corrosion of metals – definition, types, electrochemical theory of corrosion and prevention.

Extra reading, keywords: *Fuel cells and Batteries*

UNIT-IV: CHEMICAL KINETICS II 12 Hrs

4.1 The collision theory of reaction rates and its limitations. The theory of absolute reaction rates, comparison of collision theory with absolute reaction rate theory, significance of free energy of activation and entropy of activation.

4.2 Unimolecular reaction - Introduction, Lindemann's theory- Postulates-Mechanism-Derivation, Limitations.

4.3 Chain reactions - Introduction - Distinguishing features of chain reactions - Kinetics of chain reactions - steady state approximation - thermal combination of – hydrogen- bromine reaction.

4.4 Kinetics of fast reactions-Introduction - Methods - Flash Photolysis, Temperature and Pressure jump methods.

Extra reading, keywords: *Influence of solvent on the reaction rate*

UNIT-V: CATALYSIS AND ADSORPTION 12 Hrs

5.1 Catalysis - Introduction, Types of catalysis - Homogeneous catalysis and Heterogeneous catalysis, Characteristics of catalytic reactions, Promoters, catalytic poisoning, autocatalysis and negative catalysis.

5.2 Homogeneous catalysis- Intermediate compound formation theory- postulates, mechanism-kinetics, Acid - Base Catalysis- Mechanism.

5.3 Enzyme catalysis - Factors affecting the rate of enzyme reaction - Kinetics of enzyme catalyzed reaction - Michaelis-Menten equation and its verification, turnover number - effect of temperature and pH on enzyme reaction. Reversible and irreversible enzyme inhibitions, degree of inhibition.

5.4 Adsorption - Types of adsorption - Physical adsorption and chemical adsorption, Adsorption isotherms - Freundlich adsorption isotherm, Langmuir adsorption isotherm, applications.

Extra reading, keywords: *pH dependence of rate constants on catalyzed reactions.*

COURSE OUTCOMES(CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	explain the concepts of conductance and its applications	PSO1	U
CO-2	recognize the types of electrodes, thermodynamics of reversible electrodes and measures the cell EMF	PSO2	Ap
CO-3	discuss the concept of over voltage and corrosion	PSO3	Ap
CO-4	explain the concepts in chemical kinetics and fast reactions	PSO3	Ap
CO-5	discuss the types and theories of catalysis and adsorption	PSO2	U

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

TEXT BOOKS

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, '*Principles of Physical Chemistry'*, Vishal Publishing Co., Jalandhar, 2005.
2. B. S. Bahl, G. D. Tuli and Arun Bahl, '*Essentials of Physical Chemistry*', S. Chand and Co., New Delhi, 1999.
3. P. W. Atkins, "*Physical Chemistry*", (7th edition) Oxford University Press, 2009.

BOOKS FOR REFERENCES

1. Negi, A.S. & Anand, S.C.,'*A Text book of Physical Chemistry'*, 3rd Edition Wiley Eastern Ltd., 1994.
2. Walter J Moore ' *Physical Chemistry'*, 5th Edition., Prentice-Hall, 1999.
3. Bockris, J.O.M and Reddy, A.K.N. '*Modern Electro Chemistry',* 2nd Edition., 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.
6 B. Patania,,*'Chemical Kinetics'*, Campus Publications, New Delhi, 2004.
7. Gurtu J.N. and Amit Gurtu, '*Chemical Kinetics'*, 5th Edition., Mittal K.K., 1979.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year – Semester- V

Course Title	**MAJOR CORE 13– GRAVIMETRIC ANALYSIS AND PREPARATION OF INORGANIC COMPLEXES**
Total Hours	**60**
Hours/Week	**4**
Code	**U20CH5MCP13**
Course Type	**PRACTICAL**
Credits	**3**
Marks	**100**

General Objective:

To make the students understand the basic principles behind the gravimetric analysis and the preparation of inorganic complexes.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the types of precipitant used in the precipitate theory
CO-2	estimate the amount of an ion in a given solution gravimetrically
CO-3	understand the principle of gravimetric analysis
CO-4	understand the principle involved in the preparation of complexes
CO-5	develop the skills to prepare different inorganic complexes

Gravimetric analysis:

1. Nickel as nickel dimethyl glyoxime.
2. Lead as lead chromate.
3. Barium as barium sulphate.
4. Barium as barium chromate.
5. Calcium as calcium oxalate.
6. Calcium as calcium carbonate.

Preparation of Inorganic Complexes (to be tested internally)

1.Tetraamminecopper(II) sulphate monohydrate
2.Tris(thiourea)copper(II) sulphate dihydrate
3.Potassium trioxalatoferrate(III) trihydrate
4.Hexammine cobalt(III) chloride
5.Potassium trioxalatochromate(III) trihydrate

Course Outcomes (CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level

CO-1	applies the techniques of gravimetric analysis to find out the quantity of an ion in a given solution.	PSO5	Ap
CO-2	the chemistry behind the reaction of gravimetric analysis	PSO4	Ap
CO-3	purifies the crude sample.	PSO4	Ap
CO-4	records and analyse the results of the experiments	PSO5	An
CO-5	analyse biological samples and preservatives quantitatively	PSO4	An

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 PracticalChemistry*.New Delhi:2nd Edition, Sultan Chand & Sons, 1997.

BOOK FOR REFERENCES

1. Svehla. G. *Vogel's Qualitative Inorganic Analysis.*US: 7th 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: 6th 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 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

Third Year - Semester – V

Course Title	**MAJOR CORE :14 – PHYSICAL CHEMISTRY PRACTICAL - II**
Total Hours	**60**
Hours/Week	**4**
Code	**U20CH5MCP14**
Course Type	**PRACTICAL**
Credits	**3**
Marks	**100**

General Objective:

To make the students gain skills in physical chemistry experiments of conductometry, colorimetry, pH metry and Polarimetry

Course objectives (CO):
The learner will be able to

CO No.	**Course Objectives**
CO-1	determine the strength of acids by conductometry
CO-2	verify Lambert-Beer's law by photoelectric colorimeter
CO-3	verify Henderson-Hasseslbulch equation by pH metry
CO-4	estimate the strenght of weak acid by pH metry
CO-5	understand the concept of optical rotation by polarimetry

Conductometric titrations:

1. Strong acid versus strong base. (HCl Vs NaOH)
2. Weak acid versus strong base. (CH_3COOH Vs NaOH)

Colorimetry:

3. To verify Beer's law for $K_2Cr_2O_7$ solution using photoelectric colorimeter and determine the unknown concentration.
4. Estimation of Fe (III) as ferric thiocyanate complex.

pH Meter:

5. To determine the [salt]/[acid] ration of buffer solution by pH meter and verification of Henderson-Hasselbulch equation.
6. To determine the strength of the given CH_3COOH by titrating with given NaOH.

Polarimetry:

7. To determine the concentration of the given sugar solution using a polarimeter.

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 strength of strong and weak acids by experimental techniques of conductometry and pH metry	PSO5	Ap
CO-2	estimate the strength of dilute solutions by colorimetry	PSO5	Ap
CO-3	understand the principle of complex formation from colorimetry	PSO4	U
CO-4	understand the concept of pH and buffer solutions	PSO5	Ap
CO-5	analyze the concept of optical activity by polarimetry	PSO6	An

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

TEXT BOOKS

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. '*Basic Principles of Practical Chemistry'.* New Delhi:2nd Edition, Sultan Chand & Sons, 1997.

BOOKS FOR REFERENCE:

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. '*Basic Principles of Practical Chemistry'* .New Delhi:2nd Edition, Sultan Chand & Sons, 1997.
2. Puri B.R. and Sharma L.R. *Principles of Physical Chemistry* New Delhi: Shoban Lal Nagin Chand and Co., 2017.

(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

Course Title	**MAJOR ELECTIVE 4: FOOD CHEMISTRY**
Code	**U21CH5MET07**
Semester	**5**
Course Type	**Theory**
Hours/Week	**4**
Credits	**3**
Marks	**100**

GENERAL OBJECTIVE

The student learns the functions, sources, deficiency diseases of all the nutrients, food preparation, preservation and adulteration.

COURSE OBJECTIVES

The learners will be able to

CO No.	Course Objectives
CO-1	appraise the functions, sources, deficiency diseases, daily allowances of major nutrients.
CO-2	discuss the toxicants naturally present in the foods and the importance 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	identify 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 **12 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/Key words: *Balanced diet plan*

UNIT II - NUTRIENTS –II **12 Hrs.**

2.1 Vitamins – water soluble and fat-soluble vitamins – sources, functions, deficiency and disorders of taking excess of vitamins.

2.2 Water – functions, sources, deficiency diseases.

2.3 Fibre – functions, requirements and sources. Effects of deficiency of fibre.

2.4 Toxicants naturally present in foods. Fermented foods and pickles.

Extra reading/Key words: ***Importance of Spirulina***

UNIT III - FOOD PREPARATION **12 Hrs.**

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

Extra reading/Key words: ***Obesity***

UNIT IV - FOOD PRESERVATION **12 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 – enzymatic browning and non-enzymatic browning.

Extra reading/Key words: *Space food and nutrition*

UNIT V - FOOD ADULTERATION AND TASTE SENSATION **12Hrs.**

5.1 Food Adulteration – Types, intentional, 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/Key words: *Novel packing materials*

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

COURSE OUTCOMES
The learners

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

TEXTBOOKS

1. Dr. M. Swaminathan, (2008) *Hand book of food and Nutrition,* Reprint, published by The Bangalore printing and publishing co. Ltd.
2. B. Srilakshmi, *Food Science*, Third Edition, New Age international publishers, 2003.
3. Mudambi, S.R., Rao, S.M. and Rajagopal, M.V. (2006). *Food science*. 2nd Edition. New Age International publishers.
4. Damodran, S., Parkin, K.L and Fennema, D.R. (2007). *Fennema's Food Chemistry*. 4th edition. CRC Press.
5. Guthrie, H.A. (1983). *Introductory Nutrition*. 5th Edition. Mosby, St. Louis.

BOOKS FOR REFERENCE

1. Dr. M. Swaminathan. (1987) *Food Science Chemistry and Experimental foods*, second enlarged edition, published by Bangalore press.
2. Dr. M. Swaminathan. (2001) *Advanced test Book on Food and Nutrition,*Volume I and II second edition, The Bangalore printing and publishing co. Ltd.
3. Meyer, L.H. (2004) *Food Chemistry*, Textbook Publishers. ISBN: 0758149204.
4. Mudambi, S.R and Rajgopal, M.V. (2001). *Fundamentals of Foods and Nutrition*, 4th Edition, New Age International Publishers.
5. Shakuntla, M.N and Shadaksharaswamy, M. (2013), *Food Facts and Principles*, New Age International.
6. Wilson, D. (1999), *Principles of Nutrition*, 4th Edition. John Willey & Sons: New York.

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HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year - Semester – V

Course Title	**MAJOR ELECTIVE 4 : SMART WASTE MANAGEMENT FOR ENVIRONMENTAL SUSTAINABILITY**
Total Hours	**60**
Hours/Week	**4**
Code	**U20CH5MET08**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective:

To make the students to acquire knowledge about solid waste and its processing techniques, municipal solid waste management rules and its sustainable techniques.

Course Objectives:
The learner will be able to

CO No.	**Course Objectives**
CO-1	Understand the processing technique of municipal solid waste.
CO-2	Discuss the disposal techniques of chemical, biomedical and nuclear waste.
CO-3	Explain the various methods for the solid waste disposal
CO-4	Illustrate the solid waste management rules, identify the sustainable techniques for MSWM.
CO-5	Describes Smart Waste Bin using AI, Big Data Analytics and IoT

UNIT I: **MUNICIPAL SOLID WASTE AND ITS PROCESSING TECHNIQUES 12 Hrs.**

1.1 Solid waste – Introduction - Solid waste generation – Types of waste - Municipal waste, Agricultural and Sewage waste, Industrial and Mining waste, Hazardous waste, Radioactive waste

1.2 Municipal Solid waste - Characteristics of Municipal Solid waste-Physical and geotechnical properties of MSW-Sampling of MSW for physical composition – Chemical properties of MSW. Preparation of sample - Carbon Hydrogen analysis, Nitrogen analysis, Sulfur analysis. Energy content of MSW, Biological properties of MSW, Biodegradability of MSW.

1.3 Segregation of MSW at source- Collection of MSW - transfer station – Transportation of MSW - collection Routes – Material separation - Material handling – Recycling of MSW components

Extra Reading/keywords: *Municipal management of collection of solid waste*

UNIT II: CHEMICAL, BIOMEDICAL AND NUCLEAR WASTES 12 Hrs.

2.1 Chemical wastes – Sources – Domestic and Industrial - Inorganic pollutants – Environmental effects – Need for control – Treatment and disposal techniques – Physical, chemical and biological processes – Health and environmental effects.

2.2 Biomedical wastes - Definition– Classification-Infectious wastes, Pathological waste, Sharps, Pharmaceutical waste, Geotoxic waste, Chemical waste, Waste with high content of heavy metals, Pressurized containers, Radioactive waste. Characteristics of wastes. Sources of health care waste. Dangers of hospital wastes. Treatment and Disposal of Hospital wastes- On-site and Off-site Treatment.

2.3 Nuclear waste – Types of radioactive waste- Dilute and Disperse method, Delay and Decay method, Concentration and contain method, Reclamation method- Reprocessing of spent Uranium fuel and its disposal – Methods to dispose radioactive waste- Low level, Intermediate level and High level- Other Disposal methods.

Extra Reading/keywords: *Hazardous waste minimization*

UNIT III: WASTE DISPOSAL METHODS 12 Hrs

3.1 Decomposition of solid waste by landfills – types – components – site selection – landfill operations – environmental monitoring of landfill site – specifications.

3.2 Composting – aerobic composting – anaerobic composting – vermicomposting. Incineration – types – municipal waste incinerators – hazardous waste incinerators – medi-waste incinerators.

3.3 Leachate management – characteristic leachate management system – leachate collection system – leak detection and remediation – recirculation – leachate treatment – biological, physical and chemical – final disposal of leachate.

Extra Reading/keywords: *Remedial techniques*

UNIT IV: MUNICIPAL SOLID WASTE MANAGEMENT RULES & SUSTAINABLE TECHNIQUES 12 Hrs.

4.1 Environment Protection Act 1986-General powers of central government, rules to regulate environmental pollution, Prevention, Control and Abatement of environmental pollution.

4.2 Hazardous wastes management &Handling rules 1989.Hazardous microorganism rules-Function of RDAC, RCGM, IBSC, GEAC, SBCC, DLC, Bio-medical waste handling rules 1998, 2003.Municipal solid waste management & Handling rules 2000.

4.3 Reuse and Recycling Techniques- Need for the concept-Various Types - Handmade Paper production – Reuse of materials-Recycle of materials. Present Scenario of Solid waste management in ULBs- Current practices & deficiencies in solid waste

Extra Reading/keywords: *e-waste Management & Handling rules 2011*

UNIT V: 12 Hrs.

5.1 E-Waste Management - Waste Prevention: Its Impact and Analysis

5.2 Smart Waste Bin using AI, Big Data Analytics and IoT.

5.3 IoT-Enabled Services for Sustainable Municipal Solid Waste Management in India

Extra Reading/keywords: : *e-waste Management in India*

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

Course Outcomes:
The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describe the processing technique of solid waste management	PSO4	U
CO-2	Outline the various types of solid waste and their effects	PSO4	Ap
CO-3	Illustrate the methods for the disposal of solid waste	PSO5	Ap
CO-4	List out the solid waste management rules and analyze the sustainable techniques	PSO2	An
CO-5	Analyze the impact and prevention of e-waste	PSO6	

TEXT BOOKS:

1. S.C.Santra, *'Environmental Science'* , New Central Book Agency, 2005.
2. Iqbal Kahn and Naved Ahsan,' *Text book of Solid wastes managment*, CBS Publishers, 2011.
3. Techobanoglous Thiesen Ellasen*; 'Solid Waste Engineering Principles and Management',* McGraw - Hill 1997.
4. J.M. Dewan and K.N. Sudarshan, 'Hazardous Waste Management', Discovery Publishing House, New Delhi, 1996.
5. Biswaranjan Acharya, SatarupaDey, Mohammed Zidan, "IoT-Based Smart Waste Management for Environmental Sustainability", 1st Edition,2 022,CRC Press, https://doi.org/10.1201/9781003184096 Chapters: 1,2,3 and 5

BOOKS FOR REFERENCE

1. B.K. Sharma, 'Environmental Chemistry', Goel Publishing House, 2005.
2. Sushma Sahai, 'Biomedical waste Management', APH Publishing Corporation, 2009.
3. Biomedical waste (Management and Handling) Rules, 1998
4. J.M. Dewan and K.N. Sudarshan, 'Solid Waste Management', Discovery Publishing House, New Delhi, 1996.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year - Semester – V

Course Title	**MAJOR SKILL BASED ELECTIVE 2 – NUTRICOSMETICS**
Total Hours	**30**
Hours/Week	**2**
Code	**U20CH5SBT03**
Course Type	**Theory**
Credits	**1**
Marks	**100**

General Objective:

To expose the students to gain knowledge about skin, hair, facial, cosmetic techniques and hazards of cosmetics.

Course Objectives(CO):

The learner will be to

CO No.	**Course Objectives**
CO-1	categorize and identifiy the types, functions and threats to the skin
CO-2	understand and identify the types and problems of hair and suggest treatments
CO-3	list out the advantages and disadvantages of manual massage and mask treatment
CO-4	outline the preparations of face creams, toilet powders and suggest facial packs for different type of skin
CO-5	enumerate the hazards due to cosmetics and appraise various techniques for the beautification of facial skin.

UNIT I: SKIN **6 Hrs.**

1.1 Skin - Types, functions, structure, diet for healthy skin, threats to skin, protection of skin from sunlight, cold, water and heat, effects of summer, winter, wind and rain on skin.

1.2 Common skin diseases – acne and warts. Skin changes with age and skin care for different age groups

Extra reading/Keywords: *Skin diseases- Leucoderma and Psoriasis*

UNIT II: HAIR **6 Hrs.**

2.1 Physical, chemical structure of hair and scalp, – nutrients for healthy hair - growth cycle of hair – common problems in hair and scalp. The shaft - pair of scissors, tools of hair dressing.

2.2 The professional section – classic hair do's – step by step shampoo rinses, types of hair styling-skull of reference point – classic hair cut theories.

Extra reading/Keywords: *Ill effects of using chemical hair conditioner and hair colourants*

UNIT III : MASSAGE AND MASK TREATMENT **6Hrs.**

3.1 Massage – types, advantages and disadvantages.

3.2 Mask treatment – setting and non-setting masks and its uses. Different types of Face packs, skin care by light therapy.

Extra reading/Keywords: *Ayurvedic Massage Techniques*

UNIT IV: COSMETICS **6 Hrs.**

4.1 Face creams, toilet powders – ingredients, preparations, Cleansing creams, moisturizing creams and nourishing creams.

4.2 Skin tonics, astringent lotion, hair shampoos and hair setting lotions.

Extra reading/Keywords: *Herbal Facial Packs*

UNIT 5: FACIAL **6 Hrs.**

5.1 Skin facial – cleansing, toning, moisturizing, exfoliation – preparation, applications and uses.

5.2 Preparation for facial, procedure – facial for dry, acne skins – quick home facial, Hazards due to cosmetics.

Extra reading/Keywords: *Advantages of Herbal Cleansers, Toners and Moisturizers*

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

Course Outcomes:

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the different types of skins and their functions	PSO1	U
CO-2	Identify the various hair problems	PSO2	U
CO-3	Outline the advantages and disadvantages of mask treatment.	PSO2	U
CO-4	Prepare the natural facial packs on their own.	PSO3	An
CO-5	Summarize the hazards due to usage of cosmetics.	PSO4	Ap

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

TEXTBOOKS

1. Thankamma Jacob 'A Text Book of Applied Chemistry' Macmillan India Ltd. 1987.
2. Baoran Robert and howard, '*Textbook of Cosmetic Dermatology'*CRC press 2017
3. Aruna anand, '*The complete book of beauty care",* Vishu books 2011.

BOOKS FOR REFERENCE

1. Parvesh Handa, '*A complete book on Beauty, Body, Make-up and Hair styles'*, Goodwill publishing House, New Delhi, 2014
2. Parvesh Handa, '*Herbal Beauty Care*', Orient paperbacks, New Delhi 2004

(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

Third year – Semester V

Course Title	**NON-MAJOR ELECTIVE –3: BEAUTY CARE**
Total Hours	**45**
Hours/Week	**3**
Code	**U20CH5NMT06**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective:

To enable the students to understand the skin types, skin diseases and hair and learn about hair problems, hygiene, good grooming and cosmetics.

COURSE OBJECTIVES:

The learner will be able to

CO No.	**Course Objectives**
CO-1	understand the types, nerves, functions and lesions of skin.
CO-2	identify the different skin imperfections and its remedy and learn about facial and its procedure.
CO-3	describe the compositions of hair and various hair problems and hair techniques.
CO-4	discuss the different good posture and diet for good health.
CO-5	prepare cosmetics according to their skin type.

UNIT: I – SKIN **9 Hrs**

1.1 Skin – types of skin, nerves, functions, lesions of the skin. Terms applied to skin diseases. Protection of skin from sun, water, cold and heat.

1.2 Diet for a healthy skin. Skin changes with age and skin care for different age groups. Conditions affecting the skin. Skin imperfections - black heads and white heads.

1.3 Pigmentation of skin, hyper-sensitive skin, cracked skin, muddy skin, prickly heat, sunburn, birthmarks, discolouration of skin and red nose.

Extra reading / Key words: *Sebaceous gland diseases.*

UNIT: II - SKIN DISEASES AND THEIR TREATMENT **9 Hrs**

2.1 Skin diseases -Pimple and acne, moles, warts, leucoderma, dermatitis, scabies, skin allergies, atopic eczema, eczema, ringworm, skin tumour, psoriasis, urticaria, cystitis leprosy, wrinkles, thrash, skin tags, skin surgery, skin grafting and its treatment.

2.2 Facial- procedure for facial, facial for different skin types.

2.3 Skin care by electrical therapy, light therapy and aromatherapy. Facial exercises and facial Massage.

Extra reading / Key words: *Freckles, Boils and Pustules*

UNIT: III – HAIR **9 Hrs**

3.1 Know your hair – the scalp – composition of hair and its types. Some important tips on hair style. Diet for healthy hair. Face, figure and hair style, important tips on hair style.
3.2 Hair techniques – bleaching, perming, shampooing and conditioning the hair, hair dye shampoo, how to use shampoo hair dye, how to dye your hair, ill effects of chemical dye – hair fashion coloring, applying henna, scalp massage, Hair Do's.
3.3 Hair problems - dull hair, dandruff, thinning hair, baldness, hair loss due to high fever, hormonal imbalance, lice infestations and their treatments.

Extra reading / Key words: *Chronic hair falling, Stem cell hair treatments*

UNIT: IV - HEALTH AND HYGIENE **9 Hrs.**

4.1 Hygiene and good grooming, correct standing posture, correct walking posture and correct sitting posture.
4.2. Ideal weight, food to eat, foods you may eat, food should be avoided. Figure and frame of the body, ethics for self-grooming, basics for self-grooming, manicure, pedicure.
4.3 General body care-hair, eyes, nose, checks, ears, teeth, neck, hand, nails, stomach and general tips for beauty care.

Extra reading / Key words: *Hand hygiene, Dental hygiene*

UNIT: V- COSMETICS **9 Hrs.**

5.1 Your own cosmetics laboratory: Preparations for skin and hair: Cleansing creams, moisturizing creams, nourishing creams and skin tonics.
5.2 Astringent lotions – hair shampoos, hair setting lotions, hair tonics and conditioners, antidandruff lotions, herbal remedy for baldness.
5.3 Hazards of cosmetics, preparation of soaps and powder. Make up preparations.

Extra reading / Key words: *Organic cosmetics, Herbal creams*

COURSE OUTCOMES (CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	identify the skin type and diet needed for healthy skin	PSO 1	R & U
CO-2	know the ways to protect the skin from various climatic conditions and understand various skin imperfections.	PSO 1	R & U
CO-3	interpret the Skin imperfection and their treatment processes	PSO 2	Ap
CO-4	predict the various types of hair problems	PSO 3	Ap
CO-5	suggest various tips to improve the hair style and learn about various hair techniques	PSO 6	An

CO-6	analyse the correct posture and healthy diet	PSO 5	An
CO-7	prepare some herbal homemade cosmetics	PSO 5	An

TEXTBOOKS

1. Parvesh Handa, '*Speaking of skin care'*, sterling publishers 1998
2. Parvesh Handa ,'*A Complete book on Beauty, Body, Makeup and hair style's,* Goodwill publishing house March 2014.
3. Dr. Renu Gupta, '*Complete Beautician course especially useful for running parlour at home'*, 2011.

BOOKS FOR REFERENCE

1. Parvesh Handa ,'*Herbal Beauty Care'*, Orient Paperbacks, New Delhi 14th Edition 2004.
2. Thankamma Jacob*,'A Textbook of Applied chemistry for home science & Allied science'*, Macmillan Company of India limited (1979) 1st Edition. Press of Meerut.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year - Semester – VI

Course Title	Major Core 15- INORGANIC CHEMISTRY-II
Code	U20CH6MCT15
Total Hours	60
Hours/Week	4
Course Type	Theory
Credits	3
Marks	100

General Objectives:

To make the students to learn about the preparation, properties and applications of inorganic polymers, principles of photochemical reactions, instrumentation of spectrophotometry and colorimetry and to prepare them to know about magnetic properties of matter, calculation of magnetic moments, role of metal ions in biological systems, metalloenzymes, lanthanides and actinides.

Course Objectives (CO):
The learner will be able to

CO No.	Course Objectives
CO -1	describe the preparation, properties of rings and cages.
CO -2	classify the inorganic polymers and polyacids.
CO -3	explain the applications of dipole moment and magnetic properties for inorganic and organic molecules.
CO -4	analyze the interaction of metal ions with biological systems and illustrate the structure and functions of electron transfer proteins.
CO -5	understand and analyze the properties of lanthanides and actinides.

UNIT- I RINGS AND CAGES **12 Hrs.**

1.1 Introduction to cages and rings-Hemicyclic rings. Carboranes- Synthesis, Polyhedral geometrics of metelloboranes and metallocarboranes.

1.2 Boron compounds- Borazines, Boron nitrides - Methods of preparation, properties, structure and derivatives of Borazine.

1.3 Silicates- Definition, structure of silicates based on the presence of anions, classification - silicates with discrete anions, silicates containing chain anions, silicates with layered structure, silicates with three-dimensional network.

1.4 Sulphur nitrogen compounds-S_4N_4 structure, preparation, properties -SN(x) polythioxil one dimensional conductor.

Extra reading/keywords:*Reactivity of polyhedral boranes*

UNIT- INORGANIC POLYMERS AND POLYACIDS **12Hrs.**

2.1 Introduction - General properties- glass transition temperature- classification of inorganic polymers.

2.2 Phosphorus Nitrogen compounds-Polyphosphazines, cyclophosphazene. Phosphorus Sulphur compounds- P-S cages

2.3 Silicones – Manufacture of silicones: Preparation of intermediates, polymerization of intermediates, Classification: silicone fluids, silicone greases, silicone resins, coating resins, silicone rubbers or eastomers.

2.4 Iso poly acids – Iso poly molybdates, Iso poly tungstates, Iso poly vanadates, Iso polyniobates and tantalates. Hetero poly acids – Preparation, properties, industrial applications.

Extra reading/Key words: *Metal Coordination Polymers*

UNIT-III DIPOLE MOMENT AND MAGNETIC PROPERTIES 12 Hrs.

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 – antiferro magnetism – magnetic flux – magnetic permeability. Magnetic susceptibility – its determination using Guoy balance, Application to structural problems.

3.4 Calculation of magnetic moments – spin only value - spin orbit coupling – variation of magnetic moments with temperature – Curie-Weiss Law.

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

UNIT-IV BIO- INORGANIC CHEMISTRY 12Hrs.

4.1 Role of metal ions in biological systems (Na, K, Ca, Mg, Fe, Zn, Cu, Mn, Mo and Co), metallo porphyrins – hemoglobin and myoglobin in oxygen transport and storage, difference in the binding characteristics of hemoglobin and myoglobin towards oxygen, phenomenon of co-operativity and its mechanism.

4.2 Electron transport proteins – Cytochromes, iron sulphur proteins, storage and transport of iron. Role of alkali and alkaline earth metals in biological systems– Role of sodium and potassium ions, Role of magnesium and Calcium ions.

4.3 Metalloenzymes – Carbonic anhydrase, Carboxy peptidase, Peroxidases, Catalases.

4.4 Vitamin B_{12} (Cyanocobalamin) – Non enzymatic chemistry of B_{12} co enzymes, Blue copper proteins – Cyanobacteria: Nature's curious creatures.

UNIT-V f**-BLOCK ELEMEMTS 12Hrs.**

5.1 **Lanthanides**: definitions, position of lanthanides in periodic table, general properties, electronic configuration, oxidation state and oxidation potential, chemistry of +2, +3, and +4 state, atomic and ionic radii - lanthanide contraction, causes and consequences.

5.2 Magnetic properties, complex formation, lanthanide shift reagents in NMR, extraction of lanthanide from monazite, separation of individual rare earth elements by modern methods, solvent extraction method, uses of lanthanide compounds.

5.3 **Actinides:** definition, position of actinides in periodic table, general properties of actinides and their comparison with lanthanides, electronic configuration and nature of bonding in actinide compounds, oxidation state and oxidation potential, chemistry of +2, +3, +4, +5, +6, and +7 oxidation state, atomic and ionic radii: actinide contraction.

5.4 Magnetic properties, Complex formation, Separation of actinide elements, Solvent extraction method, Ion exchange method.

Extra reading/keywords*: *Special properties of radioactive elements

Course Outcomes (CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	predict the different properties of rings and cages.	PSO1	R, An
CO -2	sketch the classifications of inorganic polymers	PSO1	R, U
CO -3	explain the different types of magnetism and evaluate the applications of magnetic susceptibility of molecules	PSO2	U, Ap
CO -4	analyze the role of metal ions, electron transfer proteins and metalloenzymes in biological systems	PSO4	U,An
CO -5	Compare the properties of Lanthanides and Actinides.	PSO1	R, An

PO – Programme specific Outcome; CO – Course Outcome; U- Understand; Ap – Apply; An – Analyse; E- Evaluate

PRESCRIBED 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. S. K. Agarwala, Keemti Lal, *Advanced Inorganic Chemistry*, Pragati Prakashan Publishers, 15th Edition, 2015.

SUGGESTED REFERENCES:

1. Huheey J. E., Keiter E. A., Keiter R. L. and MedhiO. K., *Inorganic Chemistry - Principles of Structure and Reactivity,* 4th Edition, Pearson Education, 2006.
2. Soni P.L. and Chawla H.M *Text Book of Inorganic Chemistry* (26th Edition), New Delhi, Sultan Chand and sons, 2004.
3. Lee J D, *Concise inorganic chemistry*, 5thEdition, Wiley India Edition, 2009.
4. Cotton F A, Wilkinson G, MurilloC. A and Bochmann, M, *Advanced Inorganic Chemistry*, 6thEdition, John Wiley & Sons,2008.
5. Atkins P, Overton T,Rourke J M. Weller and Armstrong F, *Inorganic Chemistry*, 5th Edition, Oxford University Press, 2010.
6. Gopalan R., Ramalingam, V, *Concise Co-ordination Chemistry*, Vikas Publishing House Pvt. Ltd.2001.
7. Willard H H, MerrittL. L., and Dean J. A., *Instrumental Methods of analysis*, Delhi, 6th Edition, CBS Publishers & Distributors, Shahdara 1986.

8. Skoog D, West D, *Principles of Instrumental Analysis*; 6th Edition, Cengage Learning 2006.

(For Candidates admitted in the academic year 2020onwards)

SCHOOL OF PHYSICAL SCIENCES

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

PG & RESEARCH DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year - Semester – VI

Course Title	**Major Core – 16: ORGANIC CHEMISTRY - II**
Code	**U20CH6MCT16**
Total Hours	**60**
Hours/Week	**4**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General objective:

The student learn the concepts of stereochemistry, mechanism of rearrangement reactions, chemistry of heterocyclic compounds and structural elucidation of natural products.

Course Objectives (CO):

The learner will be able to

CO No.	**Course Objectives**
CO-1	understand the concepts of optical isomerism, geometrical isomerism and conformational analysis.
CO-2	describe the synthetic importance of reagents and catalysts
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-I STEREOCHEMISTRY **12Hrs.**

1.1 Stereochemistry – Introduction, optical isomerism, optical activity, elements of symmetry, chirality, acyclic molecules with one and two chiral centre - enantiomers and diastereomers. Optical activity of glyceraldehyde, lactic acid, tartaric acid and 2,3-dibromo butane. Optical activity without chiral centre - biphenyls, allenes and spiranes.

1.2 Configuration -D and L, Erythro and Threo, R and S. Racemization, separation of racemic mixture, asymmetric synthesis, Walden inversion.

1.3 Geometrical Isomerism- conditions, Nomenclature - cis and trans, E and Z, syn and anti. Geometrical isomerism in maleic and fumaric acid, aldoxime and ketoxime.

1.4 Conformational analysis: Introduction of terms – conformers, configuration, dihedral angle, torsional strain. Conformational analyses of ethane and n - butane. Conformation of 1,3-butadiene. 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: *Conformational Analysis of disubstituted cyclohexane*

UNIT-II REAGENTS AND CATALYSTS **12 Hrs.**

2.1 Reducing Agents: $LiAlH_4$, $NaBH_4$, Sodamide, Aluminium isopropoxide.
2.2 Oxidising Agents: Lead tetra acetate, Osmium tetroxide, Ozone, Periodic acid, SeO_2.
2.3 Coupling Agents: NBS, DCC, EDC, HBTU
2.4 Organo metallic catalysts- Zeiglar Natta Catalyst, Wilkinson Catalyst, Pd $(PPh_3)_4$ – C-C bond formation Suzuki- Miyaura rection (No mechanism)

Extra reading/Keywords: *Synthetic importance of organolithium compounds*

UNIT-III MOLECULAR REARRANGEMENTS **12 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-IV HETEROCYCLIC COMPOUNDS **12 Hrs.**

4.1 Introduction, aromatic characteristics of heterocyclic compounds and importance of heterocyclic compounds.
4.2 Five membered heterocyclics- Furan, pyrrole, thiophene- synthesis and properties.
4.3 Six membered heterocyclics – Pyridine- synthesis 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 V- NATURAL PRODUCTS **12 Hrs.**

5.1 Alkaloids: Introduction, General methods of structural elucidation. Structural elucidation of Coniine, Piperine and Nicotine.

5.2 Terpenoids: Introduction, classification, Isoprene rule. Structural elucidation of Menthol and α – terpineol.

5.3 Vitamins: Introduction, classification, deficiency diseases and structural elucidation of Ascorbic acid.

5.4 Lipids: Introduction, Biological functions, classification. Fats and oils - general physical and chemical properties and Identification – Acid value, Saponification value, Iodine value and Reichert-meissl value.

Extra reading/Keywords: *Steroids*

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	analyse the conformers of alkanes, cycloalkanes and their stability.	PSO-3	An
CO-3	identify the synthetic importance of reagents and catalysts.	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 alkaloids, terpenoids, vitamins and identification of fats and oils.	PSO-2	U

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

PRESCRIBED TEXT BOOKS

1. Parmar V.S. and Chawla H.M., '*Principles of reaction mechanism in Organic Chemistry*', 2nd Edition, Sultan Chand, 2016.
2. Jain M.K. S.C. Sharma 'Modern Organic Chemistry', Vishal Publishing Co; Golden Jubilee year Edition, 2020.

SUGGESTED REFERENCES

1. Soni P.L. and Chawla H.M, '*Text Book of Organic Chemistry*', 29th Edition, Sultan Chand, 2012.
2. Jerry March, '*Advanced Organic Chemistry Reactions, Mechanisms and Structure*', 6th Edition, John Wiley and Sons (Asia)Pt. Ltd, New Delhi, 2006.
3. Robert Thornton Morrison, Robert Neilson Boyd , Saibal Kanti Bhattacharjee, '*Organic Chemistry'*, 7th Edition, Pearson Education India, Chennai, 2011.
4. I.L. Finar, "*Organic Chemistry*" 5th Edition, Pearson Education India, 2002.
5. O.P. Agarwal, *Natural Products*, Volume-II, Krishna Educational Publishers, 2019.

(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

B.Sc. CHEMISTRY

Third year - Semester – VI

Course Title	**Major Core – 17: PHYSICAL CHEMISTRY – II [SPECTROSCOPY]**
Code	**U20CH6MCT17**
Total Hours	**60**
Hours/Week	**4**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General objective:

To make the students understand 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

CO No.	**Course Objectives**
CO-1	understand the properties of electromagnetic radiation, explain the rotational spectra of diatomic molecules
CO-2	know the energy levels of a diatomic molecule, simple harmonic and anharmonic oscillator, vibrations of polyatomic molecules and their analysis
CO-3	explain the scattering of light and Raman spectrum
CO-4	understand electronic spectra of diatomic molecules-Born Oppenheimer approximation and the salient features of fragmentation pattern of organic compounds using mass spectrometry
CO-5	explain the principle and theory of NMR and fine structure of ESR absorption, hyperfine structure

UNIT-I ROTATIONAL SPECTROSCOPY **12 Hrs.**

1.1 Properties of electromagnetic radiation, electromagnetic spectrum, Molecular energies, interaction of electromagnetic radiation with matter.

1.2 Microwave spectroscopy – rotation of molecules based on moment of inertia.

1.3 Rotational spectra – diatomic molecules, calculation of moment of inertia and bond length.

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

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

UNIT-II VIBRATIONAL SPECTROSCOPY **12 Hrs.**

2.1 Infra – red spectroscopy – energy of a diatomic molecule, the simple harmonic oscillator.
2.2 The anharmonic oscillator – fundamental absorption, overtones and hot bands, calculation of oscillation frequency and anharmonicity constant.
2.3 The diatomic vibrating rotator, the vibrations of polyatomic molecules – CO_2 and H_2O, 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-III RAMAN SPECTROSCOPY **12 Hrs.**

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.
3.3 Raman activity of vibrations of CO_2 and water, Rule of mutual exclusion.
3.4 Structure determination from Raman and infrared spectroscopy – CO_2, N_2O, H_2O, SO_2, NH_3, NO_3^{--}, ClO_3^{-} and ClF_3.

Extra reading/Key words*:* *Interpretation of functional groups*

UNIT-IV ELECTRONIC AND MASS SPECTROSCOPY **12 Hrs.**

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_{max} 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.
4.4 Nitrogen rule – Modes of fragmentation of simple organic compounds.

Extra reading/Key words: *Factors affecting UV bands and **e**lucidate structure from Mass spectrum,*

UNIT-V NMR AND ESR SPECTROSCOPY **12 Hrs.**

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. Introduction to C^{13}-NMR.
5.3 Electron Paramagnetic Resonance spectroscopy – Theory of EPR spectroscopy – presentation of the spectrum.
5.4 General rules governing hyperfine splitting – applications to simple organic radicals like hydrogen, methyl, ethyl, benzene, naphthalene, anthracene and para semibenzoquinone.

Extra reading/Key words: *Interpretation of NMR spectrum of simple organic compounds, ESR of complexes*

Course outcomes (CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	identify different molecular energies, calculate bond length, rotational constant, moment of inertia	PSO 2	Ap

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.	PSO 2	Ap
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.	PSO 3	Ap
CO-4	explain electronic spectroscopy, fragmentation pattern in mass spectrometry and apply it to simple organic molecules.	PSO 3	An
CO-5	identify, interpret the NMR signals in simple molecules, recalls the theory of ESR and explain the ESR spectrum for simple organic radicals.	PSO 3	An

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

PRESCRIBED TEXT BOOKS

1. Colin Bannwell N and Elaine McCash M, '*Fundamentals of molecular spectroscopy'*, 4th Edition, McGraw hill Publishing company limited, 1994.
2. Sharma Y.R. '*Elementary Organic spectroscopy'*, Chand S. and Co., 1989.

SUGGESTED REFERENCES:

1. Russell S. Drago, '*Physical methods for chemists'*, Saunders, 1992.
2. Manas Chanda, '*Atomic structure and Chemical Bond Including Molecular Spectroscopy'*, Tata McGraw-Hill Publishing Company Ltd, 1972.
3. McHale, J.L '*Molecular spectroscopy*', Prentice Hall Publishers**,** 1999.
4. Sindhu, P.S '*Fundamentals of Molecular spectroscopy*' 1st Edition, New Age International publishers, 2006.
5. William Kemp '*Organic Spectroscopy*', 3rd 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.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

Third Year – Semester- VI

Course Title	**Major Core 18 –ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS**
Code	**U20CH6MCP18**
Total Hours	**60**
Hours/Week	**4**
Course Type	**Practical**
Credits	**3**
Marks	**100**

General Objective:

To make the students gain skills in analyzing the various organic compounds and the preparation of organic compounds.

Course Objectives (CO):

The learner will be able to

CO No.	**Course Objectives**
CO-1	analyze the aliphatic and aromatic nature of various organic compounds.
CO-2	Identify the elements and functional group present in the compounds
CO-3	prepare the derivative of various organic compounds
CO-4	synthesize various organic compounds using single stage method
CO-5	recrystallize the various organic compounds.

Analysis of Organic Compounds

1.1 Qualitative analysis of unknown organic compounds containing simple functional groups -Acids, Phenols, Carbohydrates, Aldehydes, Ketones, Esters, Amines, Amides, Nitro Compounds, Anilides, Halo Compounds, Sulphur Compounds.

1.2 Preparation of Derivatives of Organic Compounds

Organic Preparation

Preparation involving oxidation, hydrolysis, nitration and halogenation.

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, Thiourea, Chlorobenzene.

Course Outcomes (CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	apply the basic organic theoretical concepts for analyzing the unknown compounds	PSO5	Ap
CO-2	identify the elements and functional group present in the unknown organic compounds.	PSO4	Ap
CO-3	select an appropriate method to confirm the presence of functional group of unknown organic compounds	PSO4	An
CO-4	prepare the derivative for different functional groups	PSO5	Ap

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

PRESCRIBED TEXT BOOKS

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. '*Basic Principles of Practical Chemistry*' New Delhi:2nd Edition, Sultan Chand & Sons, 1997.

BOOKS FOR REFERENCE

1. SvehlaG. Vogel's '*Qualitative Inorganic Analysis'*.US: 7th Edition, Prentice Hall, 1996.
2. Mendham J., DenneyR. C., Barnes J. D. and Thomas M. J. K.Vogel's *Prescribed Book of Qualitative Chemical Analysis,* US: 6th 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 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

B.Sc. CHEMISTRY

Third Year - Semester – VI

Course Title	**Major Core :19 – PHYSICAL CHEMISTRY PRACTICAL - III**
Code	**U20CH6MCP19**
Total Hours	**60**
Hours/Week	**4**
Course Type	**Practical**
Credits	**3**
Marks	**100**

General objective

To make the students gain skills in Physical Chemistry experiments of Conductometry, Potentiometry, Kinetics and Adsorption.

Course objectives (CO):

The learner will be able to

CO No.	**Course Objectives**
CO-1	determine the strength of acids by potentiometry
CO-2	understand the concept of cell constant
CO-3	determines the equivalent conductance and dissociation constant of electrolytes
CO-4	calculate the rate constants of I order and II order reactions
CO-5	understand the concept of adsorption

Potentiometric Titrations:

1. To find the strength of HCl potentiometrically using quinhydrone electrode.
2. To determine the strength of Ferrous ammonium Sulphate potentiometrically.

Conductivity:

3. Determination of cell constant and equivalent conductance of a strong electrolyte.
4. Determination of cell constant and dissociation constant of a weak electrolyte.

Chemical Kinetics:

5. I order - Acid catalyzed hydrolysis of ester.

6. II order - Saponification of ester.

Adsorption:

7. Verification of Freundlich adsorption isotherm

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 strength of strong and weak acids by experimental techniques of potentiometry	PSO5	Ap
CO-2	estimate the equivalent conductance and dissociation constants.	PSO5	Ap
CO-3	understand the first order and second order reactions in chemical kinetics	PSO4	U
CO-4	analyze the rate constants of reactions	PSO6	An
CO-5	analyze the concept of adsorption isotherm	PSO6	An

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

SUGGESTED REFERENCES:

1.Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. '*Basic Principles of Practical Chemistry'*.New Delhi:2nd Edition, Sultan Chand & Sons, 1997.

2.Puri B.R. and Sharma L.R. '*Principles of Physical Chemistry'* New Delhi: Shoban Lal Nagin Chand and Co., 2017.

(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

Third year - Semester – VI

Course Title	**Major Core -14-for Physics: SPECTROSCOPY**
Code	**U20PH6MCT15**
Total Hours	**60**
Hours/Week	**4**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General objective:

To make the students understand the basics of Microwave spectroscopy, Raman, UV-Visible NMR, Mass spectroscopy, ESR and learn to assign the structure of the organic molecules using spectral data

Course objectives (CO):

The learner will be able to

CO No.	**Course Objectives**
CO-1	understand the properties of electromagnetic radiation, rotational spectra of molecules and selection rules
CO-2	know the energy levels of a diatomic molecule, simple harmonic and anharmonic oscillator, vibrations of polyatomic molecules and IR analysis of different functional groups
CO-3	explain the scattering of light and Raman spectrum, electronic spectra of diatomic molecules-Born Oppenheimer approximation
CO-4	understand the theory of NMR and the explain the principle of ESR and structure of simple molecules using the spectral data.
CO-5	explain the electronic spectra, salient features of fragmentation pattern of organic compounds using mass spectrometry.

UNIT- I ROTATIONAL SPECTROSCOPY **12 Hrs.**

1.1 Electromagnetic radiations – Definition, regions of electromagnetic radiations, quantization of energies in molecules - translational, rotational, vibrational, and electronic energies, molecular spectra - origin of molecular spectra - Interaction of electro-magnetic radiations with molecules.

1.2 Born Oppenheimer Approximation, factors affecting line width and intensity.

1.3 Microwave spectroscopy - Molecular rotation, theory of microwave spectroscopy, selection

rule.

1.4 Effect of isotopic substitution and calculation of moment of inertia and bond length of diatomic molecules.

Extra reading/Key words: *Applications of Microwave radiation in synthesis*

UNIT-II IR SPECTROSCOPY **12 Hrs.**

2.1 Infra – red spectroscopy – energy of a diatomic molecule, the simple harmonic oscillator.

2.2 The anharmonic oscillator – fundamental absorption, overtones and hot bands, calculation of oscillation frequency and anharmonicity constant.

2.3 The diatomic vibrating rotator, the vibrations of polyatomic molecules – CO_2 and H_2O, combination and difference bands.

2.4 IR spectra of functional groups - HC, alcohols, ethers, halogen, aldehydes, ketones, amines and esters-identification of hydrogen bonding by IR spectroscopy.

Extra reading/Key words*:* *factors influencing group frequencies*

UNIT III RAMAN SPECTROSCOPY **12 Hrs.**

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.

3.3 Raman activity of vibrations of CO_2 and H_2O, Rule of mutual exclusion.

3.4 Structure determination from Raman and infrared spectroscopy – CO_2, N_2O, H_2O, SO_2, NH_3, NO_3^-, ClO_3^- and ClF_3.

Extra reading/Key words: *Interpretation of functional groups*

UNIT- IV NMR AND ESR SPECTROSCOPY **12 Hrs.**

4.1 NMR spectroscopy - Magnetic and non–magnetic nuclei, principle of nuclear magnetic resonance - shielding mechanism.

4.2. Chemical shift, factors affecting chemical - number of signals – proton counting - spin-spin coupling, coupling constant, NMR spectrum of ethyl alcohol.

4.3 Introduction to C^{13}-NMR spectroscopy- types of carbons and their signals and splitting only.

4.4 ESR Principle-hyperfine structure-EPR for hydrogen atom, methyl radical, p-benzo semiquinone, naphthalene negative ion, anthracene negative ion and triphenyl methyl radical-g-factor.

Extra reading, Key words: *interpretation of structural information of simple organic molecules using NMR and Mass spectral data*

Unit -V ELECTRONIC AND MASS SPECTROSCOPY **12 Hrs.**

5.1 UV-Visible spectroscopy – types of electronic transitions –chromophore, auxochrome, bathochromic and hypsochromic shifts and effect of substituents.

5.2 Electronic spectra of diatomic molecules, Born-Oppenheimer Approximation,Vibrational course structure, Intensity of vibrational electronic spectra - Franck–Condon principle.

5.3 Dissociation energy – determination from electronic spectrum, V_{max} and Birge–Sponer

method, Pre–dissociation.

5.4 Mass spectroscopy- Basic principle- molecular ion peak, base peak, isotopic peaks, metastable peaks. Ring rule and nitrogen rule - Modes of fragmentation of simple organic compounds.

Extra reading/Key words: *factors affecting UV bands and g-value*

Course outcomes (CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	identify different molecular energies, calculate bond length, rotational constant and moment of inertia	PSO 2	Ap
CO-2	distinguish between harmonic and anharmonic vibrations, identify the group frequencies related to various functional groups	PSO 2	Ap
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.	PSO 3	Ap
CO-4	interpret the structure of simple molecules from chemical shift values, discuss fragmentation pattern in mass spectrometry and apply it to simple organic molecules.	PSO 3	An
CO-5	explain the electronic spectroscopy and ESR spectrum for simple organic radicals.	PSO 2	U

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

PRESCRIBED TEXT BOOKS

1. Colin Bannwell N and Elaine McCash M, '*Fundamentals of molecular spectroscopy'*, 4th Edition, McGraw hill Publishing company limited, 1994.
2. Sharma, Y R, '*Elementary Organic Spectroscopy'*, (5th Revised Edition) S. Chand & Company Pvt. Ltd, 2013.
3. Silver Stein, M.R. and Webster, F.X.*, 'Spectral Identification of Organic compounds'* 6th Edition., John Willy& Sons, Inc. NY, 1998.

SUGGESTED REFERENCES

1. Russell S. Drago, *'Physical methods for chemists'*, Saunders, 1992.
2. Manas Chanda, '*Atomic structure and Chemical Bond Including Molecular Spectroscopy'*, Tata McGraw-Hill Publishing Company Ltd, 1972.
3. McHale, J.L '*Molecular spectroscopy'*, Prentice Hall Publishers**,** 1999.
4. Sindhu, P.S '*Fundamentals of Molecular spectroscopy*' 1st Edition, New Age International publishers, 2006.
5. William Kemp '*Organic Spectroscopy*', 3rd 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.

(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

Third Year - Semester VI

Course Title	**Non-Major Elective –4: COSMETOLOGY**
Code	**U20CH6NMT07**
Total Hours	**45**
Hours/Week	**3**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General objective:

To expose the students to gain practical knowledge in different cosmetics and self grooming.

Course objectives (CO)

The learner will be able to

CO No.	**Course Objectives**
CO-1	explain the different types of cosmetics, tools used in make-up and eye lashes
CO-2	study about the mehandi designs and cone preparations
CO-3	understands the artificial and fresh flower arrangements and bouquet making
CO-4	illustrate the skills in jewel making
CO-5	Outline the ethics of self-grooming, yoga and exercise

UNIT-I ART OF MAKEUP **9 Hrs.**

Introduction - What is make up - History of makeup - Cosmetics used in makeup - makeup techniques - Implements and tools for makeup - Facial Anatomy-Basic facial shapes - Corrective makeup - Professional makeup - Qualities of a makeup artist - Make up and age tips.

UNIT-II MEHANDI **9 Hrs.**

Introduction - History of Mehandi - Types of mehandi designs - Mehandi cone preparation.

UNIT-III FLOWER ARRANGEMENTS **9 Hrs.**

Introduction - Cutting flowers and foliage - Conditioning plant materials - principles of flower arrangement - Elements of design - principles of design - styles of flower arrangement - Types of flower arrangement - Flower making-Bouquet setting.

UNIT-IV JEWEL MAKING **9 Hrs.**

Introduction - Tools for jewellery making - Types of Jewellery- Thread Bangles.

UNIT- V SELF GROOMING **9 Hrs.**

Introduction - Definition and meaning - Dimensions of health and wellness - Ten recognised general physical skills - Five components of physical fitness - Nutrition and diet - Body composition assessment - Exercise - Yoga - History of Yoga - Asanas.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	understand the different types of cosmetics, tools used in make-up.	PSO1	U
CO-2	illustrate the different types of mehandi designs and cone preparations	PSO2	Ap
CO-3	prepare the artificial and fresh flower arrangements and bouquet making methods	PSO3	Ap
CO-4	demonstrate the skills in jewel making	PSO4	Ap
CO-5	recollect the ethics of self-grooming, yoga and exercise	PSO3	Ap

PRESCRIBED TEXTBOOKS

1. Baki Gabriella and Kenneth S. Alexander,' *Introduction to cosmetic formulation and technology*' May 2015.
2. Parvesh Handa,'*Speaking of skin care* sterling publishers' 1998.
3. Baoran Robert and howard '*Textbook of Cosmetic Dermatology*', CRC press 2017
4. Parvesh Handa *A 'Complete book on Beauty, Body, Make-up and hair styles'* Goodwill publishing house March 2014.

BOOKS FOR REFERENCES

1. Thankamma Jacob '*A Text Book of Applied Chemistry'* Macmillan India Ltd. 1987.
2. ParveshHanda, '*Herbal Beauty Care*', Orient paperbacks, New Delhi 2004
3. Aruna anand '*The complete book of beauty care'* Vishu books 2011.

HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2
Affiliated to Bharathidasan University
Nationally Accredited(4th Cycle) with A++Grade (CGPA 3.75/4) by NAAC
College with potential for Excellence
Tiruchirappalli - 620002
PG AND RESEARCH DEPARTMENT OF CHEMISTRY

PO No.	Programme Outcomes *Upon completion of the M.Sc. Degree Programme, the graduate will be able to*
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

PSO No.	*Upon completion of these courses the student would*
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 ctroscopic pri 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 DEPART MENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

M.SC. CHEMISTRY COURSE PATTERN

SEMES -TER	COURSE	TITLE OF THE COURSE	CODE	HOUR S WK.	CRED ITS	TOTAL MARKS
I	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
II	VI	Major Core6 Physical Chemistry – II	P16CH2M CT06	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

SEMES-TER	COURSE	TITLE OF THE COURSE	CODE	HOURS WK.	CREDITS	TOTAL MARKS
III	X	Major Core10 Inorganic Chemistry – II	P16CH3MCT10	4	4	100
	XI	Major Core 11 Physical Chemsitry – 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 Chemsitry In Every Day Life	P16CH3NMT02	5	3	100
		Total		30	22	600
IV	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

Course Title	MAJOR CORE 1- PHYSICAL CHEMISTRY-I
Total Hours	90
Hours/Week	6
Code	P16CH1MCT01
Course Type	Theory
Credits	4
Marks	100

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
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/keyworkds:***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 molecues, 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/keyworkds:***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/keyworkds:***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 – McConnel 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(H1, F19,P31) 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 sepetroscopy	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, 4th edition, McGraw hill Publishing company limited.
2. Barrow, G.M. (1992). Introduction to Molecular Spectroscopy (5th Ed.). New Delhi:Mc Graw Hill.
3. Levitt, M.H. (2008). Spin Dynamics: Basics of Nuclear Magnetic Resonance (2nd 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 (7th Ed.). OxfordUniversity Press.
6. Prasad, R.K. (1993). Quantum chemistry.(1st 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

Course Title	**MAJOR CORE 2: ORGANIC CHEMISTRY –I**
Total Hours	**90**
Hours/Week	**6**
Code	**P16CH1MCT02**
Course Type	**Theory**
Credits	**4**
Marks	**100**

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

CO No.	Course Objectives
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, Meerweinarylation 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_imechanism – 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: AromaticNucleophilic 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 carbonstereocenters (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 disubstitutioncyclo hexanes 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 α- 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.*(4th Ed.). New York:Wiley Eastern Ltd.
2. Mukherji, S.M and Singh. S.P., (1978).*Reaction mechanism in Organic Chemistry.*(3rd Ed.). New Delhi: McMillan.
3. Sykes, P. (1997). *Guide Book to Mechanism in Organic Chemistry.* (6th Ed.). New Delhi:ELBS and Longmann Ltd.
4. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry: Part-A, Structureand Mechanisms. (4th Edition), Kluwer Academic Publications, NewYork.
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*.(5th Ed.).London: Butterworths.
8. Finar, I.L. (1997). *Organic Chemistry, Vol II*.(6th Ed.). New Delhi: ELBS and Longmann Ltd.
9. Nasipuri, D. (1994). *Stereochemistry of Organic Compounds.*(2nd Ed.). New Delhi: New AgeInternational (P). Ltd

(For Students admitted from June 2016 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
First Year - Semester – I

Course Title	MAJOR CORE 3 - INORGANIC CHEMISTRY-I
Total Hours	90
Hours/Week	6
Code	P16CH1MCT03
Course Type	Theory
Credits	4
Marks	100

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

CO No.	Course Objectives
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, PCl_3F_2 (Bent's rule), SF_4, BrF_3, TeF_5^-, ICl_2^-, ICl_4^-, XeF_2, XeF_4, XeF_6, XeO_3, XeO_4, phosphorus trihalides, bond angle - NH_3 and NF_3,Dipole moments- H_2O, 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 π -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. NH_3, SO_2, HF and H_2SO_4 as solvents.

3.3 Variable valency and Oxidation states - standard electron potential and electrochemical series – relationships of free energy change and equilibrium constants. Oxidationreduction 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 $[Re_2Cl_8]^{2-}$, $[MoCl_8]^{2-}$ Poly nuclear clusters: $[Re_3X_{12}]^{3-}$, $[W_4(OR)_{16}]$, and quintaple bond Cryptands and crown ethers.

2.3 Silanes, Silicone halides, Silicates, Silicones, Silenes, gernenes, 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 π 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	Summaries 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**

1. Huheey, J.E., Ellen. A. Keiter & Richard .L. Keiter. (2003). *Inorganic Chemistry* (4th Ed.). London: Addison & Wesley.
2. 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* (6th Ed.). New Delhi: East West student.
5. Day, M.C. & Selbin. (1972). *Theoretical Inorganic Chemistry* (3rd Ed.) . London: Butterworth.
6. Friedlander, G. (1990). *Nuclear and Radiochemistry* (3rd Ed.). London: John Wiley & Sons.
7. H. J. *Arnikar*Essenlials of *Nuclear Chemistry,*. Second Edition.. Wiley: New York. NY. 1987.
8. Singh, A.& Singh, R. (2006). *Text book of nuclear Chemistry* (1st 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

Course Title	**MAJOR CORE 4 - INORGANIC CHEMISTRY PRACTICALS –I**
Total Hours	**75**
Hours/Week	**5**
Code	**P16CH1MCP04**
Course Type	**Practical**
Credits	**5**
Marks	**100**

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 photocolorimetrically	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: 2nd edn, Sultan Chand & Sons, 1997.

BOOKS FOR REFERENCE:

1. Svehla G. *Vogel's Qualitative Inorganic Analysis.* US: 7th 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: 6th 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 – I

Course Title	**CHEMISTRY MAJOR CORE 5 - INORGANIC CHEMISTRY PRACTICALS –II**
Total Hours	**75**
Hours/Week	**5**
Code	**P16CH1MCP05**
Course Type	**Practical**
Credits	**5**
Marks	**100**

GENERAL OBJECTIVES:

To acquire the practical skills in the quantitative estimation of metal ions.

Course Objectives:
The learner will be able to

CO No.	**Course Objectives**
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: 2nd edn, Sultan Chand & Sons, 1997.

BOOKS FOR REFERENCE:

1. Svehla G. *Vogel's Qualitative Inorganic Analysis.* US: 7th 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: 6th 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

Course Title	**MAJOR CORE : 6 - PHYSICAL CHEMISTRY – II**
Total Hours	**90**
Hours/Week	**6**
Code	**P16CH2MCT06**
Course Type	**Theory**
Credits	**5**
Marks	**100**

GENERAL OBJECTIVES:
To understand quantum applications. To know classical thermodynamics, chemical and solution kinetics.

Course Objectives:
The learner will be able to

CO No.	**Course Objectives**
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. 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.
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.
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 variables 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 155alvation.

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

BOOKS FOR REFERENCE

1. Chandra. A.K., (2004). *Introductory Quantum Chemistry* (10^{th} Ed.). Tata Mc Graw Hill.
2. Ira Levine. N., (2004).*Quantum Chemistry* (5^{th} Ed.). Pearson education.
3. Barrow. G.M., (1992). *Introduction to Molecular Spectroscopy* (5^{th} Ed.). New Delhi: McGraw Hill.
4. Moore. W.J., (1982). *Physical Chemistry* (5^{th} Ed.). Orient Longman.
5. Rajaram. J.,& Kuriacose. J.C., (1996).*Thermodynamics* . (3^{rd} Ed.). New Delhi: Shoban Lal Nagin Chand and Co.
6. Rastogi, R.P. &and Mishra. R.R., (1978). *An Introduction to Chemical Thermodynamics* (3^{rd} Ed.). New Delhi: Vikas Publishing Housing.7.
7. Samuel Glasstone, (2002).*Thermodynamics for Chemists*, (3^{rd} Ed.). Affiliated East-West press.
8. Atkins, P., & Paula, J. (2002). Physical Chemistry (7^{th} Ed.). OxfordUniversity Press

(For Students admitted from June 2016 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
First Year - Semester – II

Course Title	Major Core 7 – ORGANIC CHEMISTRY-II
Total Hours	75
Hours/Week	5
Code	P16CH2MCT07
Course Type	Theory
Credits	5
Marks	100

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

CO No.	Course Objectives
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 radicalsadditions 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 anlaysis to work out synthetic strategies for organicmolecules,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 - SNAr, SRN1 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 H2, X2, HX, H2O, 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_2 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. Stereochemicalcontrol 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_2, PCC.

3.3 Reduction: Catalytic hydrogenation (Heterogeneous: palladium/Platinum/Rhodium/Nickel etc; Homogeneous: Wilkinson), $LiAlH_4$, 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, 3difunctionalized compounds(dicarbonyland α, β – 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

Carey, F.A .and Sundberg R.J.(1990). Advanced Organic Chemistry (Part A& B).New York: springer.

Finar, I.L. (1975).Organic ChemistryVolume II. New Delhi: ELBS.

Gurdeep , R. Chatwal (2004). Organic Chemistry of Natural Products, Vol.I& II. Meerut: Goel Publications.

Warren,S. (1997).Organic Synthesis-The Disconnection Approach. New York: John Wiley & son.

Benjamin, W.A. (1972). Modern Synthetic reactions in Organic Chemistry. (2nd Ed.). New York: H.O House.

De-Mayo, P. (1963). Molecular Rearrangements. New York: Inter science Publishers.

Ingold, C.K. (1969). Structure and Mechanism in Organic Chemistry. (2nd Ed.) . New York: Cornell University Press.

Raj K. Bansal (2001). Organic Reaction Mechanism. (3rd Ed.). New Delhi: Tata McGraw Hill.

Jonathan Clayden, Nick Greeves,Stuart Warren (2012). Organic Chemistry, (2nd Ed.), Oxford University Press.

Agarwal, O.P. (1997). Chemistry of Organic natural products , Vol. I &II.Meerut: Goel Publications.

11. Badger, G. M. (1966). Aromatic Character and Aromaticity. London: Cambridge University Press.

(For Students admitted from June 2016 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
First Year - Semester – II

Course Title	**MAIN CORE 8 - ORGANIC CHEMISTRY PRACTICALS –I**
Total Hours	**90**
Hours/Week	**6**
Code	**P16CH2MCP08**
Course Type	**Practical**
Credits	**5**
Marks	**100**

GENERALOBJECTIVES:
To acquire the practical skills in the qualitative analysis of organic mixture and to synthesize organic compounds.

Course Objectives (CO):

CO No.	Course Objectives
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-napthol 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 anlayse 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

Course Title	MAIN CORE 9 - ORGANIC CHEMISTRY PRACTICALS –II
Total Hours	90
Hours/Week	6
Code	P16CH2MCP09
Course Type	Practical
Credits	5
Marks	100

GENERAL OBJECTIVES:
To acquire the practical skills in the quantitative organic analysis and preparation.

Course Objectives:
The learner will be able to

CO No.	Course Objectives
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

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
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

Course Title	Major Core 10–INORGANIC CHEMISTRY-II
Total Hours	60
Hours/Week	4
Code	P16CH3MCT10
Course Type	Theory
Credits	4
Marks	100

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

CO No.	Course Objectives
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	Interpet 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 dblock 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 quadrapole 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*, (4th Ed.). London: John Wiley and Sons Inc.
2. Huheey, J.H. (2002). *Inorganic Chemistry*, (4th Ed.). London: Pearson Education Pvt., Ltd.
3. Lever .A.P. B Principles of Inorganic Spectroscopy
4. Douglas, B.F. and McDaniel (1994). *Concepts and Models of Inorganic Chemistry*, (3rd Ed.).New York: John Wiley and Sons.
5. Drago, R.S. (1978). *Physical Methods in Inorganic Chemistry* (2nd ed.). New Delhi: East West student.
6. Wahid. U. Malik, Tuli, G.D. & Madan, R.D. (1998). *Selected topics in Inorganic Chemistry* (6th Ed.).New Delhi: S. Chand & company.
7. Gopalan, R. (2006). *Concise Coordination Chemistry*(2nd Ed.) New Delhi: Vikas Publishing House.
8. Rohatgi Mukherjee (1992). *Fundamentals of photochemistry*, (2nd Ed.) New Delhi: Wiley Eastern Ltd

(For Students admitted from June 2016 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
Second Year – Semester- III

Course Title	**Chemistry Main Core Paper 11 - Physical Chemistry – III**
Total Hours	**60**
Hours/Week	**4**
Code	**P16CH3MCT11**
Course Type	**Theory**
Credits	**4**
Marks	**100**

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

CO No.	**Course Objectives**
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 systemPhase 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", 3rd edition, Wiley Eastern Ltd.
- Samuel Glasstone, (2015) "An Introduction to Electrochemistry" McMillan India Ltd.,
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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

Course Title	MAJOR ELECTIVE 1 - ORGANIC CHEMISTRY
Total Hours	75
Hours/Week	5
Code	P16CH3MET01
Course Type	Theory
Credits	5
Marks	100

General Objective: To learn the different spectroscopic techniques - UV,IR, NMR and Mass spectrometery and organic photochemistry, pericyclic reactions and natural products.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	identify the basic principle and applications of UV and IR spectroscopic techniques.
CO-2	apply H^1 and C^{13} 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 cyclic1, 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 groupfrequencies – both Internal and external, Study of Inter and Intra molecular hydrogenbonding, 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^1NMR Spectroscopy – Coupling Constant – First order and Second order splitting, spin – Spin splitting, dependence of `j' on dihedral angle – vicinal and geminal coupling constant – Karplusequation,long range coupling constants, influence of Streochemical 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,eteronuclear, 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^{9} 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- Maclafferty 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 haloketonerule,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 α - 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-π^* and π-π^* transitions.

5.2 Norrish type I and type II cleavages – Photolysis of ketones- Paterno - Buchireactions, 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 PericyclicReactions: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 – dipolarcyclo – additions and cheleotropic 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. GurdeepChatwal, (1996). *Chemistry of Natural Products Vol. I & II*. (1st Ed.). Bombay: Himalaya.
2. Sharma,Y.R. (2007). *Elementary Organic Spectroscopy*.(4th Ed.). New Delhi: S.Chand.
3. Bassler, Morrill and Silver Stein,(1981). *Spectrometric Identification of Organic Compounds*.(4th 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*.(2nd 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, 2ndEdn.,Narosa publishing house Pvt. Ltd., New Delhi.
9. Ahluwalia -V. K. (2005), Organic Reaction Mechanisms, 4thEdn.,Narosapublishing 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

Course Title	**NON-MAJOR ELECTIVE – 1: FOOD SCIENCE**
Total Hours	**75**
Hours/Week	**5**
Code	**P16CH2NMTO1**
ourse Type	**Theory**
Credits	**3**
Marks	**100**

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

CO No.	Course Objectives
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" 3rd 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

Course Title	**Major Core 13 - Physical Chemistry Practical– II**
Total Hours	90
Hours/Week	**6**
Code	**P16CH3MCP13**
Course Type	**Practical**
Credits	**3**
Marks	**100**

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

Course Title	**Major Core 12 - Physical Chemistry Practical - I**
Total Hours	**90**
Hours/Week	**6**
Code	**P16CH3MCP12**
Course Type	**Practical**
Credits	**3**
Marks	**100**

GENERAL OBJECTIVES:
To provide the knowledge and acquire the practical skills on non- electricals experiments
Course Objectives (CO):
The learner will be able to

CO No.	**Course Objectives**
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

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
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

Course Title	**Non-Major Elective 2 – Chemistry In Everyday Life**
Total Hours	**75**
Hours/Week	**5**
Code	**P16CH3NMT02**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General objective:
To enable the students to learn about common drugs, burn Preparation, metals, corrosion of metals, polymers, rubber and chemical food poisons.
Course Objectives:
The learner will be able to

CO No.	Course Objectives
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,* 1st edition, McMillan India Ltd.,
2. Jayashree Gosh (2006), *'Fundamental concept of applied chemistry'* 1st 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
Second Year – Semester- IV

Course Title	Major Core Paper 14 - Inorganic Chemistry- III
Total Hours	90
Hours/Week	6
Code	P16CH4MCT14
Course Type	Theory
Credits	6
Marks	100

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

CO No.	Course Objectives
CO-1	Categorize the chromatographic techniques and error analysis
CO-2	demonstrate the instrumentation of spectroscopic techniques and analyze the Mossbaeur and ESR spectra.
CO-3	Explain the principle and instrumentation of nepholometry, 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 f data of a liner 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 spectrocopy: 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, Krammer'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 Nephlometric 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_2) 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_2 binding properties heme (haemoglobin and myoglobin and non-heme proteins hemocynin & 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_{12} and cytochrome P_{450} 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*.(1st Ed.). New Delhi: Gyan Books Pvt Ltd.
2. Srivastava .A.K & P.C. Jain. (1997). *Chemical Analysis - An instrumental approach*. (2nd Ed.). New Delhi: S. Chand and Company.
3. Eichron,G.L. (1975). *Inorganic Biochemistry*. (5th Ed.). New York: Elsevier Publications.
4. Addison, W.E. (1961). *Structural Principles of inorganic compounds*. (2nd Ed.). London: Longmans Publications.
5. Huheey ,J.E. (1972). *Inorganic Chemistry*. (2nd Ed.). New york: Harper & Row publishers, Lee J. D. (1998). *Concise Inorganic Chemistry* (6th Ed.). London: ELBS.
6. Huheey, J.H. (2002). *Inorganic Chemistry*, (4th Ed.). London : Pearson Education Pvt.,Ltd.
7. D.F.Shriver, P.W.Atkins, C.H.Langford, 3rd Edn. Inorganic Chemistry, ELBS.1999.
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(For Students admitted from June 2016 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
Second year- IV Semester

Course Title	MAJOR ELECTIVE 2 - Physical Chemistry
Total Hours	90
Hours/Week	6
Code	P16CH3MET02
Course Type	Theory
Credits	5
Marks	100

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 excitedmolecules- 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_2- Cl_2 reaction, Photolysis of acetaldehyde, Photochemical equilibrium.

1.3 Laser and their applications, Elementary aspects of photosynthesis, photochemical conversion andstorage 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, Rongten, 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", 10th edn., Oxford University Press.
2. Gordon M Barrow (2007) "Physical Chemistry" , 5th 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", 2nd edition.
5. Bhajpai, D.N., (2001).Advanced Physical Chemistry (2nd 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, 3rd 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

Course Title	**MAJOR ELECTIVE-3 - Green and Nano Chemistry**
Total Hours	**75**
Hours/Week	**6**
Code	**P16CH4MET03**
Course Type	**Theory**
Credits	**5**
Marks	**100**

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

CO No.	Course Objectives
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 variousorganic 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 **15 Hrs**

GREEN CHEMISTRY

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 SYNTHESES

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 Vssonochemical 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, Knoevengal 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 (2nd ed.).
5. RashmiSanghi and Srivastava M.M. (2003). Green Chemistry – Environment friendlyAlternatives.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.

(For Students admitted from June 2016 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
Second Year - Semester – IV

Course Title	SELF STUDY PAPER – APPLIED CHEMISTRY
Total Hours	60
Hours/Week	-
Code	P17CH4SST01
Course Type	Theory
Credits	2
Marks	100

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 andunderstand 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 – TiO_2, CaC_2, 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_2, CO, O_3 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 (4th edition) , London ElBS
2. Samuel Glasstone (1967) Sourcebook on Atomic Energy (3rd 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 10th editon, Mcmillian Publishing company.
6. Sharma B.K (2005) Environmental Chemistry 8th Edition, Goel Publishing house.
7. V.P. Gowariker and N.V. Viswanathan- " Polymer Science", Ist Ed., Wiley Easter Pvt. Ltd., New Delhi.