(For Candidates admitted from the academic year 2023-24)

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.

UG COURSE PATTERN

(For Candidates admitted in the academic year 2023-24)

Semester	Part	Subject	Code	Hours	Credits	Marks
I	I	Language-General Tamil/Hindi/French	**U23TL1GEN01/ U23HN1HIN01/ U23FR1FRE01**	6	3	100
	II	General English	**U23EL1GEN01**	6	3	100
	III	Core Course I – General Chemistry I	**U23CH1CCT01**	5	5	100
		Core Course II – Quantitative Inorganic Estimation and Inorganic preparations	**U23CH1CCP02**	3	3	100
		Allied-1:Mathematics I/ Allied-1: Zoology I & Allied-2: Zoology Practical I	**U23MA1ALT02/ U23ZO1ALT01& U23ZO1ALP02**	6/ 4+2	5/ 3 +2	100/ 200
	IV	Skill Enhancement Course-I (NME1)		2	2	100
	I	Foundation Course- Basic Concepts in Chemistry	**U23CH1FCT01**	2	2	100
		Value Education		-	-	
		Total		**30**	**23**	**700/ 800**
II	I	Language- General Tamil/ Hindi/ French	**U23TL2GEN02/ U23HN2HIN02/ U23FR2FRE02**	5	3	100
	II	General English	**U23EL2GEN02**	5	3	100
	III	Core Course III-General Chemistry-II	**U23CH2CCT03**	5	5	100
		Core Course IV- Qualitative Inorganic Analysis	**U23CH2CCP04**	4	3	100
		Allied–2: Mathematics - II/ Allied- 3: Zoology II & Allied- 4: Zoology Practical II	**U23MA2ALT04/ U23ZO2ALT03 & U23ZO2ALP04**	6/ 4+2	5 3+2	100/ 200
	IV	Skill Enhancement Course-II(NME)		2	2	100
		Skill Enhancement Course-III(Generic)- Sustainable Rural Development and Student Social Responsibility	**U23RE2SET03**	2	2	100
		Massive Open Online Course(MOOC)	**U23EX2ONC01**		2(Extra)	
		Value Education		1	-	100
		Internship / Field Work / Field Project 30 Hours-Extra Credit	**U23EX2INT01**		2(Extra)	
	Total			**30**	**23+4**	**800/ 900**

Semester	Part	Subject	Code	Hours	Credits	Marks
III	I	Language-General Tamil/Hindi/French	**U23TL3GEN03/ U23HN3HIN03/ U23FR3FRE03**	5	3	100
	II	General English	**U23EL3GEN03**	5	3	100
	III	Core Course V- General Chemistry- III	**U23CH3CCT05**	6	5	100
		Core Course VI- Applied Chemistry Practical	**U23CH3CCP06**	4	3	100
		Allied –5: Physics – I	**U23PH3ALT03**	4	3	100
		Allied – 6: Physics Practical – I	**U23PH3ALP04**	2	2	100
	IV	Skill Enhancement Course-IV Entrepreneurial Skills in Chemistry	**U23CH3SET04**	2	2	100
		Skill Enhancement Course-V – Industry relations- Industrial Chemistry	**U23CH3SET05**	1	1	100
		Massive Open Online Course (MOOC)	**U23EX3ONC02**		2(Extra)	
		Value Education		1	-	-
		Total		**30**	**22+2**	**800**
IV	I	Language-General Tamil/Hindi/French	**U23TL4GEN04/ U23HN4HIN04/ U23FR4FRE04**	5	3	100
	II	General English	**U23EL4GEN04**	5	3	100
	III	Core Course VII- General Chemistry-IV	**U23CH4CCT07**	5	5	100
		Core Course VIII-Physical Chemistry Practical I	**U23CH4CCP08**	3	3	100
		Allied–7: Physics Practical-II	**U23PH4ALP05**	2	2	100
		Allied–8: Physics -II	**U23PH4ALT06**	3	3	100
	IV	Skill Enhancement Course – VI(Discipline Specific)- Instrumental Methods of Chemical Analysis	**U23CH4SET06**	2	2	100
		Skill Enhancement Course – VII(Discipline Specific)- Nutricosmetics	**U23CH4SET07**	2	2	100
		EVS	**U23ES4EVS01**	2	2	100
		Value Education		1	-	100
		Internship / Field Work / Field Project 30Hours-ExtraCredit	**U23EX4INT02**		2(Extra)	
		Total		**30**	**25+2**	**1000**

Semester	Part	Subject	Code	Hours	Credits	Marks
V	III	Core Course IX- Inorganic Chemistry-I	**U23CH5CCT09**	5	5	100
		Core Course X- Organic Chemistry-I	**U23CH5CCT10**	5	4	100
		Core Course XI- Physical Chemistry-I	**U23CH5CCT11**	5	3	100
		Core Course XII- Gravimetric analysis and preparation of Inorganic complexes	**U23CH5CCP12**	6	3	100
		Elective V-		4	3	100
		Elective VI-Chemistry of Biomolecules/Food Chemistry	**U23CH5ECT02/ U23CH5ECT03**	4	4	100
	IV	Value Education		1	-	
		Internship / Field Work / Field Project 30Hours- ExtraCredit	**U23EX5INT03**	-	2	
		Total		**30**	**24**	**600**
VI	III	Core Course XIII- Inorganic Chemistry-II	**U23CH6CCT13**	5	4	100
		Core Course XIV-Organic Analysis and preparation of Organic Compounds	**U23CH6CCP14**	5	3	100
		Core Course XV-Physical Chemistry Practical-II	**U23CH6CCP15**	4	2	100
		Project with viva voce	**U23CH6DIS01**	5	4	100
		Elective VII-		4	2	100
		Elective VIII-Physical Chemistry–II/ Analytical Chemistry	**U23CH6ECT05/ U23CH6ECT06**	4	2	100
	IV	Value Education		1	2	100
		Professional Competency Skill Enhancement Course	**U23CH6SET08**	2	2	100
		RESCAPES	**U23EX6RES01**	-	2(Extra)	
	V	Extension Activity	**U23EA6SOC01**	-	1	
	Total			**30**	**22+2 (Extra)**	**900**
	Grand Total			**180**	**140+10 =150**	**4800/ 5000**

List of Allied/ME/NME courses offered to other Departments

Semester	Part	Title of the Course	Course Code	Hrs./ wk.	Credits	Marks
I	III	Allied – 1: Chemistry Paper I(For Biochemistry/Bioinformatics)	**U23CH1ALT01**	4	3	100
		Allied – 2: Chemistry Paper-II (For Biochemistry/ Bioinformatics)	**U23CH1ALP02**	2	2	100
	IV	Skill Enhancement Course-I (NME)Food and Dietetics	**U23CH1SET01**	2	2	100
II	III	Allied – 3:Chemistry Paper III (For Biochemistry)	**U23CH1ALT03**	4	2	100
	III	Allied – 4 Chemistry Paper IV (For Biochemistry)	**U23CH1ALT04**	2	2	100
	IV	Skill Enhancement Course-II(NME)-Cosmetics and Personal Grooming	**U23CH2SET02**	2	2	100
III	III	Allied–5: Chemistry Paper–I (For Botany/Zoology/Physics)	**U23CH3ALT05**	4	3	100
		Allied-6: Chemistry Practical–I (For Botany/Zoology/Physics)	**U23CH3ALP06**	2	2	100
IV	III	Allied–7:Chemistry Practical -II (For Botany/Zoology/Physics)	**U23CH4ALP07**	2	2	100
		Allied– 8: Chemistry–II (For Botany/Zoology/Physics)	**U23CH4ALT08**	3	3	100
V	III	Elective I-	**U23CH5ECT01**	4	3	100
VI	IV	Elective III-	**U23CH6ECT04**	4	2	100

(For Candidates admitted in the academic year 2023-24)

Course Title	**Core Course 1 – General Chemistry**
Code	**U23CH1MCT01**
Course type	**Theory**
Semester	**I**
Hours/Week	**6**
Credits	**5**
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 I- 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 Planck's quantum theory and particle in 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, ionization 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 andLattice 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, macroscopic properties, state variables, thermodynamic equilibrium, extensive and intensive properties, processes and their types, exact and inexact differentials, concept of heat and work.

4.2 First Law of Thermodynamics: Statement, the energy content, work, heat and energy changes, thermodynamic reversibility, work of expansion against constant external pressure, isothermal reversible work of expansion. Heat changes at constant volume and constant pressure, heat content, relationship between 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: *Writing the IUPAC Name of organic compoundsand identifying the type of organic reactions*

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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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	define the terms and know the laws in thermodynamics and thermochemistry, describe the rules of electronic configuration, nature of hybridization and electronic effects in a molecule,	K1
CO 2	discuss the general concept of thermodynamics, compare the properties of elements, diagonal relationship between elements and importance of specific inorganic compounds.	K2
CO-3	sketch the structures of homo and hetero diatomic molecules using VSEPR, VBT & MOT, compare and contrast thermodynamic properties and the processes, calculate heat capacities of ideal gas and lattice energy. Apply slater‟s rule for screening constant and effective nuclear charge. Use the IUPAC system to name the organic compounds. Apply the Joule Thomson effect to solve problems, illustrate the relationship between heat capacities and various thermodynamic variables.	K3
CO-4	explain the atomic structure, periodic properties, types of physical and organic reactions. 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**

(For Candidates admitted in the academic year 2023-24)

Course Title	**Allied 1- Chemistry Paper I (For Biochemistry & Bioinformatics)**
Code	**U23CH1ALT01**
Course type	**Theory**
Semester	**I**
Hours/Week	**4**
Credits	**2**
Marks	**100**

CONSPECTUS

To make the students to understand and apply the basic concepts of co-ordination chemistry, metals 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 Ao 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, electrochemistry, differences between conductometric titration and volumetric titrations, laws of photochemistry, distinguish between thermal and photochemical reactions.	K1
CO2	Identify and recognize the theories of coordination compounds and role of alkali and alkaline earth metals in biological system, biological importance and toxicity of metal ions, internal and external treatment of hard water, disadvantages of hard water, electrical conductance, measurement of conductance, determination of pH and buffer solutions, explain photochemical reactions, quantum yield, photo sensitized reactions	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, metalloenzymes, quantum yield in chemical reactions, boiler troubles, calculation of water quality parameters, Kohlrausch law in determination of Ao, Conductometric titrations, pH and buffer solutions, illustrate the applications of photophysical processes	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, low and high quantum yield, fluorescence and phosphorescence, analyze the photochemical reactions based on quantum yield.	K4

TEXT BOOKS

1. 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.
2. Sharma B.K, (2016), *Industrial Chemistry*, Goel Publishing House, Meerut.
3. Puri B.R., Sharma L.R. and Kalia K.C., (2021-22), *Principles of Inorganic Chemistry* 33rd Edition Jalandhar: Vishal Publishing Co.
4. Bahl B.S, Arun Bahl and Tuli G.D, (2014), Essentials *of Physical Chemistry*, New Delhi: Sultan Chand and Sons.

SUGGESTED READINGS

1. Soni P.L. and Mohankatyal , (1992.), *Text book of Inorganic Chemistry*, 20th revised Edition, Sultan Chand and Sons
2. 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

PSO-CO Mapping

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

(For Candidates admitted in the academic year 2023-24)

Course Title	**SEC 1-Non Major Elective 1: Food and Dietetics**
Code	**U23CH1SET01**
Semester	**1**
Course Type	**Theory**
Hours/Week	**2**
Credits	**2**
Marks	**100**

CONSPECTUS

This course will enable the students to learn the functions, sources, deficiency diseases of all the nutrients, food preservation, meal planning, food additives and adulteration.

COURSE OBJECTIVES

1. To appraise the functions, sources, deficiency diseases, daily allowances of major and nutrients.
2. To understand and analyse the nutritive value of food, meal planning and nutritive value.
3. To describe the concepts involved in food preservation techniques
4. To identify the different types of food adulteration and suggest few tests for their detection and relates chemical structure of ingredients with taste.
5. To understand the effects of the natural and metallic food toxicants
6. To understand the poisoning of food by microbes, insects rodents, various modern food technologies such as biofortication, nutraceuticals and food packing.

UNIT I – FOOD NUTRIENTS 6 Hrs.

1.1 Protein – functions, sources, deficiency diseases, daily allowances, Vitamins – water soluble and fat-soluble vitamins – sources, functions, deficiency and disorders of taking excess of vitamins.

1.2 Carbohydrates – functions, sources, deficiency diseases, daily allowances, Fiber – functions, requirements and sources. Effects of deficiency of fibre.

1.3 Fats and oils – functions, sources, deficiency diseases, daily allowances, disorders due to excess of fat.

Extra reading/Key words: *Balanced diet plan*

UNIT II - NUTRITIVE VALUES OF FOOD GROUPS AND MEAL PLANNING 6 Hrs.

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 - FOOD PRESERVATION AND ADULTERATION 6 Hrs.

3.1 Food preservation - Principles and methods, importance of food preservation.
3.2 Various methods of food preservation- Use of high temperature, low temperature, drying, radiation, Browning reactions – Reasons and preventions.
3.3 Food adulteration – Definition, Common adulterants in food and their ill-effects, Intentional adulterants and incidental adulterants. Tests for detection of food adulterants.

Extra reading/Keywords: *Detection of adulterants in food*

UNIT IV - CHEMICAL POISONS IN FOOD 6 Hrs.

4.1 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.
4.2 Toxic minerals and metals —lead, mercury and cadmium.
4.3 Food additives – classification of food additives- functions and uses of food additives.

Extra reading/Keywords: *Carcinogenic effects of food additives*

UNIT: V- FOOD SANITATION AND FOOD TECHNOLOGY 6 Hrs.

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: *Tips for effective food sanitation*

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

Course Outcomes (CO)

CO No.	Course Outcomes	ognitive Level
CO-1	Describes the proteins, carbohydrates, fats, vitamins, minerals and fibers, importance of food preservation and types of food adulteration.	**K1**
CO-2	Explains the sources and functions of major and minor nutrients, methods of food preservation, food sanitation and control of insects and rodents.	**K2**
CO-3	Identify the diseases caused by deficiency of major and minor nutrients, meal planning for different age groups, flavoring substances in foods, non-perishable foods, semi-perishable and perishable foods, packaging hazards, food borne diseases.	**K3**
CO-4	Analyse the disorders due to excess of nutrients, toxicants naturally present in foods, impact of temperature and pressure of food preservation, physical and chemical tests for detection of food adulterants.	**K4**

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.

SUGGESTED READINGS

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.

WEB REFERENCES

1. https://dducollegedu.ac.in/Datafiles/cms/ecourse%20content/Public%20health%20and%20hygiene%20NUTRITIONAL%20DEFICIENCY%20%20DISORDERS.pdf
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3987
3. https://uou.ac.in/sites/default/files/slm/BHM-201T.pdf
4. https://www.masterclass.com/articles/a-guide-to-home-food-preservation-how-to-pickle-can-ferment-dry-and-preserve-at-home
5. https://vikaspedia.in/health/health-campaigns/beware-of-adulteration/methods-for-detection-of-common-adulterants-in-food

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

PSO-CO Mapping

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

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

(For Candidates admitted in the academic year 2023-24)

Course Title	**Basic Concepts in Chemistry**
Code	**U23CH1FCT01**
Course Type	**Theory**
Semester	**I**
Hours/Week	**2**
Credits	**2**
Marks	**100**

CONSPECTUS:

This course will enable the students to learn the basic concepts in Chemistry such as, atoms, molecules, redox reactions, bonding in carbon, chemical reactions, states of matter, energetics and chemical equilibrium.

COURSE OBJECTIVES

1. To understand the chemical arithmetic of atoms and molecules, through empirical formulas
2. To recognize the oxidation and reduction reactions and their equivalent weights.
3. To explain the bonding in carbon compounds.
4. To illustrate the types of chemical reactions.
5. To analyze the concepts of intermolecular interactions, energetics and chemical equilibrium.

UNIT I- ATOM, MOLECULE AND CHEMICAL ARITHMETICS 3 Hrs.

Atom, molecule, atomic mass, equivalent weight, relationship between equivalent weight, atomic weight and valency, Dulong- Petit‟s rule, empirical formula, molecular formula, methods of determining molecular weight, significant figures, matter, element, classification of elements, law of conservation of mass.

UNIT II- REDOX REACTIONS 3 Hrs.

Oxidation and reduction, oxidizing agent, reducing agent, oxidation number, oxidation state, application of oxidation number, Redox reactions, balancing Redox equations, equivalent weight of oxidant and reductant.

UNIT III- CARBON AND ITS COMPOUNDS 3 Hrs.

Bonding in carbon-The covalent bond, Allotropes of carbon, Versatile nature of carbon, Saturated and Unsaturated carbon compounds, Chains Branches and Rings- Some functional groups in organic compounds, Homologous series.

UNIT IV – CHEMICAL REACTIONS AND EQUATIONS 3 Hrs.

Chemical reactions and equations: Chemical Equations, writing a chemical equation, Balanced Chemical equations. Types of Chemical reactions- Combination reaction, Decomposition reaction, Displacement reaction, Double displacement reaction, oxidation and reduction.

UNIT V – GASEOUS AND LIQUID STATES, ENERGETICS AND CHEMICAL EQUILIBRIUM

3 Hrs.

Introduction to gaseous and liquid states – three states of matter, intermolecular interactions. London or dispersion forces, dipole-dipole dipole induced dipole forces and hydrogen bonding. Energetics – Kinetic and Potential energy, energy changes in Chemistry. Chemical equilibrium – Types with examples, factors affecting chemical equilibrium.

COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive Level
CO1	Recall the terminologies in atomic and molecular masses, redox reactions, carbon compounds, chemical reactions and states of matter.	**K1**
CO 2	Understand the chemical arithmetics, types of chemical reactions, nature of carbon and its compounds and intermolecular interactions.	**K2**
CO-3	Calculate the equivalent and molecular weights, oxidation number, stoichiometry, potential and kinetic energies.	**K3**
CO-4	Analyse the significant figures, functional groups in organic compounds, homologous series, types of reactions, intermolecular interactions and chemical equilibrium.	**K4**

RBT Levels

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

TEXT BOOKS

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, „*Principles of Physical Chemistry'*, Vishal Publishing Co., Jalandhar, 2005.
2. P. W. Atkins, "*Physical Chemistry*", (7th edition) Oxford University Press, 2009.
3. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry,* New Delhi. Sultan Chand.1989.
4. Jain M.K. S.C. Sharma „Modern Organic Chemistry", Vishal Publishing Co; Golden Jubilee year Edition, 2020.

SUGGESTED READINGS

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. Soni P.L. and Chawla H.M *Text Book of Inorganic Chemistry* (26th Edition), New Delhi, Sultan Chand and sons, 2004.
5. B. S. Bahl, G. D. Tuli and Arun Bahl, „*Essentials of Physical Chemistry*", S. Chand and Co., New Delhi, 1999.

WEB REFERENCES

1. The Energy in Chemical Reactions: Thermodynamics and Enthalpy - Annenberg Learner
2. Quantum Chemistry Of Atoms And Molecules - Course (nptel.ac.in)
3. Chemistry XI Part-II - Course (swayam2.ac.in)
4. Sr.Secondary : Chemistry (313) - Course (swayam2.ac.in)
5. Chemistry XI Part-I - Course (swayam2.ac.in)

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

PSO-CO Mapping

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

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

(For Candidates admitted from the academic year 2022-23)

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK (LOCF)

UG COURSE PATTERN

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 II	**U22EL2GEN02**	3	3	100
	III	Major Core –4	Organic and Physical Chemistry	**U22CH2MCT04**	6	4	100
		Major Core –5	Semi micro Qualitative Analysis	**U22CH2MCP05**	4	3	100
		Major Core - 6	Basics of Analytical and Physical Methods	**U22CH2MCT06**	4	4	100
		Allied – 3	Basic Physics II	**U22PH2ALT04**	4	2	100
	IV	Skill-based Course– 1	Soft Skill Development	**U22SS2SBC01**	2	1	100
		Skill-based Course – 2	Sustainable Rural Development and Student Social Responsibility	**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				1(E.C)	
		Total			**30**	**23**	**900**
	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
		Major Core –7	Inorganic and Organic Chemistry	**U22CH3MCT07**	6	5	100

III	III	Major Core –8	Physical Experiments and Computer Aided Molecular Calculations	**U22CH3MCP08**	4	3	100
		Major Elective	Domestic Power generation and House wiring	**U22PH3MET01**	4	3	100
		Allied – 4	Differential Calculus and Trigonometry/ Biology of Invertebrates and Chordates	**U22MA3ALT15/ U22ZO3ALT04**	4	2	100
	IV	Major Skill-based Elective–1	Botanical Techniques for Chemistry/Basic skills in Biological Science	**U22BO3SBP03/ U22ZO3SBP03**	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		**U22EX3INT03**		2(E. C)	100
		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/Zoology and Human Welfare	**U22MA4ALT17/ U22ZO4ALT03**	4	2	100
		Allied – 6	Analytical Geometry of three Dimensions, Vector calculus and Differential Equations/Zoological Practical	**U22MA4ALT18/ U22ZO4ALP04**	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)	
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22EX4INT04**		2(E.C)	100
			Online course	**U22EX4ONC02**		1(E.C)	
			RESCAPES			1(E.C)	
		Total			**30**	**24**	**900**
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					
		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		**U22EX5INT05**		2(E. C)	100
		Total			**30**	**24**	**800**
VI	III	Major Core –16	Inorganic Chemistry -II	**U22CH6MCT16**	4	4	100
		Major Core –17	Organic Chemistry II	**U22CH6MCT17**	4	4	100
		Major Core – 18	Physical Chemistry– II	**U22CH6MCT18**	5	4	100
		Major Core – 19	Organic analysis and Organic Preparation	**U22CH6MCP19**	4	3	100
		Major Core – 20	Physical Chemistry Practical - II	**U22CH6MCP20**	4	3	100
		Major Elective	Chemistry of biomolecules	**U22CH6MET04**	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/ Bible Studies III/ Catechism III	**U22VE6LVE03/ U22VE6LVB03/ U22VE6LVC03**	1	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		**U22SP6ECC06**		2(E. C)	100
		Online Course		**U22EX6ONC03**		1(E. C)	
		RESCAPES				1(E.C)	
			Total		**30**	**24**	**800**
			Grand Total		**180**	**140**	**5100**
			Grand Total – 140 + 20(E.C) = 160				

List of Allied/ME/ NME courses offered to other Departments

Semester	**Part**	**Course**	**Title of the Course**	**Course Code**	**Hrs./ wk.**	**Credits**	**Marks**
I	III	Allied – 1	Chemistry Paper I (For Bioinformatics/ Botany/Zoology)	**U22CH1ALT01**	4	2	100
		Allied – 2	Chemistry Paper II (For Bioinformatics/ Botany/Zoology)	**U22CH1AL P02**	4	2	100
II	III	Allied – 3	Chemistry Paper III (For Botany/ Zoology)	**U22CH2ALT03**	4	2	100
III	III	Major Elective	Chemistry of Materials(For Physics)	**U22CH3MET01**	4	3	100
		Allied – 4	Chemistry Paper-I (For Biochemistry Physics)	**U22CH3ALT04/ U22CH3ALT05**	4	2	100

		Major Skill-based Elective–1	Bioanalytical Techniques for life sciences [Botany & Zoology]	**U22CH3SBP01**	2	1	100
	IV	Non Major elective - 1	Food and Nutrition	**U22CH3NMT01**	2	2	100
IV	III	Major Elective	Chemistry of Biomolecules	**U22CH4MET02**	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	Practical skills on food analysis and small scale products	**U22CH4NMP02**	2	2	100
V	III	Major Elective	Food Chemistry	**U22CH5MET03**	4	3	100
	IV	Non Major Elective – 3	Beauty Care	**U22CH5NMT03**	2	2	100
VI	III	Major Elective	Solid Waste Management	**U22CH6MET04**	4	3	100
	IV	Non Major Elective - 4	Cosmetology	**U22CH6NMT04**	2	2	100

(For Candidates admitted from the academic year 2022-23)

Course Title	**MAJOR CORE: 6 - Inorganic and Organic Chemistry**
Code	**U22CH3MCT07**
Course type	**Theory**
Semester	**III**
Hours/Week	**6**
Credits	**5**
Marks	**100**

CONSPECTUS

This paper 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 purification of metals and to 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 reason for the orientation.
4. To enumerate the preparation and properties of organohalogen compounds and to 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 on 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'srule, 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 concentration of the ore, to list the uses of DDT, fluoro and chlorofluorohydrocarbons	**K1**
CO 2	Discuss the techniques used in 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, relative strength of acids and bases, liq. Ammonia as solvent, to apply Huckel's rule to aromatic, non-aromatic and anti-aromatic compounds, 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, bonding hard-hard and soft-soft combinations, 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**

RBT Levels

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

TEXT BOOKS

1. J. D. Lee, (1996),'*Concise Inorganic Chemistry'*, 5th ed., Blackwell Science, London.
2. F. A. Cotton, G. Wilkinson and P. L. Guas, (1994),'*Basic Inorganic Chemistry'*, 3rd ed., John Wiley, New York.

3. B. Douglas, D. McDaniel and J. Alexander, (1994),'*Concepts and Models of Inorganic Chemistry'*,3rd ed., John Wiley, New York.
4. B. R. Puri, L. R. Sharma, K. C. Kalia, (1996), '*Principles of Inorganic Chemistry'*, Shoban Lal Nagin Chand and Co, New Delhi.
5. P.L. Soni and H.M. Chawla (2014). *'Textbook of Organic Chemistry' (*26thedn).: Sultan Chand and sons, New Delhi.
6. John Mc Murray, (2012). '*Organic chemistry'*, 8th Edition, International Edition.
7. Paula YurkanisBruice, (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., ArunBahl (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

PSO-CO Mapping

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

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

(For Candidates admitted from the academic year 2022-23)

Course Title	**MAJOR CORE 7- Physical Experiments and Computer Aided Molecular Calculations**
Code	**U22CH3MCP07**
Course type	**Practical**
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:

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

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 Practical's

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

TEXT BOOKS

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. Bahl B.S, Arun Bahl and Tuli G.D. (2012), *Essentials of Physical Chemistry,* New Delhi:Sultan Chand and sons.
3. 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

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

Mapping Course outcomes with Programme outcomes (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

Mapping Course outcomes with Programme specific outcomes (CO-PSO Mapping)

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

Course Title	**MAJOR ELECTIVE-1 – Chemistry Of Materials (For Physics)**
Code	**U22CH3MET01**
Course type	**Theory**
Semester	**III**
Hours/Week	**4**
Credits	**3**
Marks	**100**

CONSPECTUS

To make the students understand the fundamentals of polymer, plastics and composites, engineering materials, alloys and glass materials, metallurgy and smart materials.

Course Objectives (CO):

1. To understand the mechanism of polymerization and learn the preparation, properties and uses of polymers, plastics, rubber and composite materials.
2. To describe the Engineering materials -abrasives, lubricants and cement.
3. To summarize the alloys of ferrous and non- ferrous materials and manufacturing of glass and its varieties.
4. To learn the various metallurgical processes and extraction of metals from its ore.
5. To find the applications of smart materials in technology.

Unit I- POLYMER, PLASTICS AND COMPOSITES 12 Hrs

1.1 Definition of monomer, oligomer, polymer and co-polymer. Molecular mass of Polymers- M_n, M_w and PDI. Polymerization – types, addition and condensation mechanism, preparation, properties and uses of PVC, Teflon, poly amide and poly carbonate.

1.2 Plastics -thermo plastics, thermo setting plastics, glass transition temperature.
Rubber - natural and synthetic rubber, vulcanization, preparation and uses of Buna-S and butyl rubber.

1.3 Composites- definition, properties and uses, constituents of composite, preparation and types of FRF.

Extra reading/Keywords: ***Inorganic polymers***

Unit II - ENGINEERING MATERIALS 12 Hrs

2.1 Abrasives – definition, properties, classifications (natural and synthetic) and applications. Preparation, properties and uses of boron carbide and silicon carbide.

2.2 Lubricants – definition, role and types (liquid, semi solid, solid, emulsion, gases) with examples. Mineral and synthetic lubricant oils, effect of asphalt. Greases –properties, types.

2.3 Cement- Manufacture of Portland cement, properties of cement, role of gypsum in the setting of cement, plaster of paris, special cements.

Extra reading/Keywords: ***Refractories***

Unit III- ALLOYS AND GLASS MATERIALS 12 Hrs

3.1 Alloys- definition, reasons for alloying, manufacturing methods- fusion, reduction, electro depositon and powder metallurgy, classification of alloys. Ferrous alloys -Composition, properties and uses of steel and cast iron.

3.2 Alloys of non-ferrous materials: Composition, propertiesand uses of copper alloys – brasses and bronzes, Aluminum alloys – Al-Si, Al –Zn, Al-Cu alloys and Identification of aluminum alloys (Composition, propertiesand uses).

3.3 Glass – manufacture of glass, processing of glass-shaping, annealing, finishing classification of glass and fabrication of glass.

Extra reading/Keywords: ***Applications of Nickel Alloys***

Unit IV -METALLURGY **12 Hrs**

4.1 Metallurgy– ores and minerals, metallurgical process - concentration of ore (gravity separation, magnetic separation, Froth floatation and leaching), calcination and roasting.

4.2 Reduction to free metal (smelting, air reduction, Goldschmidt thermite process) and refining (thermal decomposition, electro refining, zone refining).

4.3 Specialized techniques for the extraction of metals, Extraction of cast iron, chromium, copper and gold from its ore.

Extra reading/Keywords: ***Powder metallurgy***

Unit V- SMART MATERIALS **12 Hrs**

5.1 Definition, passively and actively smart materials, classification based on type of response, criteria for smartness.

5.2 Smart tools – molecular design, functionalization. Shape memory materials, smart gels and electrorheological fluids.

5.3 Smart electro ceramics- varistors, thermistors and piezoelectric transducers. Technological limitations and challenges.

Extra reading/Keywords: ***Functional nanocomposites***

TEXT BOOKS

1. Jain M.K., Sharma S.C., *Modern organic chemistry*, 4th edition., Jalandhar: Vishal Publishing Co.,2012.
2. Soni P.L., Mohan Katyal., *Text book of Inorganic Chemistry*, New Delhi: Sultan Chand and Sons,1996.
3. Jayaprakash R, *Engineering Chemistry*,1st edition, New Delhi: CBS Publishers& Distributors Pvt.Ltd,
4. Vijayamohanan K Pillai, MeeraParthasarathy, *Functional Materials A Chemist's Perspective*, Universities Press-IIM.

SUGGESTED READINGS

1. Gopalan R., Inorganic *Chemistry*,1stEdition, Chennai: Universities Press India Ltd., 2009
2. Soni P.L., Chawla H.M.,*Text Book of Organic Chemistry*, 6th Reprint, New Delhi : Sultan Chand & sons, 2006.
3. Krishnamurthy K, JeyasubramanianP ,Vallinayagam, *Applied Chemistry*, New Delhi: Tata McGraw-Hill Publishing Company Ltd.

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3. https://steemit.com/science/@lymierikxz/alloy-formation-methods-of-production-and- its-various-applications
4. https://www.thoughtco.com/aluminum-or-aluminium-alloys-603707
5. https://www.tce.edu/sites/default/files/PDF/RV4-Smart-Materials.pdf
6.http://ae.metu.edu.tr/~yyaman/EPrasad2012/2012%20METU%20Lecture%201%20Introduction%20to%20Smart%20Materials%20and%20Systems.pdf

COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive Level

CO1	Describe the terms involved in polymer, plastics, composites, abrasives, lubricants, alloys, metallurgy and smart materials, manufacture of Portland cement, glass, metallurgical process, composition, properties and uses of ferrous and non-ferrous alloys, cements, glass and smart materials.	K1
CO 2	Discuss the preparation, properties, types and uses of polymers, plastics, composites, rubber, Fiber- Reinforced Plastic (FRF),abrasives, lubricants and alloys, explain the addition and condensation polymerization, metallurgical process, describe the applications of smart materials and cements, manufacture of Portland cement, glass and extraction of metals from its ore.	K2
CO-3	Calculate the molecular weight of polymers, illustrate the applications of polymers, plastics, composites, abrasives, lubricants and smart materials, list the composition, properties, types and uses of polymers, plastics, rubber, Fiber-Reinforced Plastic (FRF),abrasives, lubricants, glass, ferrous and non-ferrous alloys, apply the metallurgical process in the extraction of metals.	K3
CO-4	Classify and illustrate the different types of polymers, plastics, rubbers, abrasives and alloys, Categorize various types of smart materials and its uses.	K4
CO-5	Compare the properties of polymers, plastics, abrasives, lubricants, applications of FRP and smart materials	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	M	H	M	M	H	H	H	H	H
CO-2	M	H	M	M	H	H	H	H	H
CO-3	H	H	M	M	H	H	H	H	H
CO-4	H	H	M	M	H	H	H	H	H
CO-5	H	H	M	M	H	H	H	H	H

PSO-CO Mapping

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

Course Title	MSBE 1: Bioanalytical Techniques for Life Sciences [Botany & Zoology]
Code	U22CH3SBP01
Semester	III
Hours/Week	2
Course Type	Theory
Credits	2
Marks	100

CONSPECTUS

The student learns about preliminary ideas of phytochemistry, water quality parameters, pH meter, determines the physical constants of given organic compounds and identifies the amino acids using paper chromatographic technique.

COURSE OBJECTIVES:

1. To find the phytochemical analysis and separation of amino acids by paper chromatography
2. To elaborate the principle and procedures for the determination of physical parameters.
3. To understand the water quality parameters
4. To determine the physical constants for the given compound

A: **20 Hrs**

1. Determination of melting point of the given organic compound.
2. Determination of boiling point of the given organic compound.
3. Preparation of buffer solutions and the determination of pH of the given buffer solution.
4. Determination of Water parameters using water analyzer.
5. Extraction of phytoconstituents from a dried plant powder using Soxhlet apparatus
6. Separation of amino acids using Paper Chromatography
7. Determination of cell constant and calculation of equivalent conductance.

B. Preparation and filtration of Aqueous extracts and organic extracts of the plant sample.

C. Preliminary phytochemical screening, detection of various plant constituents and functional groups such as

a) Carbohydrates.

b) Alkaloids.

c) Flavonoids.

d) Phenolic & Polyphenolic compounds.

e) Proteins and Amino acids.

f) Glycosides

g) Terpenoids

h) Anthocyanins

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	Identify the phytconstituents present in plant extracts.	K1
CO-2	Separate any given amino acids using paper chromatography.	K2
CO-3	Determine the melting and boiling points of the given organic compounds, determination of conductance and equivalent conductance	K3
CO-4	Predict the nature of the samples based on pH measurements.	K4
CO-5	Differentiate the different qualities of any given water sample	K5

BOOKS FOR REFERENCE:

1. Phytochemical methods by J.B. Harborne, Chapman and Hall, Newyork, 3rd edition,1998.
2. Environmetnal Chemistry, A.K.De, 8th edition, 2017.

WEB REFERENCES

1. https://www.youtube.com/watch?v=w2wAYViQBXM
2. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/soxhlet-extraction

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

PSO-CO Mapping

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

Course Title	ALLIED 4: Chemistry Paper I (For Biochemistry)
Code	U22CH3ALT04
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 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, electrochemistry, differences between conductometric titration and volumetric titrations, laws of photochemistry, distinguish between thermal and photochemical reactions.	K1
CO2	Identify and recognize the theories of coordination compounds and role of alkali and alkaline earth metals in biological system, biological importance and toxicity of metal ions, internal and external treatment of hard water, disadvantages of hard water, electrical conductance, measurement of conductance, determination of pH and buffer solutions, explain photochemical reactions, quantum yield, photo sensitized reactions	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, metalloenzymes, quantum yield in chemical reactions, boiler troubles, calculation of water quality parameters, Kohlrausch law in determination of Λo, Conductometric titrations, pH and buffer solutions, illustrate the applications of photophysical processes	K3
CO4	Examine the stability of complexes using EAN, analyze the hybridization and	K4

	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, low and high quantum yield, fluorescence and phosphorescence, analyze the photochemical reactions based on quantum yield.	

TEXT BOOKS

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

SUGGESTED READINGS

1. Soni P.L. and Mohankatyal , (1992.), *Text book of Inorganic Chemistry*, 20th revised Edition, Sultan Chand and Sons
2. 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

PSO-CO Mapping

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

Course Title	ALLIED 4: Chemistry Paper I (For Physics)
Code	U22CH3ALT05
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-IIQUANTUM 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 andphase diagrams of three component system*

COURSE OUTCOMES

CO No.	COURSE OUTCOMES	Cognitive level
CO1	Recall the electrophiles, nucleophiles, the definitions of Aufbau's principle, Hund's rule and Paul's exclusion principle, recognize the concepts of quantum numbers, identify the ionic and covalent bonds, nuclear fission and fusion and Raoult's law.	K1
CO2	Explain the different field effects, the preparation and properties of some important aromatic compounds, discuss the quantum numbers, describe the factors affecting ionic bond, differentiate between nuclear fission and nuclear fusion reaction and elaborate the various colligative properties.	K2
CO3	Apply the concept of field effects to find the stability of organic molecules, the concept of grouping elements based on their properties in periodic table, apply Fajan's rule to find the polarity of molecules, sketch the construction and working of batteries and derive the relationship between the relative lowering of vapour pressure and mole fraction of solute.	K3
CO4	Sketch the resonating and hyper conjugative structures of organic compounds, examine the periodic trends, calculate the percent ionic character, applications of batteries in daily life and construct phase diagram of water and simple eutectic system	K4

RBT Levels

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

TEXTBOOKS

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. & 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, SrikrishnaHitech 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*, 7thEdition, 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

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	**NON-MAJOR ELECTIVE – 1: Food and Nutrition**
Code	**U22CH3NMT01**
Course type	**Theory**
Semester	**III**
Hours/Week	**2**
Credits	**2**
Marks	**100**

CONSPECTUS

To enable the students to identify the functions of carbohydrates, vitamins and minerals, their functions 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-IINUTRITION AND DIET 9Hrs.

2.1 Nutrition – calorific value of food, respiratory quotient of food and recommended Dietary allowances forenergy
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 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-VFOOD 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:*Good Manufacturing Practices and Sanitation*

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 forenergy 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 anddisinfection present in different types of food, various food processing methods and food preservation methods, correlate the sensory and psychological characteristics of food acceptance.	K4

TEXT BOOKS

1. Seema Yadav, (1997),*Food Chemistry*, New Delhi, Anmol Publishing (P) Ltd.
2. Sri lakshmi B., (2003)*Food Processing and Preservation*,3rdEdition., 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.

WEB REFERENCES

1. https://www.slideshare.net/harikafle944/food-and-nutrition-general-concept
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

PSO-CO Mapping

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

Course Title	Major Core 9- INORGANIC AND PHYSICAL CHEMISTRY

Code	U22CH4MCT09
Semester	IV
Total Hours	90
Hours/Week	6
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 **18Hrs**

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 **18Hrs**

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 **18 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 **18Hrs**

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 **18Hrs.**

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
3. 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

WEB REFERENCES

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 10- APPLIED CHEMISTRY PRACTICAL

Code	U22CH4MCP10
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	K3

	polymers.	
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	U22CH4MET02
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**

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

1.2 Intermediary metabolism of carbohydrates – glycogenesis, glycogenolysis, glycolysis, gluconeogenesis.

1.3 Regulation of blood sugar – Regulation by liver and regulation by kidney, glucose Tolerance Tests. Diabetics – types, pathological condition and treatment, glycosuria.

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

UNIT 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, Factors influencing enzyme action, enzyme inhibitors, Intestinal fermentation and putrefaction, properties of Hb, Types of Jaundice.	K2
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.

WEB REFERENCES

1. **https://www.zmchdahod.org/pdf/college/Digestion_and_Absorption_of_Carbohydrates_by_Dr_Pramod-29-11-2018.pdf**
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
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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	U22CH4ALT06
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.

SUGGESTED READINGS:

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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1. https://farmsquare.ng/types-names-uses-and-benefits-of-fertilizers/-Google%20search
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	**U22CH4ALT07**
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.

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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
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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	**U22CH4ALP08**
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.

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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	U22CH4ALP09

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* 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.

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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	U22CH4NMP02
Semester	IV

Total Hours	**30**
Hours/Week	**2**
Course Type	**PRACTICAL**
Credits	**2**
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.

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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-PSO Mapping

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

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

(For Candidates admitted from June 2021- 22)

UG-COURSE PATTERN

Sem	Part	Course	Title of the Course	Course Code	Hrs./wk	Credits	Marks

I	I	Language	General Tamil I/ Hindi Paper I/ French Paper I	**U21TL1GEN01/ U21HN1HIN01/ U21FR1FRE01**	3	3	100
	II	English	General English I	**U21EL1GEN01**	3	3	100
	III	Major Core – 1 Major Core – 2 Major Core -3	Fundamental concepts of chemistry Volumetric Analysis (Lab cum theory) Analytical Chemistry	**U21CH1MCT01 U21CH1MCP02 U21CH1MCT03**	5 4 4	4 3 4	100 100 100
		Allied – 1	Differential Calculus and Trigonometry/ Bio molecular 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/ Hindi Paper II/ French Paper II	**U21TL2GEN02/ U21HN2HIN02/ U21FR2FRE02**	3	3	100
	II	English	General English II	**U21EL2GEN02**	3	3	100
	III	Major Core –4	Organic and Physical Chemistry	**U21CH2MCT04**	5	5	100
		Major Core –5	Semi micro Qualitative Analysis (Lab cum Theory)	**U21CH2MCP05**	4	3	100
		Major Elective			5	3	100
		Allied – 3	Analytical geometry of three dimensions, vector calculus and differential equations / Enzymes and Enzyme Technology	**U21MA2ALT09/ U21BC2ALT03**	4	2	100
	IV	Skill-based Course– 1	Soft Skill Development	**U21SS2SBC01**	2	1	100
		Skill-based Course – 2	Sustainable Rural Development and Student Social Responsibility	**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/ Hindi Paper III/ French Paper III	**U21TL3GEN03/ U21HN3HIN03/ U21FR3FRE03**	3	3	100
	II	English	General English 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			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/ Hindi Paper IV/ French Paper IV	**U21TL4GEN04/ U21HN4HIN04/ U21FR4FRE04**	3	3	100
	II	English	General English – 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	Chemistry of Biomolecules	**U21CH4MET05**	4	3	100
		Allied – 5	Basic Physics II	**U21PH3ALT07**	4	2	100
		Allied – 6	Basic Physics Practicals	**U21PH3ALP08**	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**

Sem	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	**U21CH5MET07**	4	3	100
		Major Skill based Elective – 2	Nutricosmetics [For Chemistry students]	**U21CH5SBT03**	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
		Online Course		**U21OC5ECT01**		2(E C)	
		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	Solid state chemistry	**U21CH6MCT18**	4	3	100
		Major Core – 19	Organic analysis and Organic Preparation	**U21CH6MCP19**	4	3	100
		Major Core – 20	Physical Chemistry Practical - II	**U21CH6MCP20**	4	3	100
	IV	Non Major Elective -4			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
		RESCAPES				4(E C)	
			Total		**30**	**24**	**800**
			Grand Total		**180**	**140**	**5100**
		Grant Total – 140+ 20(EC) = 160					

List of Allied/ME/ NME courses offered to other Departments

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	III	Major Elective	Nanotechnology and Crystal Growth techniques/ Chemistry of Materials For Physics	**U21CH2MET01/ U21CH2MET02**	5	3	100
		Allied – 3	Chemistry Paper III (For Botany/ Zoology)	**U21CH2ALT03**	4	2	100
III	III	Major Elective	Nutraceuticals and Health care with Data Analysis /Renewable Energy Resources	**U21CH3MET03/ U21CH3MET04**	4	3	100
		Allied – 4	Chemistry Paper-I (For Biochemistry/ Physics)	**U21CH3ALT04/ U21CH3ALT05**	4	2	100
		Major Skill-based Elective–1	Dairy Entrepreneurship	**U21CH3SBT01**	2	1	100
	IV	Non Major elective - 1	Food and Nutrition	**U21CH3NMT01**	3	3	100
IV	III	Major Elective	Chemistry of Biomolecules	**U21CH4MET05**	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	Practical skills on food analysis and small scale products	**U21CH4NMP02**	3	3	100
V	III	Major Elective	Food Chemistry	**U21CH5MET07**	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

(For Candidates admitted from June 2021- 22)

Course Title	MAJOR CORE 10- Inorganic Chemistry-I
Code	U21CH5MCT10
Semester	V
Course Type	Theory
Hours/Week	4
Credits	4
Marks	100

Conspectus

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 preparation, properties and applications of inorganic polymers and the concepts of nuclear chemistry.

Course Objectives (CO):

The learner will be able to

1. To differentiate the types of ligands in coordination compounds.
2. To describe the theories of coordination complexes and their applications.
3. To analyze the principle, methods of gravimetric analysis and describe the types of precipitants and precipitation techniques.
4. To know the preparation of inorganic polymers and their classification.
5. To 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: *spectral data (UV & IR) to elucidate the structure of complexes.*

UNIT II -CO-ORDINATION CHEMISTRY II 12Hrs

2.1 Valence bond theory – Postulates, formation of inner and outer sphere complexes, application of VBT (Magnetic property and geometry of 4 and 6 coordination complexes), Limitations of VBT.

2.2 Crystal field theory – crystal field splitting of energy levels of d-orbitals in octahedral, tetrahedral and square planar complexes, Crystal field stabilization energy, factors affecting the magnitude of

Δ_o. Application of CFT – colour, magnetic properties and spin states of the complexes. Comparison of VBT and CFT.

2.3 Distortion of octahedral complexes -John-Teller theorem, cause and types of distortion, Limitations of CFT. Ligand field theory (LFT)– important features of LFT. Molecular Orbital Theory (MOT) - Introduction of MOT of octahedral complexes with sigma bond ($[CoF_6]^{3-}$ and $[Co(NH3)_6]^{3+}$)

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: *Trans Effect*

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- INORGANIC POLYMERS 12Hrs

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

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

4.3 Silicones – Manufacture of silicones: Preparation of intermediates, polymerization of intermediates.

4.4 Classification: siliconefluids, silicone greases, silicone resins, coating resins, silicone rubbers or elastomers.

Extra reading/Key words:*Metal Coordination Polymers*

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):

CO No.	Course Outcomes	Cognitive Level
CO -1	recall the basic terms in coordination chemistry and nomenclature, principle of gravimetric analysis, properties of inorganic polymers and subatomic particles.	K1
CO -2	understand the theories of coordination compounds, types of precipitation, classification of inorganic polymers and theories of nuclear chemistry.	K2
CO -3	apply the coordination theories in various complexes, the principle of gravimetric analysis in the estimation of ions, calculate the binding energy of the nucleus	K3
CO -4	Analyse the splitting of energy levels based on CFT and compare the theories of coordination chemistry, applications of radioisotopes, factors influencing the thermogram	K4
CO -5	evaluate CFSE of complexes and their spin states, thermal stability of compounds using TGA and DTA.	K5
CO - 6	Estimate the thermal stability of the coordination complexes	K6

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*, PragatiPrakashan Publishers, 15th Edition, 2015.

SUGGESTED READINGS

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.

WEB REFERENCES

1. https://ncert.nic.in/textbook/pdf/lech109.pdf
2. https://chandand.weebly.com/uploads/9/2/2/7/92278224/_inorganic_chemistry_a_textbook_series_lawrance_g.a.-introduction_to_coordination_chemistry-wiley_2010_.pdf
3. https://www.iitk.ac.in/che/pdf/resources/TGA-DSC-reading-material.pdf
4. file:///C:/Users/user2/Downloads/Inorganic%20polymers.pdf
5. http://www.vpscience.org/materials/Unit-IV%20Inorganic%20Polymers%20(Sem-V).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	H	M	M	M	M	H	L	L
CO-2	H	M	M	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
CO-5	H	M	H	M	M	M	H	H	H
CO-6	H	H	M	M	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	M	H	H
CO6	H	M	H

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

(For Candidates admitted from June 2021- 22)

Course Title	**MAJOR CORE -11 – Organic Chemistry-I**
Code	**U21CH5MCT11**
Course type	**Theory**
Semester	**5**
Hours/Week	**4**
Credits	**3**
Marks	**100**

CONSPECTUS

To enable the students to learn the preparations and properties of some important organic compounds containing oxygen and nitrogen.

COURSE OBJECTIVES:

1. To understand the preparation, properties of aliphatic and aromatic aldehydes and ketones
2. To describe the preparation, properties and strength of aliphatic and aromatic carboxylic, sulphonic acids and their derivatives.
3. To appraise and justify the preparation, properties and basicity of nitrogen
4. To classify, formulate and discuss the concepts of amino acids, proteins and nucleic acids.
5. To compare, 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 Active methylene Compounds - 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 and Merrifield synthesis, characterization of peptides by C- Terminal residue analysis (hydrazinolyis method) and N-terminal 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 Structure of proteins.

4.4 Nucleic acids – Introduction,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)

CO No.	Course Outcomes	Cognitive Level
CO-1	Describe the preparation, properties of organic compounds such as carbonyl compounds, carboxylic acids and its derivatives, Nitro compounds and Amines, Amino acids, proteins and carbohydrates.	K1
CO-2	Explains the reactions and mechanisms of carbonyl compounds, organic acids, nitrogen containing compounds and structure of proteins, nucleic acids and carbohydrates.	K2
CO-3	Identify the reaction mechanism of carbonyl compounds, organic acids and synthetic applications of diazonium salts, diazomethane and diazo acetic ester, peptides and poly peptides. Elucidate the structure of monosaccharides and disaccharides.	K3
CO-4	Compare the reactions and mechanisms of carbonyl compounds. Distinguish primary, secondary and tertiary nitro compounds, nucleic acids and α, β, γ hydroxy acids. Explain the separation of primary, secondary and tertiary aliphatic amines and interconversion of glucose and fructose.	K4
CO-5	Determine the acidity of organic acids and basicity of aliphatic and aromatic amines, ring size of glucose and fructose. Compare the mechanism of Aldol and Benzoin condensations, structure and functions of proteins.	K5
CO-6	Predict the reaction and mechanism of carbonyl compounds, organic acids and its derivatives, Amines and Nitro compounds. Elaborate the preparation, properties, functions and structure of proteins, amino acids, nucleic acids and carbohydrates.	K6

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, VikasPulbishing House Pvt. Ltd, 2017.

SUGGESTED READINGS

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", 6thEdition,John Wiley and Sons(Asia)Pte. Ltd, New Delhi, 2006.
3. Robert Thornton Morrison, Robert Neilson Boyd , SaibalKantiBhattacharjee, *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.

WEB REFERENCES

1.https://videos.doubtnut.com/QA/answer-1616665143_141176390/360p.mp4

2. https://www.khanacademy.org/science/organic-chemistry/carboxylic-acids-derivatives/naming-carboxylic-acids-sal/v/carboxlic-acid-introduction

3.https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291608409347arun_sethi_Nitro_compounds.pdf

4.http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_chemistry/15.amino_acids_and_food_proteins__introduction_and_general_properties/et/393_et_m15.pdf

5.http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001199/M010853/ET/1479964601P4M18Feb22.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	H	L	M	M	H	H	H	H
CO-2	H	H	M	H	M	H	H	H	M
CO-3	H	M	H	M	H	M	H	H	M
CO-4	H	H	H	M	H	H	H	M	M
CO-5	H	H	M	H	M	H	H	H	M
CO-6	H	H	H	M	H	H	H	M	H

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	M	H	H
CO2	H	M	H
CO3	H	H	H
CO4	H	H	H
CO5	H	H	H
CO6	H	H	H

(For Candidates admitted from June 2021- 22)

Course Title	**MAJOR CORE : 12 - Physical Chemistry - I**
Code	**U21CH5MCT12**
Course type	**Theory**
Semester	**5**
Hours/Week	**4**
Credits	**4**
Marks	**100**

CONSPECTUS:

This course will enable the students to 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

1. To outline the concepts and theories of electrolytic conductance.
2. To recognize the electrochemical cells, EMF of the cell and its measurement.
3. To explain the concentration cells and the theories of over voltage and corrosion.
4. To illustrate the theories of chemical kinetics, chain reactions and fast reaction techniques.
5. To analyze 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):

CO No.	COURSE OUTCOMES	Cognitive Level
CO1	Recall the terminologies in electrochemistry, chemical kinetics, catalysis and adsorption.	**K1**
CO 2	Describe each of the electrochemical methods and theories related to kinetics, catalysis and adsorption.	**K2**
CO-3	Solve problems in electrochemistry, kinetics and adsorption.	**K3**
CO-4	Analyse the conductance at high and low frequencies, relationship between electrical energy and thermodynamic properties, corrosion of metals, fast reactions, factors affecting the rate of enzyme reaction and types of adsorption.	**K4**
CO-5	Evaluate transport number, electrode potential, solubility product, rate constants.	**K5**
CO-6	Formulate an electrochemical cell for the given process.	**K6**

RBT Levels

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

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 ArunBahl, „*Essentials of Physical Chemistry*", S. Chand and Co., New Delhi, 1999.
3. P. W. Atkins, "*Physical Chemistry*", (7th edition) Oxford University Press, 2009.
4. Samuel Glasstone, „*An Introduction to Electrochemistry'* McMillan India Ltd.,2015.

SUGGESTED READINGS

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. B. Patania,,*'Chemical Kinetics'*, Campus Publications, New Delhi, 2004.
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PO-CO Mapping

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

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	M	M	H
CO5	M	M	H
CO6	M	M	H

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

(For Candidates admitted from June 2021- 22)

Course Title	MAJOR CORE 13– Gravimetric Analysis andPreparation of Inorganic Complexes
Code	U21CH5MCP13
Semester	5
Course Type	Practical
Hours/Week	4
Credits	3
Marks	100

Conspectus

To make the students to learn about the basic principles behind the gravimetric analysis, estimation of inorganic compounds and the preparation of inorganic complexes.

Course Objectives (CO):

The learner will be able to

1. Understand the types of precipitant used in the precipitate theory
2. estimate the amount of an ion in a given solution gravimetrically
3. understand the principle of gravimetric analysis
4. understand the principle involved in the preparation of complexes
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.
7. Copper as Cuprous Thiocyanate.

Preparation of Inorganic Complexes (to be tested internally)

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

Course Outcomes (CO):

CO No.	Course Outcomes	Cognitive Level
CO -1	recall the principle of gravimetric analysis	K1
CO -2	understand the types of precipitation, precipitants, steps involved in the estimation and preparation of inorganic complexes	K2
CO -3	apply the principle in the estimation of inorganic ion in the given solution	K3
CO -4	analyse the different steps and find out the reason for error in the estimation	K4
CO -5	Assess the yield of different inorganic preparation	K5
CO-6	Estimate the amount of metal ions present in domestic water	K6

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

TEXT BOOKS

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

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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.
4. Vogel"s Qualitative Inorganic Analysis, Pearson 7th Edition 2009

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4. https://edurev.in/t/126575/Theory--Procedure--Preparation-of-Inorganic-Compounds

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	M	M	M	H	L	L
CO-2	H	M	M	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
CO-5	H	M	H	M	M	M	H	H	H
CO-6	H	H	H	M	M	M	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	M	H	H
CO6	H	M	H

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

(For Candidates admitted from June 2021- 22)

Course Title	**MAJOR CORE : 14 - Physical Chemistry Practical - I**
Code	**U21CH5MCP14**
Semester	**5**
Course Type	**PRACTICAL**
Hours/Week	**4**
Credits	**3**
Marks	**100**

CONSPECTUS:

This course will enable the students to gain practical skills in Physical Chemistry experiments of Conductometry, Colorimetry, pH metry and Polarimetry

Course Objectives (CO):

1. To determine the strength of acids by conductometry and potentiometry
2. To estimate the equivalent conductance of strong electrolyte.
3. To understand Lambert-Beer‟s law by photoelectric colorimeter.
4. To verify Henderson-Hasseslbulch equation by pH metry and the concept of optical rotation by polarimetry.
5. To evaluate the rate constant of I order reactions.

Conductometric titrations:

1. To find the strength of HCl conductometrically using a strong base NaOH
2. To determine the cell constant and equivalent conductance of a strong electrolyte.

Potentiometric Titrations:

3. To find the strength of HCl potentiometrically using quinhydrone electrode.

Colorimetry:

4. To verify Lambert -Beer‟s law for $K_2Cr_2O_7$ solution using photoelectric colorimeter and determine the unknown concentration.

pH Meter:

5. To determine the [salt]/[acid] ration of buffer solution by pH meter and verification of Henderson-Hasselbulch equation.

Polarimetry:

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

Chemical Kinetics:

7.To study the I order kinetics of acid catalyzed hydrolysis of ester

Course Outcomes (CO):

CO No.	Course Outcomes	Cognitive Level
CO -1	recall the principles of conductometry and potentiometry	K1
CO -2	understand the Beer‟s law using photoelectric colorimeter	K2
CO -3	apply the Henderson-Hasselbulch equation in determining the [salt]/[acid] ratio of buffer solution	K3
CO -4	analyse the concept of optical rotation by using different concentrations of sugar solution	K4
CO -5	Assess the kinetics of reactions.	K5
CO -6	Formulate the strength of the given unknown solutions by conductometry, potentiometry, colorimetry and polarimetry.	K6

TEXT BOOKS

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of acticalChemistry.*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.
3. Vogel‟s Textbook of Practical Organic Chemistry Pearson 5th Edition 2011.

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1. Negi, A.S. &Anand, S.C.,,,*A Text book of Physical Chemistry'*, 3rd Edition Wiley Eastern Ltd., 1994.
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5. https://youtu.be/1A8Nv2tRL7c

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**	**M**	**M**	**M**	**H**	**L**	**L**
CO-2	**H**	**M**	**M**	**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**
CO-5	**H**	**M**	**H**	**M**	**M**	**M**	**H**	**H**	**H**
CO-6	**H**	**M**	**H**	**M**	**M**	**M**	**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	**M**	**H**	**H**
CO6	**M**	**H**	**H**

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

(For Candidates admitted from June 2021- 22)

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

CONSPECTUS:

This course will enable the students to learn the functions, sources, deficiency diseases of all the nutrients, food preparation, preservation and adulteration.

COURSE OBJECTIVES

The learners will be able to

1. To appraise the functions, sources, deficiency diseases, daily allowances of major nutrients.
2. To discuss the toxicants naturally present in the foods and the importance of minor nutrients.
3. To categorize and summarize the various techniques of food preparation and recommend steps to retain the nutritive value.
4. To describe the concepts involved in food preservation techniques.
5. To identify the different types of food adulteration and suggest few tests for their detection and relates chemical structure of ingredients with taste.
6. To construct different types of cooking methods and preservative methods.

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 Fiber – functions, requirements and sources. Effects of deficiency of fibre.
2.4 Toxicants naturally present in foods. Fermented foodsand 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: Processed food -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 wordsmust be tested only through Assignment and Seminars.

Course Outcomes (CO)

CO No.	Course Outcomes	Cognitive Level
CO-1	Describes the proteins, carbohydrates, fats, vitamins, minerals and fibers food preparations, importance of food preservation and types of food adulteration.	**K1**
CO-2	Explains the sources and functions of major and minor nutrients, types of cooking methods, merits and demerits of cooking methods, methods of food preservation and control of insects and rodents.	**K2**
CO-3	Identify the diseases caused by deficiency of major and minor nutrients, food faddism, flavoring substances in foods, non- perishable foods, semi-perishable and perishable foods, packaging hazards, food borne diseases.	**K3**
CO-4	Analyse the disorders due to excess of nutrients, toxicants naturally present in foods, retention of nutritive value during preparation, impact of	**K4**

	temperature and pressure of food preservation, physical and chemical tests for detection of food adulterants.	
CO-5	Evaluate the daily allowances of nutrients, moist heat methods and dry heat methods, browning reactions in foods and physiological and chemical aspects of taste sensation.	**K5**
CO-6	Create a table for major and minor nutrients with respect to their sources, functions, deficiency diseases, daily allowances, Non- perishable foods, semi-perishable and perishable foods, tests for detection of food adulterants.	**K6**

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.

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1. Dr. M. Swaminathan. (1987) *Food Science Chemistryand 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.
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4. https://www.masterclass.com/articles/a-guide-to-home-food-preservation-how-to-pickle-can-ferment-dry-and-preserve-at-home

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PO-CO Mapping

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

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	M	H	M
CO2	M	H	H
CO3	H	H	H
CO4	H	H	H
CO5	L	H	H
CO6	H	H	H

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

(For Candidates admitted from June 2021- 22)

Course Title	MAJOR SKILL BASED ELECTIVE 2 –Nutricosmetics
Code	U21CH5SBT03
Semester	5
Course Type	Theory
Hours/Week	2
Credits	1
Marks	100

Conspectus

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

Course Objectives(CO):

The learner will be able

1. To categorize and identify the types, functions and threats to the skin
2. To understand and identify the types and problems of hair and suggest treatments.
3. To list out the advantages and disadvantages of manual massage and mask treatment
4. To outline the preparations of face creams, face powders and suggest facial packs for different type of skin
5. To 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*

Course Outcomes (CO):

CO No.	Course Outcomes	Cognitive Level
CO-1	Identify the different types of skins and hair, common skin and hair problems, cosmetics used for different types of skin.	K1
CO-2	Understand the various skin and hair problems and their treatment, benefits of massage and mask treatment and hazards of using various cosmetics.	K2
CO-3	apply the step by step shampoo rinses, preparation of facial for different types of skin and classichair cut theories.	K3
CO-4	analyze the preparation of various creams and their composition, uses of facial and hazards due to cosmetics.	K4
CO-5	evaluate the hazards of using various cosmetics and uses of massage and mask treatment.	K5
CO-6	Design the cosmetics based on the skin type	K6

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. Arunaanand, „*The complete book of beauty care",*Vishu books 2011.
4. Baki Gabriella and Kenneth S. Alexander," Introduction to cosmetic formulation and technology" May 2015.

SUGGESTED READINGS

1. ParveshHanda, „*A complete book on Beauty, Body, Make-up and Hair styles'*, Goodwill publishing House, New Delhi, 2014
2. ParveshHanda, „*Herbal Beauty Care*", Orient paperbacks, New Delhi 2004
3. Baoran Robert and Howard „Textbook of Cosmetic Dermatology", CRC press 2017
4. ParveshHanda,"Speaking of skin care sterling publishers" 1998

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2. https://vedix.com/blogs/articles/common-hair-problems
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5. https://skinkraft.com/blogs/articles/types-of-facials-how-to-choose-according-to-skin-type

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	L	H	M	H	M	M	L	H
CO-2	H	M	M	M	M	M	M	M	H
CO-3	H	L	M	M	H	M	H	L	M
CO-4	H	M	H	M	H	M	M	M	M
CO-5	H	L	H	M	M	M	H	L	H
CO-6	H	L	H	M	M	M	H	L	H

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	M	H	H
CO2	H	M	H
CO3	H	M	H
CO4	H	M	H
CO5	M	H	H
CO6	M	H	H

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

(For Candidates admitted from June 2021- 22)

Course Title	**NON-MAJOR ELECTIVE –3: BEAUTY CARE**
Code	**U21CH5NMT03**
Course type	**Theory**
Semester	**5**
Hours/Week	**3**
Credits	**3**
Marks	**100**

CONSPECTUS

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:

1. To understand the types, nerves, functions and lesions of skin.
2. To identify the different skin imperfections and its remedy and learn about facial and its procedure.
3. To describe the compositions of hair and various hair problems and hair techniques.
4. To illustrate the different good postures and diet for good health.
5. To help the students 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*

TEXTBOOKS

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

SUGGESTED READINGS

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

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3. https://onlinecourses.swayam2.ac.in/nos21_ge08/preview
4. https://rajendrauniversity.ac.in/health-and-hygiene/
5. https://onlinecourses.swayam2.ac.in/nos19_as11/preview

COURSE OUTCOMES

CO No.	COURSE OUTCOMES	ognitive Level
CO1	define the skin types, skin diseases, composition of hair, diet for healthy growth and types of cosmetics.	K1
CO 2	Understand the skin imperfections, facial procedures, hair problems, general body care and hazards of cosmetics	K2
CO-3	Apply various types of skin care methods, therapies for skin care, hair techniques, self-grooming and make-up preparations	K3
CO-4	Explain the remedies for skin and hair problems.	K4
CO-5	Evaluate the hair techniques, facial massage and preparation of hair creams and lotions.	K5
CO-6	Formulate the preparation of make-up and hair tonics	K6

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**	**L**	**H**	**H**	**H**	**H**	**L**	**H**	**H**
CO-2	**H**	**M**	**H**	**H**	**H**	**H**	**M**	**H**	**H**
CO-3	**H**	**L**	**H**	**H**	**H**	**H**	**M**	**H**	**H**
CO-4	**H**	**L**	**H**	**H**	**H**	**H**	**L**	**H**	**H**
CO-5	**H**	**M**	**H**	**H**	**H**	**H**	**M**	**H**	**H**
CO-6	**H**	**M**	**H**	**H**	**H**	**H**	**M**	**H**	**H**

PSO-CO Mapping

CO/ PSO	PSO1	PSO2	PSO3
CO1	**L**	**H**	**H**
CO2	**M**	**H**	**H**
CO3	**H**	**H**	**H**
CO4	**M**	**H**	**H**
CO5	**H**	**H**	**H**
CO6	**H**	**H**	**H**

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

(For Candidates admitted in the academic year 2021-22)

Course Title	Major Core 15- INORGANIC CHEMISTRY-II
Code	U21CH6MCT15
Semester	VI
Total Hours	60
Hours/Week	4
Course Type	Theory
Credits	3
Marks	100

CONSPECTUS

To make the students to learn about the preparation, properties of rings and cages, bonding of organometallic complexes 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):

1. To describe the preparation, properties of rings and cages.
2. To understand the bonding of organometallic compounds and metal carbonyls.
3. To explain the applications of dipole moment and magnetic properties for inorganic `and organic molecules.
4. To analyze the interaction of metal ions with biological systems and illustrate the structure and functions of electron transfer proteins.
5. To understand and analyze the properties of lanthanides and actinides.

UNIT- I RINGS, CAGES AND CLUSTERS 12 Hrs.

1.1 Introduction to cages and rings-Hemicyclic rings. Carboranes- Synthesis, Polyhedral geometrics of metelloboranes and metallocarboranes.
1.2 Boron Cage compounds – Boranes.
1.3 Iso poly acids, Hetero poly acids – Preparation, properties, industrial applications.
1.4 Metal clusters – Dinuclear and trinuclear clusters.

Extra reading/keywords: *Polynuclear clusters.*

UNIT- II ORGANOMETALLIC COMPOUNDS 12Hrs.

2.1 Introduction – Definition and types – Alkene complexes- Zeise's salt- Structural features.
2.2 Bonding in metal alkene complexes, Metal Butadiene complexes, Metal allyl complexes, Metal acetylene complexes, Carbyne complexes, Carbene complexes, 18- electron rule
2.3 Metal Sandwich complexes- Structure, bonding and properties of ferrocene, Metallocenes – dibenzene chromium, Half sandwich compounds.
2.4 Metal carbonyls – EAN Rule, classification, preparation- Direct combination, High pressure synthesis, Disproportionation reaction, properties and bonding in metal carbonyls.

Extra reading/Key words: *Structures and shapes of metal carbonyls.*

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 – anti-ferromagnetism – 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), Role of alkali and alkaline earth metals in biological systems–Role of sodium and potassium ions, Role of magnesium and Calcium ions.

4.2 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. Electron transport proteins – Cytochromes, iron sulphur proteins, storage and transport of iron.

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

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

Extra reading/Key words: *Control and uses of enzyme action*

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*

PRESCRIBED TEXT BOOKS:

1. Gopalan R, Ramalingam V '*Concise Coordination Chemistry'* First revised Edition, Vikas Publishing House.2014
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. Willard H H, MerrittL. L., and Dean J. A., *Instrumental Methods of analysis*, Delhi, 6th Edition, CBS Publishers & Distributors, Shahdara 1986.
7. Skoog D, West D, *Principles of Instrumental Analysis*; 6th Edition, Cengage Learning 2006.

WEB REFERENCES

1. https://oliver.chemistry.ucsc.edu/151B/Ch16.pdf
2. https://uomustansiriyah.edu.iq/media/lectures/6/6_2017_03_14!12_38_50_AM.pdf
3. https://rnlkwc.ac.in/pdf/study-material/chemistry/C8_DIPOLE_MOMENT____DM.pdf
4. https://www.shivajicollege.ac.in/Study/Bioinorganic%20Chemistry%20(1).pdf
5. https://unacademy.com/content/wp-content/uploads/sites/2/2022/10/26.-d-_-f-block-Elements.pdf

Course Outcomes (CO):
The learners

CO No.	Course Outcomes	Cognitive Level
CO 1	Know the fundamental concepts of rings and cages, definition and types of organometallic compounds, fundamental concepts of dipole moment and magnetic properties, learn the role of metal ions in biological systems, definition and general properties of *f* -block elements.	K1
CO -2	Understand the preparation and properties of Boron compounds, metal butadiene and metal allyl complexes, Mosotti-Clausius equation and Debye equation, Role of alkali and alkaline earth metals in biological systems, extraction and separation of Lanthanides.	K2
CO -3	apply the structure and derivatives of Borazine, – EAN Rule in metal carbonyls, different types of magnetism and evaluate the applications of magnetic susceptibility of molecules.	K3
CO -4	analyze the Sulphur nitrogen compounds, bonding in organometallic compounds, magnetic moments, role of metal ions, electron transfer proteins and metallo-enzymes in biological systems.	K4
CO -5	Compare the Magnetic properties of matter, properties of Lanthanides and Actinides.	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	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	H	H	H	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
CO -5	H	H	H

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

(For Candidates admitted in the academic year 2021-22)

Course Title	Major Core – 16: ORGANIC CHEMISTRY - II
Code	U21CH6MCT16
Semester	VI
Total Hours	60
Hours/Week	4
Course Type	Theory
Credits	4
Marks	100

CONSPECTUS

To enable the students to learn and understand the concepts of stereochemistry, mechanism of rearrangement reactions, chemistry of heterocyclic compounds and reagents, and structural elucidation of natural products.

COURSE OBJECTIVES:

1. To understand the concepts of optical isomerism, geometrical isomerism and conformational analysis.
2. To describe the synthetic importance of reagents and catalysts
3. To illustrate and apply the mechanism of various molecular rearrangements to the given substrates.
4. To classify, formulate and defend the preparation, properties of heterocyclic compounds.
5. To 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, Periodic acid, SeO_2.

2.3 Coupling Agents: NBS, DCC, EDC.

2.4 Organo metallic catalysts- Zeiglar Natta Catalyst, Wilkinson Catalyst

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

UNIT-III MOLECULAR REARRANGEMENTS 12 Hrs.

3.1 Molecular Rearrangements: Classification – Intermolecular and Intramolecular Rearrangements.

3.2 Mechanism and Characteristics of Pinacol – Pinacolone, Beckmann, Benzidine rearrangements.

3.3 Mechanism of Hofmann, Curtius, Schmidt, Cope rearrangement.

3.4 Mechanism and Characteristics of 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 12Hrs.

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-Meissel value.

Extra reading/Keywords: *Steroids*

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	Cognitive Level
CO-1	describe optical isomers, conformers of alkanes, cycloalkanes, chemistry of reagents and rearrangement, preparation and properties of heterocyclic compounds and structure of alkaloids and terpenoids.	K1
CO-2	explain optical activity in organic compounds, conformers of alkanes and cycloalkanes, synthetic importance of reagents, catalyst, molecular rearrangements and hetrocyclic compounds	K2
CO-3	identify the configuration for the various optically active organic compounds, mechanism of molecular rearrangements, preparation and properties of heterocyclic compounds, methods to detect alkaloids, terpenoids, vitamins and fats and oils.	K3

CO-4	classify optical isomers and geometrical isomers, vitamins, fats and oils, lipids, compare the reaction and mechanisms of rearrangements and heterocyclic compounds.	K4
CO-5	determine the various conformers of alkanes and cycloalkanes, mechanism of molecular rearrangements, basicity of Heterocyclic compounds and structural of alkaloids, terpenoids and vitamins.	K5

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 READINGS

1. Soni P.L. and Chawla H.M, '*Text Book of Organic Chemistry*', 29th Edition, Sultan Chand, 2012.
2. Jerry March, '*Advanced Organic ChemistryReactions, 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.

WEB REFRENCES:

1. https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Introduction_to_Organic_and_Biochemistry_(Malik)/03%3A_Stereochemistry/3.01%3A_Introduction_to_stereochemistry
2. https://tmv.ac.in/ematerial/chemistry/kpb/SEM_IV_Honours_Rearrangement%20final.pdf
3. https://chemnote.weebly.com/uploads/2/5/8/6/25864552/alkaloids.pdf
4. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/heterocy.htm
5. https://www.britannica.com/science/Ziegler-Natta-catalyst

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

PSO-CO Mapping

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

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

Course Title	MAJOR CORE : 17 - PHYSICAL CHEMISTRY – II [SPECTROSCOPY]
Total Hours	60
Hours/Week	4
Code	U21CH6MCT17
Course Type	THEORY
Credits	4
Marks	100

CONSPECTUS:

This course will enable the students to learn and understand the basic principles and applications involved in Rotational spectra, IR spectra, Raman spectra, Electronic spectra, Mass spectrometry, NMR spectra and ESR spectra.

COURSE OBJECTIVES

1. To understand the properties of electromagnetic radiation and explain the rotational spectra of diatomic molecules.
2. To illustrate the simple harmonic and anharmonic oscillator and vibrations of polyatomic molecules.
3. To explain raman spectrum and elucidate the structure using IR and raman for simple systems.
4. To describe electronic spectra of diatomic molecules and the salient features of fragmentation pattern of organic compounds using mass spectrometry.
5. To explain the principle and theory of NMR and ESR.

UNIT-I ROTATIONAL SPECTROSCOPY 12 Hrs.

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

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, Selection rule

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 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, Selection rule.
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, Selection rule.
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):

CO No.	COURSE OUTCOMES	Cognitive Level
CO1	recall the spectroscopic terms	**K1**
CO 2	develop the knowledge on the basic principles and selection rules of spectroscopy.	**K2**
CO-3	calculate bond length, vibrational frequency, anharmonic constant, magnetic field, g-factor, chemical shift and predict the no. of NMR and ESR signals.	**K3**
CO-4	analyze the fragmentation pattern in mass spectrometry, the existence of Raman lines and signals in NMR.	**K4**
CO-5	evaluate the group frequencies, Raman and IR activity, m/e values and factors affecting proton signal for simple systems.	**K5**

RBT Levels

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

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.
3. Kalsi. P.S, Spectroscopy of Organic compounds, New Age International, 2007.
4. McHale, J.L '*Molecular spectroscopy*', Prentice Hall Publishers**,** 1999.

SUGGESTED REFERENCES:

1. Russell S. Drago, '*Physical methods for chemists'*, Saunders, 1992.
2. Manas Chanda, '*Atomic structure and Chemical Bond Including Molecular pectroscopy'*, Tata McGraw-Hill Publishing Company Ltd, 1972.
3. Sindhu, P.S '*Fundamentals of Molecular spectroscopy*' 1st Edition, New Age International publishers, 2006.
4. William Kemp '*Organic Spectroscopy*', 3rd Edition, ELBS publishers, 1991.
5. Russell S. Drago, '*Physical methods in Inorganic Chemistry'*, East West student Edition, 1978.
6. Manas Chanda, '*Atomic structure and Chemical Bond Including Molecular Spectroscopy'*, Tata McGraw-Hill Publishing Company Ltd, 1972.
7. Levine, I.N "*Molecular spectroscopy*", John Wiley and Sons, 2000.

WEB REFERENCES:

1. Fundamentals of Spectroscopy - Course (nptel.ac.in)
2. Application of Spectroscopic Methods in Molecular Structure Determination - Course (nptel.ac.in)
3. Organic Spectroscopy - Pathshala - CHEMISTRY PAPER No. 12: Organic Spectroscopy MODULE No. 35: - Studocu
4. Microsoft Word - CHE_P12_M1_e-Text.docx (inflibnet.ac.in)
5. https://acrobat.adobe.com/link/review?uri=urn:aaid:scds:US:3c9a9fd1-b12a-37f7-a4bb-834d10dd304f

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

PSO-CO Mapping

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

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

(For Candidates admitted in the academic year 2021-22)

Course Title	Major Core 18-SOLID STATE AND NANO CHEMISTRY
Code	U21CH6MCT18
Semester	VI
Total Hours	60
Course Type	Theory
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS

To make the students to learn about the classification, symmetry, structures, defects and theories of solid crystals and to know about nanoparticles, properties and synthesis of nanomaterials, carbon nanotubes and colloidal gold.

COURSE OBJECTIVES (CO):

The learner will be able to

1. To understand the basic concepts in crystal structures.
2. To describe the bonding in metals and superconductivity.
3. To know the origin, synthesis and properties of nanomaterials.
4. To understand the synthesis of nanoparticles and analyze the various characterization techniques involved in nanotubes.
5. To apply the concepts of carbon nanotubes and colloidal gold and analyze the applications in structural, electromagnetic, chemical and mechanical aspects.

UNIT I – SOLID STATE I **12Hrs**

1.1 Structure of solids – Classification of solids – isotropy and anisotropy, interfacial angle – symmetry in crystals – cubic and hexagonal systems. Space lattice and unit cell, seven basic crystal systems.

1.2 Bravais lattices, Designation of planes in crystals – Miller indices. Diffraction of X-rays by crystals –Bragg's equation –powder method and rotating crystal method.

1.3 Types of crystals, close packing of identical solid spheres - interstitial sites, limiting radius ratios (derivation not needed), radius ratio rule and structures of ionic crystals. Crystal structures of NaCl, CsCl, ZnS, fluorite (CaF_2) and Rutile.

1.4 Defects in solids – stoichiometric defects – Schottky defect, Frenkel defect – non-stoichiometric defects – metal deficiency defect, metal excess defect.

Extra reading/Keywords: *antifluorite structure.*

UNIT II -SOLID STATE II **12Hrs**

2.1 Solid state energetics: Lattice energy – Born-Lande equation – Kapustinski equation, Madelung constant.

2.2 Theories of bonding in metals – free electron theory, valence bond theory, band theory – semiconductors – *n* type and *p* type.

2.3 Transistors - uses – structure of alloys – substitutional and interstitial solid solutions – Hume Rothery ratio. Diodes, photovoltaic effect and light emitting diodes

2.4 Super conductivity – low temperature super conducting alloys, theory of super conductivity, high temperature super conductors.

Extra reading/Keywords: *intrinsic semiconductors*

UNIT III- INTRODUCTION TO NANO MATERIALS 12Hrs

3.1 Definition of nano materials – origin of nano technology – difference in properties between bulk and nano materials – Dimension based classification of nano materials.

3.2 Synthesis and stabilization of nanomaterials – Top-down approach (physical methods), mechanical dispersion – ball milling, methods based on evaporation of a precursor –inert gas condensation, ion sputtering, spray pyrolysis, nanolithography.

3.3 Bottom-up approach (chemical methods) – solvothermal synthesis, photochemical method, gamma radiolysis, sonochemical synthesis, sol-gel method, physical vapour deposition.

3.4 Magnetic, optical and electrical properties of nano materials.

Extra reading/Key words: *Characterization techniques of nanoparticles using STM, FE-SEM, AAS and XPS*

UNIT IV-CARBON NANOTUBES 12Hrs

4.1 Introduction – Types-single walled CNT, multiwalled CNT, functionalization of carbon nanotubes.

4.2 Synthesis of carbon nanotubes – electric arc discharge, chemical vapor deposition, laser ablation, purification of nanotubes.

4.3 Characterization of carbon nanotubes – XRD, SEM, TEM and AFM.

4.4 Applicationsofcarbonnanotubes–structural,electromagnetic,chemical and mechanical applications, colloidal gold –synthesis and applications

Extra reading/Key words*:**Synthesis ofBoronNitrideNanotube, Fullerenes*

UNIT V -APPLICATION OF NANOMATERIALS 12Hrs

5.1 Biomedical applications – drug, drug delivery, biolabeling, artificial implants, cancer treatment. Sensors – natural nanoscale sensors, chemical sensors, biosensors, electronic noses.

5.2 Optics & electronics – Nanomaterials in the next generation computer technology, high definition TV, flat panel displays, quantum dot laser, single electron transistors.

5.3 Nanotechnology in agriculture-fertilizer and pesticide nanomaterials for water purification, nanomaterials in food and packaging materials, fabric industry.

5.4 Impacts of nanotechnology-human & environmental safety risks.

Extra reading/Keywords: *Quantum dots*

Course Outcomes (CO):

CO No.	COURSE OUTCOMES	Cognitive Level
CO -1	recall the basic terms in solid state chemistry and nano-sized	K1

	particles.	
CO -2	understand the theories of metal bonding in metals, synthesis and properties of nanomaterials.	K2
CO -3	apply the concept of cubic close packing in the structure of ionic crystals and concept of nanotechnology in various fields	K3
CO -4	analyze the Super conductivity of alloys and in carbon nanotubes	K4
CO -5	summarize the applications of carbon nanotubes and colloidal gold.	K5

TEXTBOOKS

1. Lesley Smart, Elaine Moore, *Solid state chemistry- An Introduction,* 2nd edition, Replika press.Pvt.Ltd.,1995
2. Puri B.R., Sharma L.R. and Kalia, *Principles of Inorganic Chemistry*, Vishal Publishing Co., 2021.
3. Pradeep.T, *Nano: The Essentials, Understanding Nanoscience and Nanotechnology*; Narosa publishing House, New Delhi;2007.
4. Murthy, B.S, Shankar. P, Baldev Raj Rath. B.B. JamesMurday, *Textbook of nanoscience and nanotechnology,* Universities press, India Ltd, Hyderabad 2012

SUGGESTED READINGS

1. M.S. Ramachandra Rao and Shubra Singh *Nanoscience and Nanotechnology*: Fundamentals to Frontiers, Wiley India Pvt.Ltd 2013.
2. Rao C.N.R., Muller A and CheetamA.K. (2004). *TheChemistryofNanomaterials*, Vol.1, 2. Wiley–VCH, Weinheim.
3. Lakshman Desai,(2007). *Nanotechnology*. Paragon International Publishers.
4. Charles Jr. and Frank J.Owen,(2008). *Introduction to nanotechnology*. London: John Wiley & Sons.
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.

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2. https://nios.ac.in/media/documents/313coursee/l8.pdf
3. https://cds.cern.ch/record/1339313/files/9783540729921_TOC.pdf
4. http://dl.iranchembook.ir/ebook/Nano-Chemistry-1887.pdf
5. https://ggu.ac.in/gguold/download/ClassNote13/Intriduction%20to%20Nanosc.24.10.13.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**	**H**	**M**	**M**	**M**	**M**	**H**	**L**	**L**
CO-2	**H**	**M**	**M**	**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**
CO-5	**H**	**M**	**H**	**M**	**M**	**M**	**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	M	H	H

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

(For Candidates admitted in the academic year 2021-22)

Course Title	Major Core 19 –ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS
Code	U21CH5MCT19
Semester	VI
Course Type	PRACTICAL
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS:

This course will enable the students to gain practical skills in analyzing the various organic compounds and the preparation of organic compounds.

COURSE OBJECTIVES (CO):

1. To analyze the aliphatic and aromatic nature of various organic compounds.
2. To identify the elements and functional group present in the compounds
3. To prepare the derivative of various organic compounds
4. To develop the skill to synthesize various organic compounds using single stage method
5. To 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

1. Preparation of Para bromoacetanilide from acetanilide.
2. Preparation of Benzoic Acid from Benzamide.
3. Preparation of Benzoic acid from Benzaldehyde.

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):

CO No.	Course Outcomes	Cognitive Level
CO1	Recall the basic concepts of qualitative analysis of organic compounds	**K1**
CO2	The students will understand the concept of green chemistry, its importance and some synthesis using green chemistry technique.	**K2**
CO3	apply the basic organic theoretical concepts for analyzing the unknown compounds	K3
CO4	identify the elements and functional group present in the unknown organic compounds, prepare the derivative for different functional groups	**K4**
CO5	Assess the presence of functional group of unknown organic compounds by selecting an appropriate method	**K5**

TEXT BOOKS

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. '*Basic Principles of Practical Chemistry*' New Delhi:2nd Edition, Sultan Chand & Sons, 1997.
2. Vogel's Textbook of Practical Organic Chemistry Pearson 5th Edition 2011.

SUGGESTED READINGS

1. 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.
2. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.

WEB REFERENCES

1.https://www.brainkart.com/article/Organic-Qualitative-Analysis_38680/
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3.https://youtu.be/mQ035ZrdD4Y
4.https://youtu.be/nAlqxor6ZY8
5.https://youtu.be/Y4NMpO1xI8U

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**	**M**	**M**	**M**	**H**	**L**	**L**
CO-2	**H**	**M**	**M**	**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**
CO-5	**H**	**M**	**H**	**M**	**M**	**M**	**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	**M**	**H**	**H**

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

(For Candidates admitted in the academic year 2021-22)

Course Title	MAJOR CORE 20: - PHYSICAL CHEMISTRY PRACTICAL - II
Code	U21CH6MCP20
Semester	VI
Course Type	PRACTICAL
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS:

This course will enable the students to gain practical skills in Physical Chemistry experiments of Conductometry, Colorimetry, pH metry and Potentiometry.

Course Objectives (CO):

1. To determine the strength of acids by conductometry and potentiometry
2. To estimate the dissociation constant of weak electrolyte.
3. To determine the concentration of ferric ion by photoelectric colorimeter.
4. To verify Freundlich adsorption isotherm
5. To evaluate the rate constant of Second order reactions.

Conductometric titrations:

1. To find the strength of CH_3COOH conductometrically using a strong base NaOH
2. To determine the cell constant and dissociation constant of a weak electrolyte.

Potentiometric Titrations:

3.To find the strength of FAS potentiometrically using redox titrations.

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Colorimetry:

4.To determine the concentration of ferric ion solution using photoelectric colorimeter

pH Meter:

5.To determine the strength of the given CH_3COOH and its dissociation constant using pH meter.

Chemical Kinetics:

6.To study the second order kinetics- Saponification of ester.

Adsorption:

7.To Verify the Freundlich adsorption isotherm

Course Outcomes (CO):

CO No.	Course Outcomes	Cognitive Level
CO -1	recall the principles of conductometry and potentiometry	K1
CO -2	understand the Beer's law using photoelectric colorimeter	K2
CO -3	determine the strength of the given CH_3COOH and its dissociation constant using pH meter.	K3
CO -4	analyze Freundlich adsorption isotherm and verify it.	K4
CO -5	Assess the kinetics of reactions.	K5

TEXT BOOKS

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of PracticalChemistry*.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.
3. Vogel's Textbook of Practical Organic Chemistry Pearson 5th Edition 2011.

SUGGESTED READINGS

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.

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3.https://youtu.be/x3CbfUr449Y?si=ZgcL2PqUiqTARtN5
4. https://youtu.be/8JuX8lJrcr8?si=oHtqoekAknrNZwAu
5. https://youtu.be/hLu9VmcAtU0?si=32xWabHrUOD1viJk

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	M	M	M	H	L	L
CO-2	H	M	M	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
CO-5	H	M	H	M	M	M	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	M	H	H

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

(For Candidates admitted in the academic year 2021-22)

Course Title	Non-Major Elective –4: COSMETOLOGY
Code	U21CH6NMT04
Semester	VI
Total Hours	45
Hours/Week	3
Course Type	Theory
Credits	3
Marks	100

CONSPECTUS

To expose the students to gain knowledge in different cosmetics, flower arrangement, jewel making, mehandi designs and self-grooming.

Course objectives (CO)

1. Toexplain the different types of cosmetics, tools used in make-up and eye lashes
2. To study about the mehandi designs and cone preparations
3. To understand the artificial and fresh flower arrangements and bouquet making
4. To illustrate the skills in jewel making
5. To outline the ethics of self-grooming, yoga and exercise

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

1.1 Introduction - What is make up - History of makeup - Cosmetics used in makeup - makeup techniques.

1.2 Implements and tools for makeup - Facial Anatomy-Basic facial shapes - Corrective makeup - Professional makeup.

1.3 Qualities of a makeup artist - Make up and age tips.

UNIT-II MEHANDI **9 Hrs.**

2.1 Introduction - History of Mehandi.

2.2 Types of mehandi designs

2.3 Mehandi cone preparation.

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

3.1 Introduction - Cutting flowers and foliage - Conditioning plant materials - principles of flower arrangement.

3.2 Elements of design - principles of design - styles of flower arrangement - Types of flower arrangement.

3.3 Flower making-Bouquet setting.

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

4.1 Introduction to jewel making.

4.2 Tools for jewellery making.

4.3 Types of Jewellery- Thread Bangles.

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

5.1 Introduction - Definition and meaning - Dimensions of health and wellness.

5.2 Ten recognised general physical skills - Five components of physical fitness -

Nutrition and diet - Body composition assessment.

5.3 Exercise - Yoga - History of Yoga – Asanas, Importance of breathing exercise.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Remember the history of cosmetics, mehandi, yoga, tools used in make-up and principle of flower arrangement	K1	CO1
CO-2	understand the different types of cosmetics, mehandi designs and cone preparations	K2	CO2
CO-3	apply the principle to prepare cosmetics, mehandi designs, artificial and fresh flower arrangements and bouquet making methods jewel making and diets	K3	CO3
CO-4	compare the cosmetic types, types of mehandi designs, flower making and arrangement.	K4	CO4
CO-5	justify the rules to be followed for self-grooming, makeup preparations and flower arrangements	K5	CO5

RBT Levels

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

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.

WEB REFERENCES

1. https://www.lorealparisusa.com/beauty-magazine/makeup/face-makeup/how-to-prep-skin-for-makeup

2. https://play.google.com/store/apps/details?id=com.studio.junkylogic.mehndidesigns&hl=en
3. https://www.etsy.com/in-en/market/artificial__flowers
4. https://www.kernowcraft.com/jewellery-making-tips/jewellery-making-basics
5. https://www.everydayhealth.com/yoga/

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**	**H**	**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	H	H

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

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	exhibit a profound mastery of fundamental concepts, theories, methodologies, and tools in their field, equipping them to skillfully analyze and evaluate issues that pertain to their area of expertise.
PO-2	conduct original and independent research to create findings and solutions to address the societal problems
PO-3	apply employability skills to confidently navigate in the job market and excel in competitive examinations in diverse professional settings.
PO-4	demonstrate a strong commitment to ethical and moral values, actively engage in activities that promote social responsibility, decision making as inspired leaders to contribute positively for the betterment of society both locally and globally.
PO-5	embrace a commitment to lifelong learning and professional development, possessing the skills to adapt to the evolving trends, engage in self-directed learning and continuously enhance their expertise.
PO-6	demonstrate the ability to design and conduct experiments, demonstrations, create models to analyze and interpret data in the field of physical sciences.
PO-7	Exhibit competence in educational, industrial and research pursuits that contributes towards the holistic development of self and society.

PSO No.	*Upon completion of these courses the student would*
PSO-1	develop the knowledge of chemistry to appreciate and recognize the fundamental and experimental applications in the field of research, industry and academics
PSO-2	apply the skills of critical thinking, problem solving, procedural skills and technical skills developed in chemistry to emerge as entrepreneurs
PSO-3	apply different green chemistry techniques to conduct chemical synthesis, analysis and other chemical investigation towards environmental sustainability

(For Students admitted in the year 2023-2024)

PG & RESEARCH DEPART MENT OF CHEMISTRY

CHOICEBASED CREDIT SYSTEM

M.SC. CHEMISTRY COURSE PATTERN-TANSCHE

Semester	Subject	Code	Hours	Credits	Marks
I	Core Course I-Organic Reaction Mechanism -I	**P23CH1CCT01**	6	5	100
	Core Course II- Structure and Bonding in Inorganic Compounds	**P23CH1CCT02**	6	5	100
	Core Course III-Organic Chemistry Practical-I	**P23CH1CCP03**	4	2	100
	Core Course IV-Organic Chemistry Practical -II	**P23CH1CCP04**	4	2	100
	Elective I – Molecular Spectroscopy/ Pharmaceutical Chemistry	**P23CH1ECT01/ P23CH1ECT02**	5	3	100
	Elective II- Green & Nano chemistry/ Medicinal Chemistry	**P23CH1ECT03/ P23CH1ECT04**	5	3	100
	Value Education		-	-	
	Total		**30**	**20**	**600**
II	Core Course V-Organic reaction mechanism-II	**P23CH2CCT05**	5	5	100
	Core Course VI- Physical Chemistry-I	**P23CH2CCT06**	4	5	100
	Core Course VII- Inorganic Chemistry Practical-I	**P23CH2CCP07**	4	2	100
	Core Course VIII-Inorganic Chemistry Practical- II	**P23CH2CCP08**	4	2	100
	Elective III – Bio Inorganic Chemistry/Material Science	**P23CH2ECT05/ P23CH2ECT06**	4	3	100
	Elective IV(Generic)- Food Science	**P23CH2ECT07**	4	3	100
	Skill Enhancement Course– I(Generic)- NME1 Preparation of Consumer Products	**P23CH2SEP01**	4	2	100
	Value Education		1	-	
	MOOC Online Course	**P23EX2ONC01**	-	2(Extra)	
	Internships(30hrs)	**P23EX2INT01**		2(Extra)	
	Total		**30**	**22+4**	**700**

III	Core Course IX- Organic Synthesis and Photochemistry	**P23CH3CCT09**	5	5	100
	Core Course X-Coordination Chemistry-I	**P23CH3CCT10**	5	5	100
	Core Course XI- Physical Chemistry Practical-I	**P23CH3CCP11**	4	3	100
	Core Course XII- Physical Chemistry Practical-II	**P23CH3CCP12**	4	2	100
	Core Course XIII(Industry Module)-Analytical Instrumentation Techniques	**P23CH3CCP13**	5	4	100
	Elective-V(Generic)-Solid Waste Management	**P23CH3ECT08**	4	3	100
	Skill Enhancement Course – II(Generic)-NME2- Chemistry for Life Sciences	**P23CH3SET02**	3	2	100
	Internship - 30 Hrs(in the I Year Summer Vacation)	**P23CH3INT02**	-	2	
	Total		**30**	**26**	**700**
IV	Core Course XIV-Coordination Chemistry II	**P23CH4CCT14**	6	5	100
	Core Course XV-Electrochemistry	**P23CH4CCT15**	6	5	100
	Elective VI-Chemistry of Natural Products/Polymer Chemistry	**P23CH4ECT09/ P23CH4ECT10**	4	3	100
	Project		10	7	100
	SEC III – Professional Competency Skill Enhancement Course	**P23CH4SET03**	4	2	100
	Extension Activity	**P23EA4SOC01**	-	1	100
	Self-Study Paper	**P23CH4SSC01**		2(Extra)	100
	Total		**30**	**23+2**	**700**
	Grand Total		**180**	**91+6**	**2700**

(For Candidates admitted in the academic year 2023-24)

First Year - Semester – I

Course Title	Core Course 1 – Organic Reaction Mechanism - I
Code	P23CH1CCT01
Hours/Week	6
Course Type	Theory
Credits	5
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 methodsinvolved in the determination of reaction mechanism.
CO-2	understand the free radical substitution reactions and apply the mechanism for various namingreactions
CO-3	correlate and appreciate the differences involved in the various types of organic reactionmechanisms.
CO-4	understand and apply the concepts of stereochemistry in stereo selective and stereospecificreactions and analyse the asymmetric synthesis using chiral catalyst and reagent
CO-5	describe the stability and reactivity of acyclic and cyclic compounds.

UNIT-I: METHODS OF DETERMINATION OF REACTION MECHANISM 18Hrs.

1.1 Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate.

1.2 Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping.

1.3 Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism.

1.4 Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.

Extra Reading/ Keywords: *Mechanism of Enzyme Catalysed Reactions*

UNIT: II FREE RADICAL REACTIONS 18Hrs.

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.

2.4 Name reactions - Sandmeyer, Gomberg – Beckman, Ullmann, Pschorr and Hunsdiecker reactions, Kolbe, Meerwein arylation and Hofmann- Loffier-Fetag.

Extra Reading/ Keywords: *Norrish Reaction*

UNIT-III: ALIPHATIC SUBSTITUTION AND ELIMINATION REACTIONS 18Hrs.

3.1 Aliphatic Nucleophilic Substitution: S_N1, S_N2 and S_Ni mechanism, reactivity of the substrate, attacking nucleophile, leaving group, reaction medium and stereo chemistry, Aliphatic nucleophilic substitutions at allylic and vinylic carbons.

3.2 Substitution reactions of ambident nucleophiles- Swain- Scott, Grunwald -Winstein relationship. Neighbouring group participation of O, S, N, halogens, aryl groups, alkyl and cycloalkyl groups in nucleophilic substitution reactions.

3.3 Aliphatic Electrophilic Substitution: S_E2, S_E1 and S_Ei mechanisms - Alkyl exchange, Halo-demercuration, Proto-demercuration, Decarboxylation of aliphatic acids, Hell- Vohlard-Zelinsky (HVZ) reaction, Stork Enamine reaction, Diazonium coupling reactions.

3.4 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. Mechanism of pyrolytic elimination reactions- Chagaev reaction, Hofmann degradation and Cope Elimination reactions.

Extra Reading/ Keywords: *Aromatic Nucleophilic and Electrophilic Substitution Reactions*

UNIT-IV: STEREOCHEMISTRY-I 18Hrs.

4.1 Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers.

4.2 Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining the configuration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation.

4.3 Nomenclature - D, L system, Cram‟s and Prelog‟s rules: R, Snotations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes.

4.4 Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.

Extra Reading/ Keywords: *New Synthetic Chiral reagents and Chiral Catalysts*

UNIT-V: STEREOCHEMISTRY-II 18Hrs.

5.1 Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle.

5.2 Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems.

5.3 Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett‟s rule.

5.4 Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.

Extra Reading/ Keywords: *Stereochemistry of Drugs*

COURSE OUTCOMES (CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	explain the stability of reactive intermediates	PSO 1	U
CO-2	predict the mechanism for free radical substitution and elimination reaction	PSO 2	An
CO-3	differentiate the aliphatic nucleophilic and electrophilic substitution reactions	PSO 3	Ap
CO-4	identify the optical activity of organic molecules	PSO 3	Ap
CO-5	summarize the asymmetric synthesis using chiral catalysts and chiral reagents	PSO 3	Ap
CO-6	obtain knowledge about various chemical reactions and stereochemistry	PSO 2	Ap

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

PRESCRIBED TEXT BOOKS

1. March, J. (1999). *Advanced Organic Chemistry.*(4th Ed.). New York:WileyEastern 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.

BOOKS FOR REFERENCE

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 Candidates admitted in the academic year 2023-24)

Course Title	**Core Course 2 – Structure and Bonding in Inorganic Compounds**
Code	**P23CH1CCT02**
Semester	**1**
Hours/Week	**6**
Course Type	**Theory**
Credits	**5**
Marks	**100**

General Objectives:

To learn about structure of cages, clusters, significance of back bonding, structural features of crystal systems, techniques in solid state chemistry and various concepts behind magnetic properties of lanthanides and actinides.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	determine the structural properties of main group compounds and clusters.
CO-2	understand the periodicity, halogen and behaviour of noble gases and its bonding.
CO-3	evaluate the structural aspects of solids.
CO-4	explain the applications of diffraction techniques.
CO-5	analyse the magnetic properties of lanthanides and actinides.

UNIT-I: STRUCTURE OF MAIN GROUP COMPOUNDS AND CLUSTERS 18 Hrs

1.1 VB theory – Effect of lone pair and electronegativity of atoms (Bent‟s rule) on the geometry of themolecules.

1.2 Structure of silicates - applications of Pauling‟s rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three- dimensional silicates.

1.3 Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids– types, examples and structures.

1.4 Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade‟s rule to predict the structure of borane cluster; main group clusters –zintl ions and mno rule.

Extra reading/keywords*: Binuclear clusters*

UNIT- II: PERIODICITY, HALOGENS AND NOBLE GASES 18 Hrs

2.1 Periodicity – The use of p-orbitals in π-bonding – pπ – pπ bonding in heavier non-metals – the use of d-orbitals by non-metals – experimental evidence for pπ – dπ bonding.

2.2 Comparison of pπ bonding in phosphine complexes and oxides – experimental evidences for d - orbital contraction and participation.

2.3. Chemistry of halogens and noble gases - polyhalide ions – oxyacids of heavier halogens –anomalous behavior of fluorine.

2.4 Bonding in noble gas fluorides and their reactivity

Extra reading/keywords: *Applications of back bonding*

UNIT- III: SOLID STATE CHEMISTRY **18 Hrs**

3.1 Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice,Radius ratio, Crystal systems and Bravais lattices.

3.2 Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.

3.3 Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti- fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse typesand perovskite structures.

3.4 Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles andexamples.

Extra reading/keywords: *Advanced Crystal growth techniques*

UNIT-IV: TECHNIQUES IN SOLID STATE CHEMISTRY **18 Hrs**

4.1 X-ray diffraction technique: Bragg‟s law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, latticeconstants calculation; Systematic absence of reflections.

4.2 Electron diffraction technique – principle, instrumentation and application.

4.3 Neutron diffraction technique – principle, instrumentation and application.

4.4 Comparison of X-ray diffraction with neutron diffraction.

Extra reading/keywords: *Standard JCPDS files*

UNIT-V MAGNETIC PROPERTIES, LANTHANIDES AND ACTINIDES **18 Hrs**

5.1 Magnetic properties: Paramagnetism – calculation of magnetic moments – spin only value –magnetic susceptibility – spin orbit coupling.

5.2 Variation of magnetic moments with temperature – Curie-Weiss Law – ferromagnetism and anti-ferromagnetism.

5.3 Lanthanides: Position in the periodic table - electronic configuration – oxidation states – sizerelationships – lanthanide contraction, gadolinium break – spectral and magnetic properties –coordination compounds - lanthanide shift reagents in NMR – MRI contrasting agents.

5.4 Actinides: Electronic configuration - oxidation states of actinides – spectral and magnetic properties – comparative account of lanthanides and actinides.

Extra reading/keywords: Newest elements in the periodic table

Course Outcomes (CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	predict the geometry of main group compounds and clusters.	PSO 1	An
CO-2	examine the different types of π bonding and its uses in p and d -block elements.	PSO 2	Ap

CO-3	explain the various types of crystal systems and analyse their structural features.	PSO 2	U
CO-4	describe the principle and instrumentation of diffraction techniques	PSO 3	R
CO-5	compare the properties of Lanthanides and Actinides.	PSO 3	An

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

Ap –Apply; An – Analyse

TEXTBOOKS

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 Weststudent.
5. Day, M.C. & Selbin. (1972). *Theoretical Inorganic Chemistry* (3rd Ed.). London: Butterworth.
6. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley &Sons Ltd., 2014.
7. K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
8. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012

BOOKS FOR REFERENCE

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry,3rd Ed, 1994.
2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication,2013.
3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, CambridgeUniversity Press, 199.
4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford UniversityPress: London, 2001

(For Candidates admitted in the academic year 2023-24)

Course Title	Elective 1 : Molecular Spectroscopy
Code	P23CH1ECT01
Hours/Week	5
Course Type	Theory
Credits	3
Marks	100

General Objectives

To make the students to learn the theory of Rotational, IR, Raman, Electronic, Photoelectron, NMR, ESR, EPR and Mossbauer spectroscopies

Course Objectives (CO)

The learner will be able to

CO No.	Course Objectives
CO-1	To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
CO-2	To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy and fragmentation patterns in Mass spectroscopy.
CO-3	To highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions.
CO-4	To interpret the first and second order NMR spectra in terms of splitting and coupling patterns.
CO-5	To carry out the structural elucidation of molecules using different spectral techniques.

UNIT-I ROTATIONAL AND RAMAN SPECTROSCOPY 15 Hrs

1.1 Rotational Spectroscopy: Basic principles - Classification of Molecules – Rigid rotator.

1.2 Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators.

1.3 Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules.

1.4 Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons, Structure determination from Raman and IR spectroscopy.

Extra reading/keywords: *Resonance Raman spectroscopy*

UNIT-II VIBRATIONAL SPECTROSCOPY 15 Hrs

2.1 Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression.

2.2 Vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution.

2.3 Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies.

2.4 Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.

Extra reading/keywords: *Vibrational spectra of metal carbonyls*

UNIT-III ELECTRONIC SPECTROSCOPY 15 Hrs

3.1 Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation, The Fortrat diagram and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules.

3.2 UV spectroscopy- Factors affecting the position of UV bands. Woodward-Fieser rules- Alkenes, conjugated ketones, Esters, Carboxylic acids, Mono and Di substituted benzene derivatives.

3.3 Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (XPS).

3.4 Lasers: Laser action, population inversion, properties of laser radiation, examples of laser systems.

Extra reading/keywords: *Electronic spectra of different spin states*

UNIT-IV NMR AND ESR SPECTROSCOPY 15 Hrs

4.1 Theory of NMR - Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX_2, AB types. Vicinal, germinal and long-range coupling-spin decoupling.

4.2 Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. ^{13}CNMR and structural correlations, Satellites.

4.3 Theory of ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy.

4.4 Spin orbit coupling and significance of g tensors, zero/non-zero field splitting, Kramer‟s degeneracy, application to transition metal complexes (having one to five unpaired electrons) ESR spectra of magnetically dilutesamples.

Extra reading/keywords: Brief introduction to 2D NMR –COSY, NOESY. Introduction to ^{31}P, ^{19}F NMR.

UNIT-V MASS SPECTROMETRY, EPR AND MOSSBAUER SPECTROSCOPY 15 Hrs

5.1 Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI).

5.2 Isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum.

5.3 EPR spectra of anisotropic systems - anisotropy in gvalue, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Structural elucidation of organic compounds by combined spectral techniques.

5.4 Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.

Extra reading/keywords: *Mass spectrometry Instrumentation.*

COURSE OUTCOMES(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	understand the importance of rotational and Raman spectroscopy	PSO1	U
CO-2	apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.	PSO2	Ap
CO-3	evaluate different electronic spectra of simple molecules using electronic spectroscopy.	PSO3	Ap
CO-4	outline the NMR, 13C NMR and ESR spectroscopic techniques.	PSO3	Ap
CO-5	develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy techniques.	PSO3	An

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

TEXTBOOKS

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular spectroscopy, 4th Ed., Tata McGraw Hill, New Delhi, 2000.
2. R. M. Silverstein and F. X. Webster, Spectroscopic Identification of Organic Compounds, 6th Ed., John Wiley & Sons, New York, 2003.
3. W. Kemp, Applications of Spectroscopy, English Language Book Society, 1987.
4. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. R. S. Drago, Physical Methods in Chemistry; Saunders: Philadelphia, 1992.

BOOKS FOR REFERENCES

1. P.W. Atkins and J. de Paula, Physical Chemistry, 7th Ed., Oxford University Press, Oxford, 2002.
2. I. N. Levine, Molecular Spectroscopy, John Wiley & Sons, New York, 1974.
3. A. Rahman, Nuclear Magnetic Resonance-Basic Principles, Springer-Verlag, New York,1986.
4. K. Nakamoto, Infrared and Raman Spectra of Inorganic and coordination Compounds, Part B: 5th ed., John Wiley& Sons Inc., New York, 1997.
5. J. A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance; Wiley Interscience, 1994.
6. A.B.P. Lever, Inorganic and Electronic Spectroscopy, Elsevier 1986.

(For Candidates admitted in the academic year 2023-24)

Course Title	Elective-2- Green and Nano Chemistry
Hours/Week	5
Code	P23CH1ECT03
Course Type	Theory
Credits	3
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- GREEN CHEMISTRY **15 Hrs**

1.1 Introduction to green chemistry, Green chemistry - relevance and goals, Anasta's twelve principles of green chemistry, tools of green chemistry, alternative starting materials.

1.2 Reagents - dimethyl carbonate, polymer supported reagents, polymer supported peracids, PNBS.

1.3 Catalysts-acid, oxidation, basic, polymer supported phase transfer catalyst. Solvents and processes with suitable examples - aqueous phase reactions, reactions in ionic liquid

1.4 Organic synthesis in solid state, solid supported organic synthesis.

Extra Reading/ Keywords: *Applications of green chemistry principles*

UNIT: II- MICROWAVE MEDIATED AND ULTRASOUND ASSISTED ORGANIC SYNTHESES

15 Hrs

2.1 Microwave activation – advantage of microwave exposure, specific effects of microwave.

2.2 Neat reactions – Solid supports reactions - deacetylation, deprotection, saponification of ester, reduction, functional group transformations, condensations reactions, oxidations-reduction reactions, Multi-component reactions.

2.3 Ultrasound Assisted Green Synthesis– Introduction, Applications of Ultra Sound-Esterification, Saponification.

2.4 Substitution and Addition reactions.

Extra Reading/ Keywords: *Comparison of Microwave synthesis Vssonochemical synthesis*

UNIT: III - IONIC LIQUIDS AND PTC **15 Hrs**

3.1 Synthesis of ionic liquids, physical properties, applications in alkylation.

3.2 Hydroformylations, epoxidations, synthesis of ethers, Friedel-crafts reactions,

3.3 Diels-Alder reactions, Knoevengal condensations, Wittig reactions.

3.4 Phase transfer catalyst - Synthesis and applications.

Extra Reading/ Keywords*: Alternative green methods*

UNIT: IV- NANO CHEMISTRY **15 Hrs**

4.1 Introduction, Nano particles – Classification of nano particles, Properties- Melting point, electrical,mechanical and optical properties.

4.2 Production - Inert Gas Condensation (IGC), Physical Vapour Deposition (PVD), Chemical VapourDeposition (CVD), Sol-Gel Process, Ball-milling.

4.3 Characterization - XRD, SEM, TEM and AFM. Safety issues.

4.4 Fullerenes – variations, properties of fullerenes.

Extra Reading/ Keywords: *Characterization techniques of nanoparticles using STM, FE-SEM, AAS andXPS*

UNIT: V- CARBON NANOTUBES AND COLLOIDAL GOLD **15 Hrs**

5.1 Carbon nanotube – Types and related structures, Properties,

5.2 Synthesis of nanotubes - Arc discharge method, Laser ablation and CVD method. Defects ofnanotubes.

5.3 Applications of carbon nanotubes - Structural, Electromagnetic, Chemical and Mechanical applications.

5.4 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 2	U
CO-5	Summarizes the applications of carbon nanotubes and colloidal gold.	PSO 3	App
CO-6	Gain knowledge about Green chemistry and Nano technology	PSO 3	App

TEXT BOOKS

1. Ahluwalia V. K. (2006) Green Chemistry - Environmentally benign reactions, Ane Books India.
2. T. Pradeep, (2007) Nano: The Essentials-Understanding Nanoscience and Nanotechnology- TataMcGraw Hill Education Pvt. Ltd.
3. M. S. Ramachandra Rao and Shubra Singh (2013) Nanoscience and Nanotechnology: Fundamentalsto Frontiers, Wiley India Pvt. Ltd.

BOOKS FOR REFERENCE

1. Paul T. Anastas& Tracy C. Williamson (1998). Green Chemistry – Designing Chemistry for theEnvironment (2^{nd} ed.).
2. Rashmi Sanghi and Srivastava M.M. (2003). Green chemistry – EnvironmentFriendly Alternatives. Narora Publishing House.
3. Rao C.N.R., Muller A and Cheetam A.K. (2004). The Chemistry of Nanomaterials,Vol.1, Wiley– VCH, Weinheim.
4. Lakshman Desai, (2007). Nanotechnology. Paragon International Publishers.
5. Charles Jr. and Frank J. Owen, (2008). Introduction to nanotechnology. London: John Wiley& Sons.

(For Candidates admitted in the academic year 2023-24)

Course Title	Core Course –V: ORGANIC REACTION MECHANISM - II
Code	P23CH2CCT05
Semester	II
Hours/Week	5
Course Type	Theory
Credits	5
Marks	100

General Objectives:

To enable the students to understand the concepts of aromaticity, mechanisms of rearrangement reactions and applications of oxidizing and reducing reagents in organic synthesis.

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 radicals additions to carbon- carbon multiple bonds.
CO-3	design a detailed mechanism for various rearrangement reactions.
CO-4	identify the oxidation and reduction reactions in the organic compounds.
CO-5	List the applications of synthetically important reagents

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 Electrophilic Substitution - The Arenium ion mechanism, orientation and reactivity in monosubstituted benzene rings, the effect of the leaving group, Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene.

1.3 Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Ipso substitution.

1.4 Aromatic Nucleophilic substitution - SNAr, and Benzyne mechanisms – Evidences - Reactivity, effect of structure, leaving group and attacking nucleophile. Reactions- Oxygen and Sulphur-nucleophiles.

Extra reading/ Key words: Problems related to aromaticity and reaction mechanisms.

UNIT II -ADDITIONS TO CARBON-CARBON MULTIPLE BONDS 15 Hrs

2.1 Additions to carbon-carbon multiple bonds- addition reactions involving electrophiles-(Addition of H_2, X_2, HX, H_2O, oxymercuration, epoxidation, ozonolysis), nucleophiles and free radicals, cyclic mechanism .orientation and stereochemistry.

2.2 Hydrogenation of double and triple bonds Addition to conjugated Nucleophilic addition-Michael addition. Addition to cyclopropane ring.

2.3 Addition to Carbon-Hetero atom Multiplebonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl compounds.

2.4 Mannich, Prins, Stobbe, Darzen, Thrope, Tollen's reactions and Benzoin condensation

Extra reading/ Key words: Nucleophilic additions to chiral carbonyl compounds.

UNIT III – REARRANGEMENT REACTIONS 15 Hrs

3.1 Rearrangements: Rearrangements to electron deficient carbon: Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Dienone-phenol and Wolff rearrangements.

3.2 Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, and Beckmann.

3.3 Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Stevens.

3.4 Aromatic rearrangement -Fries, Sommelet-Hauser. Intramolecular rearrangements – Claisen, Cope, oxy-Cope.

Extra reading/ Key words: Di- π- methane rearrangement including aza-di- π -methane.

UNIT IV -OXIDATION REACTIONS 15 Hrs

4.1 Oxidations of alcohols to carbonyls: Chromium based reagents ($K_2Cr_2O_7$, Jones reagent, PCC) and TEMPO based reagents. oxidation of phenols -Fremy's salt.

4.2 alkenes to epoxides (peroxides/per acids based), Sharpless asymmetric epoxidation, alkenes to diols (Mn, Os based), Sharpless asymmetric dihydroxylation, Prevost reaction.

4.3 alkenes to carbonyls with bond cleavage -ozonolysis, alkenes to alcohols/carbonyls without bond cleavage -hydroboration-oxidation, Wacker oxidation.

4.4 DMSO-Oxalyl chloride (Swern oxidation), Corey-Kim oxidation, selenium dioxide, lead tetra acetate, Aluminium tri-isopropoxide.

Extra reading/ Key words: Electro Anodic oxidation

UNIT V -REDUCTION REACTIONS **15 Hrs**

5.1 Mechanism of reduction reactions- Clemmenson, WolffKishner, Rosenmund, reduction with Trialkyltin hydrides, McFadyen-Steven's reduction.

5.2 Catalytic hydrogenation- Heterogeneous: Pd/Pt/Rh/Ni, Homogeneous: Wilkinson, Reduction by dissolving metals- Na- alcohol, sodium-liquid ammonia (Birch reduction)

5.3 Reduction with metal hydrides- $LiAlH_4$, $NaBH_4$, $NaBH_3CN$, triacetoxyborohydride, Diisobutylaluminium Hydride (DIBAL-H)

5.4 Meerwein-Ponndorf-Verley Reduction, McMurry reduction, Bouveault-Blanc reduction and L and K – Selectrides,

Extra reading/ Key words: *Photoreduction*

COURSE OUTCOMES (CO):

The learners will be able to

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Understand the basic principles of aromaticity of organic compounds	PSO 1	U
CO-2	Identify mechanism of substitution reactions in aromatic compounds.	PSO 2	An
CO-3	Explain the addition mechanism of reagents across carbon-carbon multiple bonds.	PSO 3	Ap
CO-4	Illustrate the mechanism of the various rearrangement reactions	PSO 4	Ap
CO-5	Outline the applications of reducing and oxidizing reagents	PSO 5	Ap
CO-6	Predict the suitable reagents for the conversion of selective organic compounds	PSO 5	Ap

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

TEXTBOOKS

1. March, J. (1999). *Advanced Organic Chemistry.* (4th Ed.). New York: Wiley Eastern Ltd.
2. Sykes, P. (1997). *Guide Book to Mechanism in Organic Chemistry.* (6th Ed.). New Delhi: ELBS and Longmann Ltd.

3. V. K. Ahluwalia and Rakesh Kumar Parashar (2007) Organic Reaction Mechanisms, Third edition, Narosa Pub
4. Mukherji, S.M and Singh. S.P., (1978). *Reaction mechanism in Organic Chemistry.* (3rd Ed.). New Delhi: McMillan.
5. P. Y.Bruice, Organic Chemistry, 7thedn.,Prentice Hall, 2013. 5. R. T. Morrison, R. N. Boyd, S. K. BhattacharjeeOrganic Chemistry, 7 th edn., Pearson Education, 2010.

BOOKS FOR REFERENCES

1. Carey, F.A .and Sundberg R.J.(1990). *Advanced Organic Chemistry (Part A& B)*.New York: springer.
2. Jonathan Clayden, Nick Greeves, Stuart Warren (2012). Organic Chemistry, (2nd Ed.), Oxford University Press.
3. Badger, G. M. (1966). *Aromatic Character and Aromaticity*. London: Cambridge University Press.
4. Benjamin, W.A. (1972), *Modern Synthetic reactions in Organic Chemistry*. (2nd Ed.). New York:
H.O House.
5. De-Mayo, P. (1963). *Molecular Rearrangements*. New York: Inter science Publishers.
6. Finar, I.L. (1975).*Organic ChemistryVolume II*. New Delhi: ELBS.
7. Ingold, C.K. (1969). *Structure and Mechanism in Organic Chemistry*. (2nd Ed.) . New York: Cornell University Press.
8. Raj K. Bansal (2001). *Organic Reaction Mechanism*. (3rd Ed.). New Delhi: Tata McGraw Hill.

(For Candidates Admitted in the academic year 2023-24)

CourseTitle	**CoreCourse VI–PHYSICAL CHEMISTRY-I**
Code	**P23CH2CCT06**
Semester	**II**
Hours/Week	**4**
CourseType	**Theory**
Credits	**5**
Marks	**100**

General Objectives:

To understand quantum mechanics and its applications, chemical and solution kinetics.

Course Objectives (CO):

The learners 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 box
CO-2	think critically about, explain, integrate, and apply physical models to describe wave function and energy levels associated with atoms
CO-3	identify the applications of quantum chemistry in explaining MO, VB and HMO theories and construct hybridization schemes
CO-4	recalls the concepts of kinetics and explain the theories of unimolecular and bimolecular reactions
CO-5	appraise the effects of few variables of solution kinetics

UNIT: I- QUANTUM MECHANICS **12Hrs**

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.

1.4 Three dimensional box, cubical box , distortion of the cubical box and lifting of degeneracy.

Extra reading/keywords: ***Application to simple physical models***

UNIT:II - QUANTUM CHEMISTRY –*I* **12Hrs**

2.1 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.

2.2 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.

2.3 Perturbation method to non – degenerate systems – Application of perturbation method to helium atom. Hartree – Fock self consistent field methods.

2.4 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: III - QUANTUM CHEMISTRY-III **12Hrs**

3.1 The Born – Oppenheimer approximation. MO theory as applied to hydrogen molecular ion (H_2^+) and hydrogen molecule – coulomb integral and exchange integral and an overlap integral.

3.2 VB theory as applied to hydrogen molecular ion (H_2^+) and hydrogen molecule – coulomb integral and exchange integral and an overlap integral.

3.3 Construction of sp, sp^2 and sp^3 hybrid orbitals.

3.4 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: IV - CHEMICAL KINETICS **12Hrs**

4.1 Theories of reaction rates –Molecular activation, activated complex, theoretical calculation of activation energy-potential energy surface, Simple collision theory.

4.2 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.

4.3 Theory of Unimolecular reactions – Lindemann's theory, Hinshelwood theory, Treatment of RRK theory (Kassel, Rice and Ramsperger), the Slater's treatment.

4.4 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 - SOLUTION KINETICS **12Hrs**

5.1 Factors determining reaction rates in solution – collisions in solution, Transition state theory, influence of internal pressure and solvation.

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.

5.4 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	Solve the Schrödinger equation for one and three dimensional box	PSO 1	U
CO-2	Identify, describe and explain the quantum mechanical behaviour of simple systems, such as the harmonic oscillator and the rigid rotor	PSO 2	U
CO-3	Discuss LS and J.J coupling scheme and derive ground state term symbol for various atoms	PSO 3	App
CO-4	Explain HMO theory and apply it in the calculation of pi – electron energies for simple conjugated 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

TEXT BOOKS

1. Chandra. A.K., (2004). *Introductory Quantum Chemistry* (10th Ed.). Tata Mc Graw Hill.
2. Ira Levine. N., (2004).*Quantum Chemistry* (5th Ed.). Pearson education.
3. Barrow. G.M., (1992). *Introduction to Molecular Spectroscopy* (5th Ed.). New Delhi: McGraw Hill.
4. Moore. W.J., (1982). *Physical Chemistry* (5th Ed.). Orient Longman.

BOOKS FOR REFERENCE

1. Atkins, P., & Paula, J. (2002). *Physical Chemistry* (7th Ed.). Oxford University Press
2. Gurdeep Raj, (2014). *Chemical Kinetics*. Krishna Prakashan Media (P) Ltd
3. Keith J. Laidler (2014) Chemical Kinetics,(3rd Ed) Pearson Education India.
4. Bajpai.D.N. (2001), Advanced Physical Chemistry, S. Chand & Company. New Delhi

(For Candidates admitted from the academic year 2023-24onwards)

Course Title	Core Course VII- INORGANIC CHEMISTRY PRACTICAL – I
Code	P23CH2CCP07
Semester	II
Hours/Week	4
Course Type	Practical
Credits	2
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	enhance the visual observation as an analytical tool for the quantitative estimation of ions.
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 COLORIMETRICESTIMATION

1. Estimation ofChromium.
2. Estimation ofCopper.
3. Estimation ofNickel.
4. Estimation of Ferricion.
5. Estimation ofManganese.

II SEMI MICRO QUALITATIVE ANALYSIS

Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested.

Group-I : W and Pb.
Group-II : Mo, Cu, Bi and Cd.

Group-III : Ce, V, Cr and Fe.
Group-IV : Zn, Ni, Co and Mn.
Group-V : Ca, Ba and Sr.
Group-VI : Li and Mg.

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 calorimetrically	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. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry.* New Delhi: 2nd edn, Sultan Chand & Sons,1997.
2. A. Jeyarajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.
3. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rd., The National Publishing Company, Chennai, 1974.

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.
3. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965.

(For Candidates admitted in the academic year2023-24)

Course Title	Core Course VIII - INORGANIC CHEMISTRY PRACTICAL –II
Semester	II
Code	P23CH2CCP08
Course Type	Practical
Hours/Week	4
Credits	2
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 BY VOLUMETRY(V) AND GRAVIMETRY(G):

1. Estimation of Iron (V) and Copper (G)
2. Estimation of Copper(V) and Nickel(G)
3. Estimation of Zinc (V)and Copper(G)
4. Estimation of Magnesium(V) and Calcium(G)

PREPARATIONS:

1. Preparation of Prussian Blue
2. Preparation of TrisThioureaCopper(I) Chloride
3. Preparation of PotassiumTrisOxalatoChromate(III) trihydrate
4. Preparation of TrisThioureaCopper(II) Sulphate
5. Preparation of Reinecke's salt

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 Candidates Admitted in the academic year 2023-24)

CourseTitle	**Elective III–BIO-INORGANIC CHEMISTRY**
Code	**P23CH2ECT05**
Semester	**II**
Hours/Week	**4**
CourseType	**Theory**
Credits	**3**
Marks	**100**

GENERAL OBJECTIVES:
To understand essential trace elements, storage and transport of metal ions, nitrogen fixation, photosynthesis, therapeutic effects of metals, enzymes and metalloenzymes

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

CO No.	Course Objectives
CO-1	understand the role of trace elements.
CO-2	understand the biological significance of iron, sulphur.
CO-3	know about nitrogen fixation and photosynthesis
CO-4	study the toxicity of metals and acquire knowledge on diagnostic agents.
CO-5	discuss on various properties of metalloenzymes.

UNIT I - ESSENTIAL ELEMENTS **12Hrs**

1.1 Essential trace Elements-Criteria and working. Essential ultra-trace metals and non-metals, antagonism among the essential trace elements.
1.2 Role of metals in biological molecules, Bio mineralisation-functions of bio minerals, Role of non-metals in biological molecules.
1.3 Selective transport and storage of metal ions- The transport mechanism, transport and storage of alkali and alkaline earth metals- Sodium/Potassium pump, Calcium Pump.
1.4 Transport and storage of Iron- Ferritin, Transferrin and Siderophore. Transport and storage of Copper, Zinc and other metals.
Extra reading/keywords:*Biologically important ligands for metal ions*

UNIT:II- TRANSPORT PROTEINS **12Hrs**

2.1 Oxygen carriers -Hemoglobin and myoglobin – tertiary and quaternary Structure, oxygen affinity, cooperativity and Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin.
2.2 Biological redox system: Cytochromes – Classification, cytochrome a, b and c. Cytochrome P-450- structure and functions.
2.3 Non-heme oxygen carriers-structure and functions of Hemerythrin and hemocyanin.

2.4 Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.
Extra reading/keywords:*Blue copper proteins*

UNIT: III- NITROGEN FIXATION AND PHOTOSYNTHESIS 12Hrs

3.1 Nitrogen fixation-Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property
3.2 Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia- Biofertilizer.
3.3 Photosynthesis: photosystem-I and photosystem-II-chlorophylls structure and function, 3.4 Light reactions- excitation and electron transport, Dark reactions- Calvin cycle.
Extra reading/keywords:*Nitrogen fixation and Agricultural practice*

UNIT: IV - ENZYMES AND METALLOENZYMES 12Hrs

4.1 Enzymes -Introduction and properties -nomenclature and classification.
4.2 Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis – Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.
4.3 Zinc enzymes–carboxypeptidase and carbonic anhydrase. Iron enzymes–catalase, peroxidase.
4.4 Copper enzymes – superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosinase.
Extra reading/ keywords:*Coenzymes - Vitamin-B12*

UNIT: V - METALS IN MEDICINE 12Hrs

5.1 Toxic elements, Toxicity and deficiency, Enzyme inhibition, other toxic effects.
5.2 Toxic effects of Lead, Arsenic, Cadmium, Mercury, Copper Zinc and selenium.
5.3 Therapeutic Compounds: General remarks, Platinum-Containing Anticancer Agents. Chelation therapy; Cancer treatment.
5.4 Diagnostic Agents: Radiodiagnostic agents, Magnetic resonance imaging(MRI) Agents. temperature and critical magnetic Field.
Extra reading/ keywords*: Vanadium based Diabetes drugs*

COURSE OUTCOMES (CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level

CO-1	Analyse the role of trace and ultra-trace elements in biological systems.	PSO 2	Ana
CO-2	Explain the role of biological redox systems and transport proteins	PSO 3	U
CO-3	Analyze the toxic level and therapeutic effect of metals	PSO 2	Ana
CO-4	Outline the applications of metals as diagnostic agents.	PSO 5	App
CO-5	Learn about the nitrogen fixation and photosynthetic mechanism.	PSO 1	U
CO-6	Illustrate the mechanism of enzyme catalysis and the factors contributing to the efficiency of enzymes	PSO 4	App
CO-7	Describe the role and significance of metalloenzymes	PSO 3	U

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

Ap – Apply; An – Analyse

TEXT BOOKS

1. Ajay Kumar Bhagi and G. R. Chatwal- Bioinorganic and Supramolecular Chemistry, First Edition, 2003, Himalaya Publishing house, Mumbai.
2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry, Royol Society of Chemistry, Monograph for Teachers-31
3. K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co., USA.
4. G.N. Mugherjea and Arabinda Das, Elements of Bioinorganic Chemistry - 1993.
5. R. Gopalan, V. Ramalingam, Concise Coordination Chemistry, S.Chand, 2001.
6. Stephen J. Lippard, Principles of Bioinorganic Chemistry, Volume 38, Wiley Publications, 2009

BOOKS FOR REFERENCE

1. M.Satake and Y.Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996)
2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London.
3. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.
4. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002.
5. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.
6. James E. Huheey, Principles of Structure and reactivity, Pearson Education, 2006.
7. Shriver & Atkins, Inorganic Chemistry, Macmillan Publishing solutions, 2010.

(For Candidates admitted in the academic year2023-24)

Course Title	**ELECTIVE IV (GENERIC): FOOD SCIENCE**
Code	**P23CH2ECT07**
Semester	**II**
Hours/Week	**4**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective:

To learn about functions of food, therapeutic nutrition, food additives, various cooking methods, food preservation techniques, food adulterations and food sanitation.

Course Objectives (CO):

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 the nutritive value of food, meal planning and nutritive value.
CO-3	evaluate the effects of the natural and metallic food toxicants and food toxicants.
CO-4	explain the food preservation and adulteration techniques.
CO-5	analyze the poisoning of food by microbes, insects, rodents, various modern food technologies such as biofortification, nutraceuticals and food packaging.

UNIT: I- FOOD SCIENCE **12 Hrs**

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.

1.4 Retention of nutritive value during preparation.

Extra reading/Keywords: Harmful effects of junk foods

UNIT: II- NUTRITIVE VALUES OF FOOD GROUPS AND MEAL PLANNING 12 Hrs

2.1 Nutritive values of food: Cereals and cereal product, Millets, 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.

2.3 Meal planning for the expectant and nursing mothers, geriatric nutrition and obesity.

2.4 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- CHEMICAL POISONS IN FOOD 12 Hrs

3.1 Sources of Chemical poisons in food and Natural Toxicants in foods.

3.2 Toxic factors present in food stuffs – Kesari dhal, mushroom, drumsticks, soybeans, fish, Spices and condiments, cabbage, tea leaves.

3.3 Toxic minerals and metals —lead, mercury and cadmium.

3.4 Food additives – classification of food additives- functions and uses of food additives.

Extra reading/Keywords: Carcinogenic effects of food additives

UNIT: IV- FOOD PRESERVATION AND ADULTERATION 12 Hrs

4.1 Food preservation - Principles and methods, importance of food preservation,

4.2 Various methods of food preservation- Use of high temperature, low temperature, drying,radiation, Browning reactions – Reasons and preventions.

4.3 Food adulteration – Definition, Common adulterants in food and their ill-effects, Intentional adulterants and incidental adulterants.

4.4 Simple physical and chemical tests for detection of food adulterants.

Extra reading/Keywords: Detection of adulterants in food

UNIT: V- FOOD SANITATION AND FOOD TECHNOLOGY 12 Hrs

5.1 Practical rules for good sanitation of food,food selection, purchase and storage.

5.2 Food poisoning by microorganisms, insects and rodents- prevention and its Control.

5.3 Food technology- Bio-technology in food, Biofortification,

5.4 Nutraceuticals – classification, phytochemicals as nutraceuticals, dietary fibre and Packaging of foods.

Extra reading/Keywords: Phytonutrients present in Herbal drinks

Course Outcomes (CO):
The learners

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	summarize the modern concepts of biofortification and nutraceuticals	PSO 5	U

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

TEXT BOOKS

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 International (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.

BOOKS FOR REFERENCE

1. Sumathi R, Mudambi, M.V, Rajagopal M.V, (2006) Fundamentals of Food and Nutrition 3rd edn., Wiley Eastern Ltd.
2. Swaminathan M., (1982), Handbook of Food and Nutrition, 2nd edition, Bappco Publications.
3. Andrew Schloss and David Joachim with A. Philip Handel, (2009). The Science of Good Food (Paper Back). Oriented Paper Backs.
4. Sharma Avantina, (2010) A Text book of Food Science and Technology, International Book Distribution Company.

(For Candidates admitted in the academic year 2023-24)

Course Title	NME 1:- PREPARATION OF CONSUMER PRODUCTS
Code	P23CH2SEP01
Semester	II
Hours/Week	4
Course Type	Practical
Credits	2
Marks	100

GENERAL OBJECTIVE

To enable the students to learn the preparation of different household products, skin care products and adulterants in food products.

COURSEOBJECTIVES

The learner will be able to

CO No.	Course Objectives
CO-1	know about the adulterants present in food samples
CO-2	identify the adulterants present in some solid and liquid food samples
CO-3	acquire knowledge in the preparation of various household care products
CO-4	distinguish between the herbal based and chemical based personal products
CO-5	analyse the adulterants in food products.
CO-6	develop the entrepreneurial skill in the preparation of household and personal care products

PRACTICAL:

1. Preparation of
   - i. Phenyl
   - ii. Floor cleaner
   - iii. Liquid detergents
   - iv. Hand wash
   - v. Washing powder
   - vi. Dish wash powder
   - vii. Dish wash gel
2. Preparation of
   - i. Candle
   - ii. Incense stick
   - iii. Naphthalene
   - iv. Air freshener
3. Preparation of
   - i. Herbal soap
   - ii. Herbal shampoo
   - iii. Henna based hair dye
   - iv. Natural face mask
4. Preparation of
   - i. Lipstick
   - ii. Face powder
   - iii. Moisturizing cream
   - iv. Perfumes

Chemical analysis of adulterants present in

i.	Turmeric powder	vii.	Coffee powder
ii.	Milk	viii.	Chili powder
iii.	Honey	ix.	Chickpea flour
iv.	Ghee	x.	Sugar
v.	Oil	xi.	Pepper
vi.	Mustard seed		

COURSE OUTCOMES (CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	describe the basic adulterants added in the food samples	PSO1	U
CO-2	identify the natural and chemical ingredients present in cosmetics.	PSO2	An
CO-3	apply the practical experience in enhancing their employability	PSO3	Ap
CO-4	Study the importance of herbal products over chemical products	PSO2	U
CO-5	appraise the benefits of homemade herbal products	PSO5	U
CO-6	analyze the adulterants present in food samples using chemical tests.	PSO4	An

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

TEXT BOOKS

1. Srilakshmi B, *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 Raja Gopal, M.V. *Food science*. 2nd Edition. New Age, 2006.
2. Baki Gabriella and Kenneth S. Alexander *Introduction to cosmetic for*

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)
Second 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 compounds, 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)
Second Year – Semester- III

Course Title	MAJOR 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

1. A.S. Negi & S.C. Anand (1994) " A Text book of Physical Chemistry", 3rd edition, Wiley Eastern Ltd.
2. Samuel Glasstone, (2015) "An Introduction to Electrochemistry" McMillan India Ltd.,
3. Walter J Moore (1999) "Physical Chemistry", 5th edition., Prentice-Hall.
4. Rajaram, J and Kuriacose,J.C. (2013). "Chemical Thermodynamics", Pearson
5. Bockris, J.O.M and Reddy, A.K.N. (1998) " Modern Electro Chemistry" 2nd edition, New York: Plenum Press.
6. Crow, D.R. (1991) "Principles And Applications To Electrochemistry", Chapman And Hall.
7. Dalahay, P. (1965) "Electrode Kinetics And Structure Of Double Layer" ,New York: Inter Science.
8. Carter, A.H (2001) "Classical and Statistical Thermodynamics", Prentice Hall.

(For Students admitted from June 2016 onwards)
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, 2nd Edn.,Narosa publishing house Pvt. Ltd., New Delhi.
9. Ahluwalia -V. K. (2005), Organic Reaction Mechanisms, 4th Edn.,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- 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.
8. Glasstone, Source book of Atomic Energy, 3rd Edn., ELBS, 1986.

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

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.

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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 (4^{th} edition) , London ElBS
2. Samuel Glasstone (1967) Sourcebook on Atomic Energy (3^{rd} Edition) Devan and nostrand.
3. Cotton F.A and Wilkinson G (1985) Advanced Inorganic Chemistry (1985) New Delhi
4. Sashai V.N. (1993) Fundamental of soil 2nd Edition kalyani publishers.
5. Nyle C. Brady (1996), The nature and properties of soil 10^{th} editon, Mcmillian Publishing company.
6. Sharma B.K (2005) Environmental Chemistry 8^{th} Edition, Goel Publishing house.
7. V.P. Gowariker and N.V. Viswanathan- " Polymer Science", I^{st} Ed., Wiley Easter Pvt. Ltd., New Delhi.