

PG & RESEARCH
DEPARTMENT OF CHEMISTRY
(SHIFT – I&II)
(2020-2021)



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
SCHOOL OF PHYSICAL SCIENCES
PG AND RESEARCH DEPARTMENT OF CHEMISTRY
Programme: BSc

	Program Outcomes: <i>Upon completion of the B.Sc. Degree Programme, the graduate will be able to</i>
PO1	understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life
PO2	acquire the skills in handling scientific instruments, planning and performing in laboratory experiments
PO3	tackle issues and problems related to the field of chemistry through their analytical skills.
PO4	communicate scientific information and research results in written and oral formats effectively.
PO5	understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics and other disciplines to a wide variety of chemical problems
PO6	gain Knowledge and skills required to get placements in schools, the chemical industries etc.

	Programme Specific Outcomes: <i>Upon completion of the B.Sc. Degree Programme, the graduate would</i>
PSO1	have a firm foundation in the fundamentals and application of current and scientific theories in various branches of chemistry.
PSO2	present the concepts of chemistry effectively and efficiently.
PSO3	predict the structure and mechanism of Chemical compounds.
PSO4	recognise and analyse qualitative and quantitative problems and plan strategies for their solution.
PSO5	explain the laboratory skills needed to design and interpret chemical research.
PSO6	carry out scientific experiments as well as record and analyze the results of such experiments.

SCHOOL OF PHYSICAL SCIENCES
(For Candidates admitted from June 2020 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2
PG AND RESEARCH DEPARTMENT OF CHEMISTRY
B.Sc. CHEMISTRY- COURSE PLAN OF CHEMISTRY DEPARTMENT
2020-2021

Sem ester	Part	Course	Title of the Course	Code	Hrs./wk.	Credits	Marks
I	I	Language	Tamil paper I/ Hindi Paper I/ French Paper I	U20TL1TAM01/ U20HN1HIN01/ U20FR1FRE01	3	3	100
	II	English	English Paper I	U20EL1GEN01	3	3	100
	III	Major Core – 1	Inorganic, Organic and Physical chemistry	U20CH1MCT01	5	4	100
		Major Core – 2	Volumetric Analysis (Lab cum theory)	U20CH1MCP02	4	3	100
		Major Core -3	Analytical Chemistry	U20CH1MCT03	4	4	100
		Allied – 1	Chemistry Paper I (For Bot/Zoology)	U20CH1ALT01	4	2	100
		Allied – 2	Chemistry Paper II (For Bot/ Zoology)	U20CH1ALP02	4	2	100
	IV	Skill based Course - 1	Environmental Studies	U20RE1EST01	2	1	100
		Value Education	Ethics-I/ Bible Studies-I/ Catechism-I	U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01	1	-	-
			Service Oriented Course			-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		U20SP1ECC01	-	2(Extra Credit)	100
		Total			30	22 +2	800 +100
II	I	Language	Tami Paper II/ Hindi Paper II /French Paper II	U20TL2TAM02/ U20HN2HIN02/ U20FR2FRE02	3	3	100
	II	English	English Paper II	U20EL2GEN02	3	3	100
	III	Major Core –4	Organic and Physical Chemistry	U20CH2MCT04	6	5	100
		Major Core –5	Semi micro Analysis (Lab cum Theory)	U20CH2MCP05	4	3	100
		Major Elective - 1(For Physics)	1. Chemistry of materials	U20CH2MET01	5	3	100
			2. Nano technology and Crystal growth techniques	U20CH2MET02			
Allied – 3	Chemistry Paper III (For Bot/ Zoology)	U20CH2ALT03	4	2	100		

	IV	Skill-based Course– 2	Soft Skill Development	U20RE2SBT01	2	1	100	
		Skill-based Elective – 3	Rural Enrichment and Sustainable Development	U20RE2SBT02	2	1	100	
			Industrial Relations	U20CH2IRT01	1	1	100	
		Value Education	Ethics I/ Bible Studies I/ Catechism I	U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01	1	1	100	
		Service Oriented Course -						
		Internship / Field Work / Field Project 30 Hours - Extra Credit		U20SP2ECC02		2(Extra Credits)	100	
		Total			30	23	1000 + 100	

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

Course Title	Major Core 1 – Inorganic, Organic and Physical Chemistry
Total Hours	60 Hours
Hours/Week	5 Hrs./Wk.
Code	U20CH1MCT01
Course Type	Theory
Credits	4
Marks	100

General Objectives:

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(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	describe the position of elements in the modern periodic table and assess the trend in periodic properties.
CO-2	understand the fundamental concepts of ionic, covalent and hydrogen bonding and predict the shapes of molecules using VSEPR, VBT and draw the molecular orbital diagram for homonuclear and heteronuclear diatomic molecules
CO-3	apply the fundamental principles of atomic theory to explain the structure of the atom and understand the postulates of quantum mechanics
CO-4	interpret the terms in thermodynamics, explain the first law of thermodynamics, relates heat, work and energy, explain the heat changes, Joule-Thomson effect, classify heat of reaction and thermochemical laws.
CO-5	apply IUPAC system of nomenclature, classify covalent bonds, reactions of organic compounds and reaction intermediates

UNIT -I PERIODICITY

12Hrs

- 1.1 Periodic variation of properties of elements – effective nuclear charge, screening effect, Slater's rule. Periodicity of properties of s, p, d and f block elements with respect to atomic radii, ionic radii, ionisation energy, electronegativity, electron affinity, flame colouration, reducing properties, hydration of ions, oxidation of ions and oxidation potential.
- 1.2 Chemistry of s- block elements – Discussion of alkali metal group with respect to their oxides, halides and hydroxides.

- 1.3 Comparison of Li with other elements, diagonal relationship between Li and Mg
- 1.4 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 -II CHEMICAL BONDING

12Hrs

- 2.1 Ionic bond -Properties of ionic compounds – Factors favouring the formation of ionic compounds (ionization energy, Electron affinity, Electro negativity and Lattice energy) – Lattice energy – definition, Born Lande equation (Derivation not required) factors affecting lattice energy – Born Haber cycle – Illustration and calculation for NaCl
- 2.2 Covalent bond – Covalent character in ionic bond, polarisation of ions and Fajan's rules with illustrations, percentage ionic character of a polar covalent bond. Hydrogen Bonding.
- 2.3 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 .
- 2.4 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 III- FUNDAMENTALS OF QUANTUM CHEMISTRY

12Hrs

- 3.1. Atomic structure - Rutherford's nuclear model of atom. Planck's Quantum theory of radiation. Photoelectric effect and quantum theory.
- 3.2. Bohr's model of an atom. Bohr's theory and the origin of hydrogen spectrum. Somerfield's extension of Bohr's theory.
- 3.3. Particle and wave character. de Broglie's equation. Heisenberg's uncertainty principle.
- 3.4. 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- IV FIRST LAW OF THERMODYNAMICS AND THERMOCHEMISTRY

12Hrs

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

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

UNIT V - INTRODUCTION TO ORGANIC CHEMISTRY

12Hrs

- 5.1 IUPAC Nomenclature of Organic Compounds. Isomerism-Types and examples Types of covalent bonds – 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, Carbanions 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 compounds and identifying the type of organic reactions

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

Course Outcomes(CO)

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	compare and contrast the periodic properties of elements	PSO1	Ap
CO-2	interpret the geometry of molecules using VSEPR	PSO4	An
CO-3	describe the shapes of atomic orbitals	PSO2	R
CO-4	explain the first law of thermodynamics and relate the work, heat and energy	PSO2	Ap
CO-5	compare the stabilities of the intermediates	PSO3	U
CO-6	draw the MOT for N_2 and O_2	PSO3	U

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

1. Raj K. Bansal, *A Text Book of Organic Chemistry*, 5th edn., New Age, 2007.
2. Bahl B.S, Arun Bahl, *A Textbook of Organic Chemistry*. New Delhi: Sultan Chand and sons, 2010.
3. Soni P.L. and Mohankatyal ,*Text book of Inorganic Chemistry*, 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.
5. Samuel Glasstone, *Thermodynamics for Chemists* 3rd printing., East-West edn.,1974.
6. Lee, J.D., *Concise Inorganic Chemistry*, 5th edn., Blackwell Science, 1996.
7. Jain M.K. *Organic Chemsitry*, 12th edn.,, New Delhi: Shoban Lal Nagin Chand and Co, 2003.

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

Course Title	MAJOR CORE - 2: VOLUMETRIC ANALYSIS – Lab cum theory
Total Hours	60
Hours/Week	4 Hrs /Wk
Code	U20CH1MCP02
Course Type	Theory Cum Lab
Credits	3
Marks	100

General Objective:

To expose the students to the various concepts in volumetric analysis and 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(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	understand the terminologies and principle involved in volumetric analysis
CO-2	define a primary standard ,standard solution and determine the equivalence point
CO-3	determine the concentration of solution in various units and prepare standard solution and dilute solution
CO-4	determine the strength of the given solution from different types of titrations like acid base, redox,and precipitation
CO-5	solve volumetric problems using formula method

UNIT: I – PRINCIPLES OF VOLUMETRIC ANALYSIS

12Hrs

- 1.1 Terminology, Basic requirement of a titration, standard solution – primary standard, preservation of standard solution, expressing concentration of standard solution, simple correlation for quick and convenient volumetric calculation, p-functions.
- 1.2 Volumetric Titrations: Acid base titration – acid base titration and use of indicators, titration of a strong acid against a strong base, titration of a weak acid with a strong base, titration of a weak base with strong acid, titration of Na_2CO_3 with HCl , the theory of acid base indicators, action of phenolphthalein and methyl orange.
- 1.3 Redox titration – theory – titration of Mohr salt against KMnO_4 , oxalic acid against KMnO_4 , FeSO_4 against $\text{K}_2\text{Cr}_2\text{O}_7$, internal indicator, external indicator, starch, iodimetry and iodometry. Precipitation titrations – conditions for precipitation titration and indicators.
- 1.4 Complexometric titration:-EDTA titrations, indicators of EDTA titrations, complexometric titration curves, EDTA – titration methods – masking of ions, precautions to avoid errors in titrimetric analysis, corrections for unavoidable errors.

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

VOLUMETRIC ANALYSIS:

1. Acidimetry
 - i. Estimation of NaOH
 - ii. Estimation of Oxalic acid.
2. Permanganometry:
 - i. Estimation of Oxalic acid
 - ii. Estimation of FAS.
 - iii. Estimation of Calcium. (Direct Method).
3. Iodimetry & Iodometry:
 - i. Estimation of copper.
 - ii. Estimation of Arsenious oxide.
4. Dichrometry:
Estimation of Ferrous ion.
5. EDTA Titrations:
 - i. Estimation of Magnesium.
 - ii. Estimation of Zinc.

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

Course Outcomes(CO)

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describe the basic requirements of titration	PSO 2	U
CO-2	Prepare the standard solutions of different strength.	PSO 5	U
CO-3	Explain the acid base, redox and complexometric titrations with examples.	PSO 4	An
CO-4	Estimate the strength of the given unknown solution	PSO 5	Ap

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

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.

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

Course Title	Major Core 3 : Analytical Chemistry
Total Hours	60 Hrs
Hours/Week	4 Hrs Wk
Code	U20CH1MCT03
Course Type	Theory
Credits	4
Marks	100

General objective:

To make the students to learn about the laboratory hygiene and safety, data analysis, handling and use of different glass wares, separation. purification techniques and different chromatographic techniques

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	identify various chemicals used in the laboratory and explain first aid techniques and treatment for specific poisons.
CO-2	calculate the mean, median, deviations, types of errors and different types of tests
CO-3	identify the different types of apparatus in the laboratory and their uses
CO-4	analyse the different types of separation techniques, understand the solubility products
CO-5	understand, apply and analyse the various tests in data analysis and different chromatographic techniques.

UNIT 1 - LABORATORY, HYGIENE AND SAFETY

12Hrs

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

Extra reading/Key words: *Radioactive wastes*

UNIT 2 - DATA ANALYSIS

12Hrs

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

Extra reading/Key words: *Problem solving using MS-Excel.*

UNIT 3 –LABORATORY OPERATIONS**12Hrs**

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

Extra reading/Key words: *Principle and working of colorimeter***UNIT 4 - SEPARATION AND PURIFICATION TECHNIQUES****12Hrs**

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

Extra reading/Key words: *Steam Distillation***UNIT 5 – CHROMATOGRAPHY****12Hrs**

- 5.1 Column chromatography – principle, types of adsorbents, preparation of column, elution-applications,
- 5.2 Paper chromatography – principle, R_f value and its significance, factors affecting R_f value, selection of solvents, development of chromatogram, applications.
- 5.3 Thin layer chromatography–principle, choice of adsorbent, preparation of plates, development and applications.

Extra reading/Key words: *Ion exchange and GC- MS chromatographic techniques***Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.****Course Outcomes(CO)****The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	categorize the various chemicals and recognizes the precautions to handle poisonous chemicals and to avoid the accidents.	PSO1	An
CO-2	evaluate the statistical tests and summarize the types of errors	PSO3	An
CO-3	explain the different types apparatus used in the laboratory and their applications	PSO2	U
CO-4	summarize the different types of purification techniques used for the different types of mixtures	PSO4	E
CO-5	summarize the principles and applications of various chromatographic techniques.	PSO5	Ap

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

1. Puri B.R., Sharma, L.R and Madan S. Pathania , *Principles of Physical Chemistry*New Delhi: 35thedn, Shoban Lal Nagin Chand and Co.2008
2. Willard H H, MerrittL. L., and Dean J. A., *Instrumental Methods of analysis*,Delhi, 6th edn, CBS Publishers & Distributors, Shahdara 1986.
3. Gary D. Christian, *Analytical Chemistry*, John Wiley & Sons, 6th edition, 2007.
4. BobbittJ. M, Roy Gritter, *Introduction to chromatography*, Holden Day; 2nd edition.1985
5. Soni P.L., Chawla H.M., *Text Book of Organic Chemistry*, 6th Reprint, New Delhi: Sultan Chand & sons, 2006.

(For Candidates admitted from the academic year 2020-21 onwards)
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SCHOOL OF PHYSICAL SCIENCES
PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
First Year - Semester – I

Course Title	Allied – 1: Chemistry Paper I [For Botany and Zoology]
Total Hours	60
Hours/Week	4 Hrs/ Wk
Code	U20CH1ALT01
Course Type	Theory
Credits	2
Marks	100

General Objective:

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

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	recognize and understand the quantum numbers, periodic table and periodic properties.
CO-2	categorize, discuss and apply the different types of organic reactions and reaction intermediates.
CO-3	recall, classify and identify the different types of carbohydrates amino acids and proteins.
CO-4	understand, apply and determine the water quality parameters.
CO-5	understand and apply the concepts of chromatography and osmosis in everyday life

UNIT 1 - PERIODIC TABLE

12Hrs

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

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

UNIT 2 - FUNDAMENTAL CONCEPTS OF ORGANIC CHEMISTRY

12Hrs

- 2.1 Types of organic reactions – substitution (one example each of nucleophilic and electrophilic), addition (preparation of 1,2- Dibromoethane), elimination (Dehydration of ethanol), rearrangement (pinacol pinacolone rearrangement) and Polymerization reactions (PVC).

- 2.2 Types of reaction intermediates- Carbanion, Carbocation and Free radicals
 2.3 Types of reagents - Electrophiles and nucleophiles: definition and examples

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

UNIT 3 – CARBOHYDRATES, AMINO ACIDS AND PROTEINS

12Hrs

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

Extra Reading/Keywords: *Chemistry behind Natural products*

UNIT 4 - CHEMISTRY OF WATER

12Hrs

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

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

UNIT 5- CHROMATOGRAPHY AND OSMOSIS

12Hrs

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

Extra Reading/Keywords: *Applications in Chromatographic techniques*

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

Course Outcomes(CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	compare and contrast the periodic properties of the elements	PSO2	Ap
CO-2	recognise the types of organic Reactions and their intermediates	PSO1	U
CO-3	recall the preparation and properties of carbohydrates, amino acids and proteins.	PSO2	U
CO-4	analyse the given water sample.	PSO2	An
CO-5	explain the different types of chromatographic techniques.	PSO4	An

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

1. Soni P.L. and Mohankatyal, *Text book of Inorganic Chemistry* , 20th revised edition, sultan chand., 1992.
2. Bahl B.S, Arun Bahl and Tuli G.D, *Essentials of Physical Chemistry*, New Delhi: Sultan Chand and sons., 2012.
3. Robert Thornton Morrison, Robert Neilson Boyd , Saibal Kanti Bhattacharjee, *Organic Chemistry* (7th Edition), Chennai: Pearson Education India, 2011.
4. A.K.De, *Environmental Chemistry*, (8th Edition) , New age international (P) limited,2017.
5. Jain M.K, Sharma S.C, *Modern Organic Chemistry* , Vishal Publishing Co., 2007

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CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
First Year - Semester – I

Course Title	ALLIED 2: CHEMISTRY PAPER II
Total Hours	60
Hours/Week	4 Hrs /Wk
Code	U20CH1ALP02
Course Type	Theory Cum Lab
Credits	2
Marks	100

General Objective:

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

Course Objective(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	understand the terminologies and principle involved in volumetric analysis
CO-2	define a primary standard ,standard solution and determine the equivalence point
CO-3	determine the concentration of solution in various units and prepare standard solution and dilute solution
CO-4	determine the strength of the given solution from different types of titrations like acid base, redox,and precipitation
CO-5	solve volumetric problems using formula method

UNIT 1 - VOLUMETRIC ANALYSIS

12 Hrs

- 1.1 Definitions - Titration, Back Titration, End point, Equivalence point, Indicator, Normality, Molality, Molarity, Mole Fraction, ppm, ppb and ppt. Equivalent weights of acid, base, salt, oxidizing and reducing agents.
- 1.2 Standard solution, requirements of a primary standard, preparation of standard solution, secondary standard, principle of volumetric analysis.
- 1.3 Acid-Base titrations – HCl with NaOH, CH₃COOH against NaOH, Na₂CO₃ with HCl. Acid-Base indicators – Ostwald's theory and quinonoid theory.
- 1.4 Redox titrations – Mohr salt against KMnO₄, Oxalic acid with KMnO₄, FeSO₄ against K₂Cr₂O₇. Redox indicator – Diphenyl amine, Iodometry - Estimation of copper sulphate

Extra reading/Keywords: EDTA Titrations

VOLUMETRIC ANALYSIS (DOUBLE TITRATION WITH WEIGHING):

(3 hrs. External)

I Acidimetry and Alkalimetry:

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

II Permanganometry:

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

III Iodometry:

5. Estimation of copper sulphate

IV Dichrometry:

6. Estimation of iron (internal indicator)

Course Outcomes(CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	recognise the procedures in order to define the common methods of analysis..	PSO 2	U
CO-2	use correct titrimetric procedure when carrying out titrations	PSO 5	An
CO-3	prepare the standard solution of different strength.	PSO 5	U
CO-4	explain the acid base, redox and complexometric titrations with examples.	PSO 6	An
CO-5	apply the knowledge of concentrations of solutions to everyday examples and estimate the strength of the given unknown solution	PSO 6	Ap

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

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 from the academic year 2020-21 onwards)
HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002
SCHOOL OF PHYSICAL SCIENCES
PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
First Year - Semester – II

Course Title	Major Core 4- Organic and Physical Chemistry
Total Hours	60 Hours
Hours/Week	5 Hrs./Wk.
Code	U20CH2MCT04
Course Type	Theory
Credits	5
Marks	100

General Objectives:

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

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO -1	understand the preparation and properties of alkanes, cycloalkanes and explain the stability of cycloalkanes
CO -2	classify dienes and understand its stability, explain the elimination reactions and properties of alkynes
CO -3	understand the law of gases, explains the molecular speeds and molecular energies and classify the molecular velocities.
CO -4	understand second law of thermodynamics, analyse thermodynamic cycles, classifies entropy, interprets work function and free energy
CO -5	interpret the concept of chemical potential and partial molar properties, apply the third law of thermodynamics and relate free energy and chemical reactions.

Unit I : ALKANES AND CYCLOALKANES

12 Hrs

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

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

Unit II: ALKENES AND ALKYNES

12Hrs

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

effect), sulphuric acid, water, hydroboration, ozonolysis, dihydroxylation with KMnO_4 , allylic bromination by NBS.

- 2.3. Dienes - Types, Stability of dienes (conjugated, isolated and cumulative dienes). General methods of preparation and Reactions- Mechanism of 1, 2- and 1,4-additions, Diels- Alder reactions. Addition polymerization reactions, mechanism of Ziegler Natta polymerization.
- 2.4. Alkynes - Preparation- Mechanism of dehydrohalogenation and dehalogenation. Reactions: acidity of alkynes, formation of acetylides, Electrophilic and Nucleophilic additions, reduction and oxidation.

Extra reading/Keywords: *Problems related to alkynes*

UNIT III- THE GASEOUS STATE

12Hrs

- 3.1. Gas Laws-Kinetic of theory gases, Kinetic equation of gases, Derivation of gas laws from Kinetic equation, Different types of molecular velocities, Maxwell's law of distribution of molecular velocities.
- 3.2. Collision Parameters - Collision number, collision cross section, collision frequency, collision diameter, Transport phenomenon in gases.
- 3.3. Real gases and ideal gases - Deviation of real gases from ideal behaviour, Derivation of Vanderwaals equation for real gases, Vanderwaals constants.
- 3.4. Critical phenomenon - critical constants of a gas, critical temperature, critical pressure, critical volume, PV isotherms for real gases

Extra reading/Keywords: *Problems in molecular velocities, collision diameter and collision frequency*

UNIT IV - SECOND LAW OF THERMODYNAMICS

12Hrs

- 4.1 The second Law of thermodynamics - Need for the second law of thermodynamics, spontaneous or irreversible processes, Statements of the II law, Conversion of heat into work – the Carnot's theorem, the Carnot cycle, maximum efficiency of heat engine, refrigeration engine, thermodynamic scale of temperature.
- 4.2 Entropy – definition, entropy as a function of pressure, volume and temperature, entropy changes in reversible and irreversible processes, entropy change and phase change, entropy changes of ideal gases, entropy of mixing, entropy and disorder.
- 4.3 Variation of entropy with temperature, Maxwell's relations, the thermodynamic equations of state.
- 4.4 Free energy and work function – definition, Work function and Free energy relationships. Gibb's Helmholtz equation.

Extra reading/Keywords: *Thermodynamic cycles, Applications of Entropy*

UNIT V - CHEMICAL POTENTIAL AND THIRD LAW OF THERMODYNAMICS 12Hrs

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

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

Course Outcomes(CO):**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	explain the preparation and properties of alkanes and cycloalkanes	2	U
CO -2	recognise the stability of cycloalkanes.	3	Ap
CO -3	recall the properties of Alkenes and Alkynes	3	U
CO -4	describe the molecular velocities and molecular energies	1	U
CO -5	calculate the work function and free energy.	1	Ap
CO -6	derive Maxwell's relations.	2	E
CO -7	describe Nernst heat theorem.	2	An

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

TEXT BOOKS

1. Soni P.L. and Chawla H.M. *Text Book of Organic Chemistry*, 26th edn., New Delhi: Sultan Chand and sons, 2014.
2. Puri B.R., Sharma. L.R. and Madan S. Pathania, *Principles of Physical Chemistry*, (46 th edition), New Delhi, Vishal Publishing Co, 2012.
3. Bahl B.S., Arun Bahl and Tuli, *Essentials of Physical Chemistry*, New Delhi, Sultan chand and sons,2007.

BOOKS FOR REFERENCE

1. Robert Thornton Morrison, Robert Neilson Boyd ,SaibalKanti Bhattacharjee, *Organic Chemistry*, 7th edn., Chennai: Pearson Education India, 2011.
2. Raj K. Bansal, *A Text Book of Organic Chemistry*, 5th edn., New Age, 2007.
3. Bahl B.S, Arun Bahl, *A Textbook of Organic Chemistry*. New Delhi: Sultan Chand and sons, 2010.
4. Jain M.K, Sharma S.C, *Modern Organic Chemistry* , Vishal Publishing Co., 2007
5. Samuel Glasstone. *Thermodynamics for Chemists*(3rd printing) East-WestEdn., 2007.
6. Rajaram. J&Kuriacose. J.C., *Chemical Thermodynamics*, New Delhi, Pearson Education, 2013.

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

Course Title	Major Core 5- Semi-Micro Qualitative Analysis
Total Hours	60
Hours/Week	4 Hrs /Wk
Code	U20CH2MCP05
Course Type	Theory Cum Lab
Credits	3
Marks	100

General Objectives:

To understand the principles involved in qualitative analysis.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO -1	understand the principles involved in qualitative analysis
CO -2	identify the simple acid and basic radicals
CO -3	identify the interfering radicals
CO -4	differentiate the acid and inferring radical
CO -5	analyse the acid and basic radicals for unknown inorganic substance using systematic procedure.

Unit 1- PRINCIPLES OF INORGANIC QUALITATIVE ANALYSIS

- 1.1 Basic principles of Chemical analysis - Solubility product, Common ion effect, Complexation, oxidation and reduction.
- 1.2 Reactions of the Acid Radicals: Carbonate, Sulphate, Sulphide, Nitrate, Chloride, Bromide, Fluoride, Oxalate, Phosphate, Arsenite, Arsenate, Chromate and Borate
- 1.3 Elimination of Interfering Radicals – Fluoride, Oxalate, Phosphate, arsenate and Borate
- 1.4 Reactions of the Basic Radicals and its Group Separations. Lead, Copper, Bismuth, Cadmium, Antimony, Iron, Chromium, Aluminum, Cobalt, Nickel, Manganese, Zinc, Barium, Strontium, Calcium, Ammonium and Magnesium

Unit 2 – ANALYSIS OF INORGANIC SALT MIXTURE

Analysis of a given salt containing Cations and Anions.

Course Outcomes(CO)

The learners

CO No.	CourseOutcomes	PSOs Addressed	Cognitive Level
CO -1	describe the common ion effect and solubility product	PSO-1	U
CO -2	identify the acid and basic radicals	PSO-2	Ap
CO -3	identify of interfering radicals	PSO-3	Ap
CO -4	recognise the difference between acid and inferring radicals	PSO-4	U
CO -5	Identify the groups	PSO-4	Ap

CO -6	Analyse the acid and basic radicals for unknown substance through semi micro qualitative tests	PSO-5	An
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PO – Programme Specific Outcome; CO – Course Outcome; U- Understand; Ap – Apply; An – Analyse

TEXT BOOKS

1. Venkateswaran V. R., Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, New Delhi. Sultan Chand & Sons, 1993.

BOOKS FOR REFERENCE

1. Svehla G. Vogel's Qualitative Inorganic Analysis. US: 7th Edition, Prentice Hall, 1996. 2. 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.

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CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
First Year - Semester – II

Course Title	MAJOR ELECTIVE-1 – CHEMISTRY OF MATERIALS (FOR PHYSICS)
Total Hours Code	60 Hrs
Hours/Week	5 Hrs Wk
Code	U20CH2MET01
Course Type	Theory
Credits	3
Max Marks	100

General Objectives:

To learn the preparation, properties and uses of important chemical materials used in various fields.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	understand the mechanism of polymerization and learn the preparation properties and uses of polymers, plastics, rubber and composites materials.
CO-2	describe the Engineering materials abrasives, lubricants and cement.
CO-3	summarize the alloys of ferrous and non-ferrous materials and manufacturing of glass and its varieties.
CO-4	learn the various metallurgical processes and extraction of metals from its ore.
CO-5	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 Reasons for alloying, manufacturing methods, classification. Composition and properties of cast iron, wrought iron. Alloy of steel and its uses.
- 3.2 Alloys of non ferrous materials: copper alloy – brasses and bronzes, Aluminium alloys – Al-Si, Al-Zn, Al-Cu alloys. (Properties and uses).
- 3.3 Glass – manufacture of glass, annealing, varieties of glass and thermoplastics.

Extra reading/Keywords: *Applications of Nickel Alloys***Unit IV -METALLURGY****12 Hrs**

- 4.1 Metallurgical process – concentration of ore, calcination, roasting,
- 4.2 Reduction to free metal, specialized techniques for the extraction of metals, refining and purification.
- 4.3 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***Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.****Course Outcomes(CO):****The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	recognise the properties and uses of polymers, plastics, rubber and composite materials.	PSO3	R
CO-2	explain the preparation, properties and uses of engineering materials abrasives, lubricants and cement.	PSO1	U
CO-3	list the alloys of ferrous and non- ferrous materials, different glass varieties.	PSO1	U
CO-4	recall the various metallurgical processes and extraction of metals from its ore.	PSO2	U
CO-5	categorize various types of smart materials and its uses.	PSO5	Ap

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

- Jain M.K., Sharma S.C., (2012), Modern organic chemistry, Fourth edition, Vishal Publishing Co., Jalandhar.
- Soni P.L., Mohan Katyal., (1996), Text book of 'Inorganic Chemistry', Sultan Chand and Sons, New Delhi.

3. R. Jayaprakash, Engineering Chemistry I, CBS Publishers & Distributors Pvt.Ltd, New Delhi.
4. Vijayamohan K Pillai, Meera Parthasarathy, Functional Materials A Chemist's Perspective, Universities Press-IIM.

BOOKS FOR REFERENCE

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

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

Course Title	Major Elective-1 – Nano Technology and Crystal Growth Techniques (For Physics)
Total Hours Code	60
Hours/Week	5 Hrs /Wk
Code	U20CH2MET02
Course Type	Theory
Credits	3
Max Marks	100

General Objectives:

To learn about nano technology and crystal growth techniques.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO -1	understand nanotechnology, nanoparticle synthesis and its characterization
CO -2	discuss the applications of carbon nanotubes and colloidal gold
CO -3	describe crystallography and symmetry of crystals
CO -4	summarize various crystal growth techniques
CO -5	discuss the types and characterization of crystals.

UNIT: I- NANO CHEMISTRY

12 Hrs

- 1.1 Nanomaterials –Nano technology, nanoscience, nano particles. Nanoparticles – Classification, Properties and uses.
- 1.2 Synthesis- Inert Gas Condensation (IGC), Physical Vapour Deposition (PVD), Chemical Vapour Deposition (CVD), Sol-Gel Process, Ball-milling.
- 1.3 Characterization – UV and SEM

Extra reading/Keywords: *Characterization techniques of nanoparticles using AFM and AAS*

UNIT: II- CARBON NANOTUBES AND COLLOIDAL GOLD AND SILVER

12Hrs

- 2.1 Carbon nanotube - Types –SWNTs and MWNTs, Properties – mechanical, electrical, thermal and kinetic properties. Graphene based materials.
- 2.2 Synthesis of nanotubes – Carbon ARC method, laser evaporation, CVD and pyrolysis. Applications of carbon nanotubes.
- 2.3 Colloidal gold and silver– properties, synthesis and applications.

Extra reading/Keywords: *Synthesis of Boron Nitride Nanotube*

UNIT: III- CRYSTALLOGRAPHY

12Hrs

- 3.1 Crystallography- Introduction, types of solids-crystalline and amorphous solids. External features of crystals- faces, form, edges and interfacial angles.

3.2 Symmetry of crystals – plane of symmetry, axis of symmetry, centre of symmetry, point groups and space lattice.

3.1 Growth of crystals, nucleation and factors affect the shape of the crystal.

Extra reading/Keywords: *Liquid crystals*

UNIT: IV- CRYSTAL GROWTH TECHNIQUES

12Hrs

4.1 Growth from solution - Low temperature solution growth, High temperature solution growth, Hydro Thermal growth methods.

4.2 Growth from melt - Bridgmann method, Czochralski method, Zone melting method, Kyropoulos technique, Skull melting.

4.3 Gel Growth technique – Growth by chemical reaction, chemical reduction, complex decomplexion method and Solubility reduction method.

Extra reading/Keywords: *Vapour Growth Techniques*

UNIT: V- CRYSTAL TYPES AND CHARACTERIZATION

12Hrs

5.1 Classification of crystals by shape- cubic, hexagonal, tetragonal, rhombic, trigonal, monoclinic, and triclinic systems. Bravais lattices.

5.2 Types of crystals- Ionic, covalent, metallic, molecular. Packing arrangements in crystals – hexagonal and cubic close packing.

5.3 Determining crystal structures by X-Ray Crystallography and FTIR spectroscopy.

Extra reading/Keywords: *Solid state defects and Chemical Etching*

Course Outcomes(CO)

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	explain the basics of nanotechnology, synthesis of nanoparticles and its characterization.	PSO-3	U
CO-2	recall the applications of carbon nanotubes and colloidal gold.	PSO-1	U
CO-3	explain crystallography.	PSO-1	R
CO-4	list the various crystal growth techniques.	PSO-2	Ap
CO-5	categorise various types of crystals and characterization of crystals.	PSO-5	U

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

Ap – Apply

TEXT BOOKS

1. T. Pradeep, (2007) The essentials, Understanding Nanoscience and Nanotechnology- Tata McGraw Hill Education Pvt. Ltd.
2. M. S. RamachandraRao and Shubra Singh (2013) Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley India Pvt. Ltd.
3. A.Goel, (2006), Crystallography, Discovery publishing house, Dew Delhi\
4. M.A.Wahab,(2014), Essentials of crystallography, Second edition, Narosa Publishing House, Dew Delhi.

BOOKS FOR REFERENCE

1. Lakshman Desai, (2007). Nanotechnology.Paragon International Publishers.
2. Charles Jr. and Frank J. Owen, (2008). Introduction to nanotechnology.London:JohnWiley & Sons.
3. K. Byrappa, T. Ohachi, Crystal Growth Techniques, Materials processing, Springer William Andrew publishing.
4. J.W. Mullin, (2004), Crystallization, Elsevier Butterworth-Heinemann, London.
5. B.R. Pamplin,(1975), Crystal Growth, Pergamon Press, Oxford.

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SCHOOL OF PHYSICAL SCIENCES
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CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
First Year - Semester – II

Course Title	Allied – 3: Chemistry Paper III [For Botany and Zoology]
Total Hours	60
Hours/Week	4 Hrs Wk
Code	U20CH2ALT03
Course Type	Theory
Credits	2
Marks	100

General Objective:

To make the students to learn about coordination compounds, pharmaceuticals, thermodynamics, electrochemistry and industrial application of chemical compounds.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	identify, propose and apply the theories of co-ordination chemistry to the mononuclear complexes.
CO-2	classify and identify the therapeutic applications of drugs and role of metal ions in biological systems.
CO-3	relate and recognize the different photochemical laws electrochemistry
CO-4	understand and apply the basic concepts of conductance in the determination of pH, Kohlrausch's law and conductometric titration
CO-5	analyse the industrial applications of chemical compounds

UNIT 1 -CO-ORDINATION CHEMISTRY

12Hrs

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

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

UNIT 2- CHEMICALS IN PHARMACY

12Hrs

- 2.1 Definition and therapeutic uses – Antiseptics: Alum, boric acid- Mouth washes: Hydrogen peroxide- Antacids: Aluminium hydroxide- Analgesics: Aspirin, Paracetamol.
- 2.2. Antibiotics - Penicillin , Tetracyclines- Hematinics: Ferrous Fumarate, Ferrous glucomate- Laxatives : Epsom salt, milk of magnesia- Sedatives: Diazepam
- 2.3 Metal ions in Biology- Essential and trace elements in biological system – biological importance and toxicity of elements such as Fe, Cu, Zn, Co, Mo, W, V, Mn and Cr in biological system and their vital role in the active site.

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

UNIT 3- PHOTOCHEMISTRY**12Hrs**

- 3.1 Photochemistry – Photochemical reactions – Lambert’s law, Beer’s law, Stark Einstein’s law of photochemical equivalence.
- 3.2 Photochemical processes – fluorescence, phosphorescence and Chemiluminescence.
- 3.3 Photosensitized reactions.

Extra reading/Keywords: Jabonlski Diagram, singlet, triplet states.

UNIT 4 - ELECTROCHEMISTRY**12Hrs**

- 4.1 Electrical conductance –Conductance, specific conductance, equivalent conductance and molar conductance, determination of conductance, variation of specific and equivalent conductances with dilution.
- 4.2 Kohlrausch’s law and its application to determine Λ_0 of a weak electrolyte, Conductometric titrations – HCl Vs NaOH, KCl Vs AgNO₃, CH₃COOH Vs NaOH.
- 4.3 Determination of pH by conductivity method, buffer solution.

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

UNIT 5 - APPLICATIONS OF CHEMISTRY IN INDUSTRIES**12Hrs**

- 5.1 Fuel gases – water gas, producer gas, LPG, Gobar gas and Natural gas
- 5.2 Fertilizers – NPK, micronutrients and mixed fertilizers
- 5.3 Soaps and Detergents an elementary idea of soaps, detergent, cleaning action of soaps and detergents

Extra reading/Keywords: Industrially important chemicals

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

Course Outcomes(CO)**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	classify the coordination compounds according to the IUPAC nomenclature.	PSO1	U
CO-2	discusse the therapeutic applications of drugs	PSO2	U
CO-3	explain the laws of photochemistry Determine the efficiency of Carnot Cycle	PSO3	Ap
CO-4	analyze the variation of specific and equivalent conductance with dilution.	PSO4	An
CO-5	illustrate the industrial applications of chemical compounds.	PSO2	U

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

TEXT BOOKS

1. Soni P.L. and Chawla H.M, *Text Book of Organic Chemistry*(26th edn). New Delhi: Sultan Chand and sons., 2014.
2. Textbook Of Pharmaceutical Chemistry, by Jayashree Ghosh (Author),S Chand & Company Pvt Ltd (Publisher)

3. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Physical Chemistry* (35th edn).New Delhi:Shoban Lal Nagin chand and Co.,2013.
4. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Inorganic Chemistry* (35th edn).New Delhi:Shoban Lal Nagin chand and Co., 2013.
5. Industrial Chemistry – B.K. Sharma(Goel Publishing House, Meerut)

BOOKS FOR REFERENCE

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

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PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
First Year - Semester – II

Course Title	Industrial Chemistry
Total Hours	15
Hours/Week	1 Hr/Wk
Code	U20CH2IRT01
Course Type	Theory
Credits	1
Marks	50

General objective:

To gain knowledge in the manufacture of various industrial products like aspirin, soap and detergents, glass, cement, pigment and paper.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	illustrate the types of fuels and their calorific values
CO-2	identify the preparation and uses of various dyes
CO-3	describe the stereochemistry of polymers
CO-4	summarize the raw materials and manufacturing of glass and cement industry
CO-5	discuss the processes involved in sugar and paper industry

UNIT I

3hrs

GENERAL INDUSTRIAL ASPECTS

- 1.1 General industrial aspects in chemistry – Coal- Types of coal, properties, calorific value, distillation of coal.
- 1.2 Petroleum, fractionation of crude oil - gaseous fuels- cracking.

UNIT II

3hrs

DYES AND PIGMENTS

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

UNIT III

3hrs

POLYMERS

- 3.1 Rubbers- Origin, classification – chemical nature of rubber, vulcanization of rubbers.
- 3.2 Polymers – classification – types of polymerization - tacticity, plasticity. Types of plastics. Preparation of Nylons, Teflon and polyester.

UNIT IV

3hrs

GLASS AND CEMENT INDUSTRY

- 4.1 Glass Industry – Raw materials. Manufacture Annealing, varieties of glass.
- 4.2 Portland cement – raw materials, Manufacture, setting of cement, concrete.

UNIT V**3hrs****SUGAR AND PAPER INDUSTRY**

- 5.1 Sugar industry – Manufacture – clarification, concentration, separation of crystals and recovery refining
- 5.2 Paper industry – raw materials used, Manufacture, Filling and sizing, calendaring.

Course Outcomes(CO)**The learners**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	describe general industrial aspects and types of fuels	2	R
CO-2	classify dyes according to structure and application	1	Ap
CO-3	describe the preparation of various polymers	1	U
CO-4	explain manufacturing process of Glass industry and Cement industry.	6	An
CO-5	differentiate the process in Sugar and Paper industry.	3	An
CO-6	gain knowledge to work in Industries.	3	Ap

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

1. Gopalan R., 2009, Inorganic Chemistry', First Edition, Universities Press India Ltd, Chennai.
2. Soni P.L., Chawla H.M., (2006), 'Text Book of Organic Chemistry', 6th Reprint, Sultan Chand & sons, New Delhi.

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

Semester	Part	Course	Title of the Course	Code	Hrs./wk	Credits	Marks
III	I	Language	Tamil Paper III/ Hindi Paper III/ French Paper III	U15TL3TAM03/ U15HN3HIN03/ U15FR3FRE03	6	3	100
	II	English	English Paper III	U15EL3GEN03	6	3	100
	III	Major Core –4	General Chemistry – III	U15CH3MCT04	6	6	100
		Major Core –5	Volumetric Analysis - Theory Cum Lab - I	U15CH3MCP05	4	4	100
		Allied – 4	Allied Optional Paper I (For Physics)	U15CH3AOT01	4	3	100
	IV	Skill-based Elective–3	Experimental Chemistry For Life Science [For Botany]	U15CH3SBT03	2	2	100
		Value Education	Ethics/Bible Studies/ Catechism		1	-	
		Gender studies	Gender studies	U15WS3GST01	1	1	100
	VI		Service Oriented courses		-	-	-
		EXTRA CREDIT	Field Work/Internship/Field projects	U18SP3ECC03		2(Extra Credits)	100
Total					30	22	700
IV	I	Language	Tamil Paper IV/ Hindi Paper IV/ French Paper IV	U15TL4TAM04/ U15HN4HIN04/ U15FR4FRE04	5	3	100
	II	English	English Paper – IV	U15EL4GEN02	6	3	100
	III	Major Core –6	General Chemistry – IV	U15CH4MCT06	5	5	100
		Major Elective - 1	Laboratory Techniques and Virtual Lab (Theory Cum Lab) – II	U17CH4MEP01	5	5	100
		Allied – 5	Allied Optional Paper II (For Physics)	U15CH4AOT02	4	4	100

	Allied – 6	Allied Optional Paper III (For Physics)	U15CH4AOP03	4	3	100
IV	Value Education	Ethics II/Bible Studies II/ Catechism II	U15VE4LVEP2/ U15VE4LVB02/U15VE4LVC02	1	1	100
VI		Service Oriented courses			1	100
	EXTRA CREDIT	Field Work/Internship/Field projects	U18SP4ECC04		2(Extra Credits)	100
Total				30	25	800

Semester	Part	Course	Title of the Course	Code	Hrs./wk.	Credits	Marks
V	III	Major Core –7	Inorganic Chemistry	U15CH5MCT07	4	4	100
		Major Core –8	Organic Chemistry	U15CH5MCT08	4	4	100
		Major Core –9	Physical Chemistry – I [Electro Chemistry And Phase Rule]	U15CH5MCT09	4	4	100
		Major Core –10	Practical II – Gravimetric, Organic analysis and Organic Preparation/ III – Physical Chemistry	U15CH5MCP10/ U15CH5MCP11	8	5	100
		Major Elective – 2	Chemistry of Biomolecules/ Food Chemistry	U15CH5MET03/ U17CH5MET03	5	4	100
	IV	NME – 1	Home Care/ Cosmetology	U15CH5NMT01/ U15CH5NMT02	2	2	100
		SBE – 4	Experimental Chemistry for Life Science [For Zoology]	U15CH5SBT04	2	2	100
			Online course	U19CH5OCT01			
		EXTRA CREDIT	Field Work/Internship/Field projects	U18SP5ECC05		2(Extra Credits)	100
			Value Education		1	-	
Total					30	25	700
VI	III	Major Core –11	Organic Chemistry	U15CH6MCT12	5	5	100
		Major Core –12	Physical Chemistry– II [Spectroscopy]	U15CH6MCT13	5	5	100
		Major Core –13	Practical III - Physical Chemistry/ II - Gravimetric, Organic analysis and Organic Preparation	U15CH6MCP11/10	8	5	100
		Major Elective – 3	Analytical Chemistry	U15CH6MET04	5	5	100
	IV	NME – 2	Home Care/ Cosmetology	U15CH6NMT01/ U15CH6NMT02	2	2	100
		SBE – 5	Computer Literacy [For Chemistry students]	U19CH6SBT05	2	2	100
		SBE – 6	Research Methodology	U15DS6SBT06	2	2	100

		Value Education		1	-		
		EXTRA CREDIT	Field Work/Internship/Field projects	U18SP6ECC06		2(Extra Credits)	100
		Total			30	26	700
	V	RESCAPES- Impact Study		U15RE6ETF01		1	100
Grand Total					180	141	4400

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PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY
Second Year – Semester - III

Course Title	MAIN CORE PAPER – GENERAL CHEMISTRY – III
Total Hours	90
Hours/Week	6 Hrs /Wk
Code	U15CH3MCT04
Course Type	Theory
Credits	6
Marks	100

General Objective:

To understand the second, third law of thermodynamics and the concept of chemical potential, the general characteristics of s and p block elements and their compounds and the properties of aromatic hydrocarbons.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	understand second law of thermodynamics, analyse thermodynamic cycles, classifies entropy, interprets work function and free energy
CO-2	interpret the concept of chemical potential and partial molar properties, apply the third law of thermodynamics and relate free energy and chemical reactions.
CO-3	analyse the characteristics of s- block elements and compares the properties of alkali and alkaline earth metals
CO-4	outline the characteristics of p- block elements and find out the anomalous behaviour of Carbon, oxygen and fluorine
CO-5	formulate the preparation, properties of mononuclear and polynuclear aromatic hydrocarbons and predict the products formation.

UNIT 1 - SECOND LAW OF THERMODYNAMICS

18Hrs

- 1.1 The second Law of thermodynamics: Need for the second law of thermodynamics, spontaneous or irreversible processes, Statements of the II law, Conversion of heat into work – the Carnot's theorem, the Carnot cycle, maximum efficiency of heat engine, refrigeration engine, the thermodynamic scale of temperature.
- 1.2 Entropy – definition, entropy changes in reversible and irreversible processes, entropy change and phase change, entropy changes of ideal gases, entropy of mixing, entropy and disorder.

- 1.3 Variation of entropy with temperature, Maxwell's relations, the thermodynamic equations of state.
- 1.4 Free energy and work function – definition, Work function and Free energy relationships. The Gibb's Helmholtz equation, conditions of equilibrium.

Extra reading/Keywords: *Thermodynamic cycles, Applications of Entropy*

UNIT 2 - CHEMICAL POTENTIAL AND THIRD LAW OF THERMODYNAMICS 18Hrs

- 2.1 Chemical potential – partial molar properties, physical significance of partial molar property, partial molar free energy – Gibb's Duhem equation, variation of chemical potential with temperature and pressure.
- 2.2 Chemical potential in a mixture of ideal gases, Clausius-Clapeyron equation.
- 2.3 The Third law of thermodynamics – Nernst heat theorem, the third law, determination of absolute entropies of solids liquids and gases, exceptions to III law, applications of III law of thermodynamics.
- 2.4 Free energy and chemical reactions – Vant-Hoff reaction isotherm, standard free energy of reaction, variation of equilibrium constant with temperature – The Vant-Hoff's equation.

Extra reading/Keywords: *Concept of fugacity and its relationship to chemical potential*

UNIT 3- S – BLOCK ELEMENTS

18Hrs

- 3.1 General characteristics of s-block elements with respect to atomic and ionic radii, ionization energy, reducing properties, the electro positive character, hydration of ions, oxidation potentials, flame colouration, lattice energy and chemical properties.
- 3.2 Trends in physical and chemical properties of compounds of s-block elements: Comparison of Li with other elements of group I. Comparison of Be with other elements of group II. Diagonal relationship between Li and Mg, Al and Be. Biological functions of Na, K, Ca and Mg ions.
- 3.3 Compounds of s block elements: LiAlH_4 , NaNH_2 , NaCN , Beryllium acetate, CaC_2 , CaCN_2 , Plaster of Paris, Epsom Salt - Preparation, properties and uses.

Extra reading/Keywords: *Isotopes of Hydrogen, Metallic Hydrides*

UNIT 4- P- BLOCK ELEMENTS

18Hrs

- 4.1 General characteristics of p-block elements: Characteristics of p-block elements- atomic radii, ionization potential, electronegativity, electron affinity, metallic and non-metallic properties, oxidation states, inert pair effect, allotropy, catenation, flame colouration.
- 4.2 Boron compounds: Diborane – structure. Borax and borazole – preparation, properties and structure. Comparison of borazole with benzene.
Carbon - Anomalous behavior of carbon, structure of graphite and diamond.
Nitrogen – Liquid NH_3 as non-aqueous solvent.
- 4.3 Oxygen compounds – Anomalous behaviour of oxygen, Classification of oxides based on their chemical behaviour – acidic oxides, basic oxides, amphoteric oxides and neutral oxides – examples.
- 4.4 Halogens: Unique character of fluorine, Pseudo halogens - Properties. Positive nature of

iodine. Chloro fluoro carbons – applications and hazards. Biological functions and toxicity of iodine.

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

UNIT 5- AROMATIC HYDROCARBONS

18Hrs

- 5.1 Aromatic hydrocarbons: Nomenclature. Structure of benzene. Stability of benzene ring. Molecular orbital picture of benzene. Aromaticity- Huckel's rule and its applications.
- 5.2 Effect of substituent groups - Activating and deactivating groups, directive influence, orientation. Hammett equation - Substituent effect.
- 5.3 Reactions of benzene ring. Electrophilic substitution reaction in aromatic compounds-general mechanism, mechanism for nitration, sulphonation, halogenations and Friedel Craft's reactions. Nucleophilic substitution reactions in benzene ring- Benzyne mechanism.
- 5.4 Aromatic poly nuclear hydrocarbons – Naphthalene, Anthracene and Phenanthrene– synthesis, properties and uses.

Extra reading/Keywords: *Aromaticity in annulenes*

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

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Calculates the work function and free energy.	PSO 1	Ap
CO-2	Derives Maxwell's relations.	PSO 2	U
CO-3	Describes Nernst heat theorem.	PSO 2	U
CO-4	Compares the periodic properties of alkali and alkaline earth metals.	PSO 3	R,U
CO-5	Explains the anomalous behavior of fluorine and oxygen	PSO 3	U
CO-6	Predicts aromaticity using Huckel's rule.	PSO 3	An
CO-7	Summarizes the mechanism of aromatic electrophilic substitution reaction.	PSO 4	U
CO-8	Predicts the oxidation and reduction product of aromatic poly nuclear hydrocarbons.	PSO 5	U, Ap

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

TEXT BOOKS

1. Bahl B.S., Arun Bahl and Tuli, *Essentials of Physical Chemistry*, New Delhi, Sultan chand and sons, 2007.
2. Bahl B.S., Arun Bahl, *A Text Book of Organic Chemistry*, New Delhi, Sultan Chand & sons, 2010.
3. Puri B.R. and Sharma L.R., '*Principles of Inorganic Chemistry*', New Delhi, Sultan Chand, 1989.

BOOKS FOR REFERENCE

1. Puri B.R., Sharma. L.R. and Madan S. Pathania, '*Principles of Physical Chemistry*', 35th edition, New Delhi, Shoban Lal Nagin Chand and Co., 2011.
2. Jain M.K. '*Organic Chemistry*, 12th Edition, New Delhi, Shoban Lal Nagin (35th Edition), New Delhi, Shoban Lal Nagin Chand and Co., 2003.
3. Lee, J.D. *A New Concise Inorganic Chemistry* (4th Ed.). London:ELBS, 1995.
4. Samuel Glasstone, *Thermodynamics for Chemists* (3rd printing). East-West Edn., 1974.
5. Clayden, Warrenn, Wothers, '*Organic chemistry*', 2nd Edition, Oxford University Press, 2012.
6. John Mc Murray, '*Organic chemistry*', 8th Edition, Internation Edition, 2012.
7. Paula Yurkanis Bruice,. '*Organic chemistry*', 8th Edition, Pearson Education Ltd., 2016.
8. Robert Thornton Morrison, Robert Neilson Boyd , Saibal Kanti Bhattacharjee, *Organic Chemistry*, 7th Edition, Pearson Education India, Chennai, 2011.
9. Soni P.L. and Chawla H.M., "*Text Book of organic Chemistry*", 27th Edition, Sultan Chand and Sons, 1997.

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

Course Title	MAINCORE – 5: VOLUMETRIC ANALYSIS – Theory Cum Lab -I
Total Hours	60
Hours/Week	4 Hrs /Wk
Code	U15CH3MCP05
Course Type	Theory Cum Lab
Credits	3
Marks	100

General Objective:

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

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understands the terminologies and principle involved in volumetric analysis
CO-2	Define a primary standard ,standard solution and determine the equivalence point
CO-3	determine the concentration of solution in various units and prepare standard solution and dilute solution
CO-4	determine the strength of the given solution from different types of titrations like acid base, redox,and precipitation
CO-5	Solve volumetric problems using formula method

UNIT: I - VOLUMETRIC ANALYSIS

12Hrs

- 1.5 Terminology, Basic requirement of a titration, standard solution – primary standard, preservation of standard solution, expressing concentration of standard solution, simple correlation for quick and convenient volumetric calculation, p-functions.
- 1.6 Volumetric Titrations: Acid base titration – acid base titration and use of indicators, titration of a strong acid against a strong base, titration of a weak acid with a strong base, titration of a weak base with strong acid, titration of Na_2CO_3 with HCl, the theory of acid base indicators, action of phenolphthalein and methyl orange.

- 1.7 Redox titration – theory – titration of Mohr salt against KMnO_4 , oxalic acid against KMnO_4 , FeSO_4 against $\text{K}_2\text{Cr}_2\text{O}_7$, internal indicator, external indicator, starch, iodimetry and iodometry. Precipitation titrations – conditions for precipitation titration and indicators.
- 1.8 Complexometric titration:-EDTA titrations, indicators of EDTA titrations, complexometric titration curves, EDTA – titration methods – masking of ions, precautions to avoid errors in titrimetric analysis, corrections for unavoidable errors.

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

VOLUMETRIC ANALYSIS:

1. Acidimetry
Estimation of Oxalic acid.
2. Permanganometry:
 - i. Estimation of FeSO_4 .
 - ii. Estimation of Calcium. (Direct Method).
3. Iodimetry & Iodometry:
 - i. Estimation of copper.
 - ii. Estimation of Arsenious oxide.
4. Dichrometry:
Estimation of Ferrous ion.
5. EDTA Titrations:
 - i. Estimation of Magnesium.
 - ii. Estimation of Zinc.

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

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understands the procedures in order to define the common methods of analysis..	PSO 2	U
CO-2	Uses correct titrimetric procedure when carrying out titrations	PSO 5	An
CO-3	Prepares the standard solution of different strength.	PSO 5	U
CO-4	Explains the acid base, redox and complexometric titrations with examples.	PSO 6	An
CO-5	Applies knowledge of concentrations of solutions to everyday examples and estimate the strength of the given unknown solution	PSO 6	Ap

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

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.

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

Course Title	ALLIED – 4: Allied Chemistry Paper I (For Physics Main)
Total Hours	60
Hours/Week	4 Hrs /Wk
Code	U15CH3AOT01
Course Type	Theory
Credits	4
Marks	100

General Objective:

To make the students to understand the basic concepts in organic reactions, quantum numbers, chemical bonding, electrical and magnetic properties, solutions, colligative properties and phase equilibria.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	illustrate the types of organic reactions and the influence of field effects
CO-2	recognizes the concept of grouping elements based on their properties in periodic table
CO-3	understand the basic concepts of ionic and covalent bonding
CO-4	identify polar and non-polar molecules and to draw the molecular structure of some molecules and understand the concept of magnetic properties
CO-5	differentiate ideal and non-ideal solutions and to draw the phase diagram of water and lead-silver system

UNIT1 - FUNDAMENTAL CONCEPTS

12 Hrs

- 1.1 Types of organic reactions and reagents, common electrophiles, nucleophiles and free radicals.
- 1.2 Inductive, resonance, hyperconjugation and steric effects – an elementary idea.
- 1.3 Aromatic compounds - Benzene, phenol, benzaldehyde and acetophenone –preparation, properties and uses.

Extra reading/keywords : *Carbenes and Nitrenes*

UNIT 2 -QUANTUM NUMBERS AND PERIODIC TABLE

12 Hrs

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

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

UNIT3 -CHEMICAL BONDING

12 Hrs

- 3.1 Ionic bond – definition, Factors influencing formation of ionic bonding, variable electrovalency, properties of ionic compounds. Covalent bond - orbital overlap concept of molecules like H₂, F₂, O₂ and HF, Variable covalency, properties of covalent compounds.
- 3.2 Polarity in covalent bonds, Fajan's rules. Polarisation of molecules, Effects of polarization, percent ionic character.

Extra reading/keywords : *Problems in dipole moment and planar pentacoordinate carbons*

UNIT 4 -ELECTRICAL AND MAGNETIC PROPERTIES OF MOLECULES

12 Hrs

- 4.1 Dipole moment – Polar and nonpolar molecules, Induced dipole moment – polarisability, polarization of molecule in an electric field. Mosotti – Clausius equation and Debye equation (derivation not required).
- 4.2 Dipole moment and molecular structure - CO₂, BCl₃, NH₃, CCl₄, and H₂O.
- 4.3 Magnetic properties – Magnetic permeability, magnetic susceptibility and magnetic moment. Diamagnetism, paramagnetism and ferro magnetism.

Extra reading/keywords : *Magnetic hypothermia and ferrimagnetism*

UNIT5 - SOLUTIONS AND PHASE EQUILIBRIA

12 Hrs

- 5.1 Solutions of liquids in liquids – ideal and non-ideal solutions – Raoult's law – criteria for ideal solutions, non-ideal solutions – Type I, Type II and Type III.
- 5.2 Colligative properties – Lowering of vapour pressure by a non-volatile solute, Measurement of vapour pressure lowering by Ostwald-Walker method, Osmosis and osmotic pressure – Measurement of osmotic pressure by Berkeley – Hartley method, Isotonic solutions, Reverse osmosis.

- 5.3 Phase Equilibria:- Phase, component, degree of freedom, Phase rule (derivation not required). One component system – water system. Two component system – simple eutectic system (Pb-Ag system).

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

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

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identifies the type of organic reaction and field effect in the given examples	PSO 1	U
CO-2	Predict the periodic trends along the group and the period	PSO 2	Ap
CO-3	Examines the polarity of the molecules using Fajan's rule	PSO 3	An
CO-4	Distinguishes the types of magnetism	PSO 3	U
CO-5	Recalls the different colligative properties of solutions	PSO 4	U

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

TEXT BOOKS

1. Puri B.R. Sharma L.R. and Kalia K.C., *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 1997.
2. Puri B.R. Sharma L.R and Madan S. Pathania, *Principles of Physical Chemistry*. New Delhi: 35th edition, Shoban Lal Nagin Chand and Co., 1994.
3. Vasudevan, A.N.S. *Ancillary Chemistry*, Part I and Part II. 1981.

BOOKS FOR REFERENCE

1. Huheey, J.E., Ellen. A. Keiter and Richard L. Keiter. *Inorganic Chemistry*. London: 4th edn., Addison & Wesley, 2003.
2. Lee, J.D. *A New Concise Inorganic Chemistry*. London: 4th edn., ELBS, 1995.
3. Veeraiyan, V. *Text Book of Allied Chemistry*, Volume I and Volume II. 1997.
4. Parmer V.S. and Chawla B.M. *Principles of reaction mechanism in Organic Chemistry*. New Delhi: 2nd edn., Sultan Chand., 1973.

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

Course Title	SBE-3 & 4 : Experimental Chemistry for life science [Botany & Zoology]
Total Hours	30
Hours/Week	2 Hrs Wk
Code	U15CH3SBT03/ U15CH5SBT04
Course Type	Theory
Credits	2
Marks	100

General Objective:

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(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	deliver the concepts of primary and secondary metabolites and outline the phytochemical analysis and separation of aminoacids by paper chromatography.
CO-2	elaborate the principle and procedures for the determination of physical parameters.
CO-3	Explain the water quality parameters
CO-4	Determine the physical constants for the given compound, conductance and pH.
CO-5	Determine the quality of the given water sample by testing its salinity, conductivity, turbidity and pH.

UNIT1- PHYTOCONSTITUENTS

5 Hrs

- 1.1 Primary metabolites- Definition and examples. Secondary metabolites- sources and effects. Differences between primary and secondary metabolites.
- 1.2 Preliminary phytochemical Analysis. Extraction of phyto constituents from plants by soxhlation method.
- 1.3 Chromatography – Principle, separation of amino acids by paper chromatography.

Extra reading/keywords : *Soxhlet apparatus*

UNIT 2- DETERMINATION OF PHYSICAL PARAMETERS

5 Hrs

- 2.1. Purity of organic compounds- melting and boiling point determination- principle and Procedures.
- 2.2 Water quality parameters- Turbidity, pH, Temperature, electrical conductivity, salinity,

dissolved oxygen, nitrate and phosphate. Testing water quality parameters- water sampling, and testing procedures- Physical tests and chemical tests.

2.3 Buffer- definition, pH and buffer, Types of buffer, preparation of buffer solution, buffer action, determination of pH and Hendersen equation.

Extra reading/keywords : *Hardness of water*

PRACTICAL:

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

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

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identifies the phytconstituents present in plant extracts.	PSO4	U
CO-2	Separates any given amino acids using paper chromatography.	PSO5	Ap
CO-3	Determines the melting and boiling points of the given organic compounds.	PSO5	Ap
CO-4	Predicts the nature of the samples based on pH measurements.	PSO4	An
CO-5	Differentiates the different qualities of any given water sample	PSO6	An

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

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.

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

Course Title	MAJOR CORE - 6 : GENERAL CHEMISTRY – IV
Total Hours	75
Hours/Week	65Hrs /Wk
Code	U15CH4MCT06
Course Type	Theory
Credits	5
Marks	100

General objective:

To study the general characteristics of d- block elements and their compounds, Halogen compounds, carbonyl compounds, mechanisms of SN_i , SN_1 and SN_2 reactions and the kinetics of the reaction rate

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Analyze the characteristics of d-block elements and outline the industrially important compounds of d-block elements.
CO-2	Deliver the main ideas regarding the general methods of formation, properties of aliphatic, aromatic halides, organ metallic compounds, formulate and explain the mechanisms of SN_1 , SN_2 and SN_i reactions.
CO-3	Measure the reaction rates and determine the rate laws
CO-4	Discuss the theories of reaction rates, catalysis and to understand the basic concepts involved in photochemistry.
CO-5	Discuss the mechanism of various reactions of carbonyl compounds.

UNIT 1 - d-BLOCK ELEMENTS

15Hrs

- 1.1 General characteristics of d-block elements – electronic configuration, comparative study of elements of first transition series with reference to atomic and ionic radii, ionization potential, oxidation states, redox active metals, magnetic properties, complex formation, catalytic activities and colour.
- 1.2 Biological function and toxicity of elements – Cr, Mn, Co, Ni, Cu, Mo, Cd, Hg, Pb, Fe and Zn.
- 1.3 Prussian blue – preparation, uses and structure. Verdigris – preparation and uses. Oxidizing properties of $K_2Cr_2O_7$ and $KMnO_4$. TiO_2 , V_2O_5 , Sodium nitro prusside – preparation, properties and uses.
- 1.4 Ammonium molybdate, amalgams, philosopher's wool (ZnO), colloidal Au, Tungsten carbides, Silver chloride – Properties and uses.

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

UNIT 2-HALOGEN COMPOUNDS

15Hrs

- 2.1 Alkyl halides – Nomenclature, structure, General methods of formation and General chemical properties. DDT –structure and uses.
- 2.2 Aliphatic Nucleophilic substitution reactions – Mechanism of SN_1 , SN_2 and SN_i reactions. Effect of solvents, leaving groups, Nucleophiles and structure of substrates. Ambient nucleophiles and regioselectivity, ambient substrates – examples.
- 2.3 Aromatic Halogen Compounds – General methods of preparation and properties. Low reactivity of aryl halides. Chemical properties of Aralkyl halides.
- 2.4 Organo metallic compounds: Grignard reagents – Synthetic applications. Haloalkenes (allyl chloride and vinyl chloride) – nucleophilic substitution at allylic carbon and vinylic Carbon.

Extra reading/Keywords:*Aromatic nucleophilic substitution reaction*

UNIT 3 - CHEMICAL KINETICS I

15Hrs

- 3.1 Rate of reaction, its determination, rate equation, rate constant, factors influencing rate of reaction, stoichiometry, order and molecularity of reactions.
- 3.2 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.
- 3.3 Experimental techniques involved in following the kinetics of reactions – volumetry, manometry, dilatometry, polarimetry and colorimetry – typical examples for each of the techniques.
- 3.4 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 4-CHEMICAL KINETICS II AND PHOTOCHEMISTRY

15Hrs

- 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 Lindemann's theory of unimolecular reactions, thermal chain reactions – hydrogen-bromine reaction.
- 4.3 Catalysis – Types of Catalysis- Homogeneous catalysis – the intermediate compound formation theory – Enzyme catalysis – the mechanism of enzyme catalysed reaction, Heterogeneous catalysis – the adsorption theory – active centers, poisoning of catalyst.
- 4.4 Photochemical reactions, Grothuss Draper's law, Stark Einstein's law of photochemical equivalence, quantum yield – definition, classification of photochemical reactions based on quantum yield and determination. Photochemical kinetics of hydrogen – bromine reaction.

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

UNIT 5 -CARBONYL COMPOUNDS

15Hrs

- 5.1 Carbonyl compounds – general properties of aliphatic and aromatic aldehydes and ketones.
- 5.2 Individual members : Formaldehyde, acetone, acetophenone – preparation and properties.
- 5.3 Mechanisms of Aldol, Claisen, Perkin, Knoevenagel, Benzoin condensation, Reformatsky, Wittig, Claisen- Schmidt, Cannizzaro and haloform reactions. Mechanisms of reduction (NaBH_4 , Wolff-Kishner and MPV reduction)
- 1.4 α , β – unsaturated carbonyl compounds – preparation and properties, Mechanism of Michael addition.

Extra reading/Keywords: *Salicylaldehyde, Benzophenone*

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

Course Outcomes (CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Compares the periodic properties of d-block elements.	PSO 1	U
CO-2	Explains the Nucleophilic substitution mechanisms.	PSO 2	U
CO-3	Summarizes the synthetic applications of Organometallic compounds.	PSO 2	U
CO-4	Derives the rate equation of the first, second, third and zero order reactions.	PSO 3	R,U
CO-5	Calculates the activation using Arrhenius equation.	PSO 2	An
CO-6	Elaborates the theories of reaction rates.	PSO 2	U
CO-7	Solves problems in quantum yield.	PSO 3	Ap
CO-8	Derives the mechanism of given naming reactions.	PSO 3	U, Ap

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

TEXT BOOKS

1. Puri B.R., Sharma L.R. and Madan S. pathania, “*Principles of Physical Chemistry*”, Shoban Lal Nagin Chand and Co, 35th edn., 1994.
2. Puri B.R. and Sharma L.R., ‘*Principles of Inorganic Chemistry*’, Shoban Lal Nagin Chand and Co., 2002.
3. M.K. Jain, “*Modern Organic Chemistry*”, 4th Edition, Vishal Publishing Co, Jalendhar

BOOKS FOR REFERENCE

- 1 Gurtu J.N. and Amit Gurtu, '*Chemical Kinetics*', 5th edn., Mittal K.K., 1979.
- 2 Madan R.D., '*Modern Inorganic chemistry*', S. Chand and Company (PVT) limited. 1st edn., 1987.
- 3 Samuel Glasstone, '*Text Book of Physical Chemistry*', 2nd edn., 1974.
- 4 Parmar V.S. and Chawla H.M., "*Principles of reaction mechanism in Organic Chemistry*", 2nd edition, Sultan Chand, 1978.
- 5 Gurdeep Chatwal R, '*Photochemistry*', Good Publishing House.
- 6 Tewari K.S., Vishnoi N.K., Mehrotra S.N., "*A Text Book of Organic Chemistry*", 2nd revised edition, Vikas Publishing House Pvt. Ltd.
- 7 Jagadamba singh and Yadav L.D.S., "*Advanced Organic Chemistry*", 22nd edition, Pragati Prakashan Educational Publishers, 2015.
- 8 Clayden, Warren, Wothers., '*Organic chemistry*', 2nd Edition, Oxford University Press, 2012.
- 9 John Mc Murray, '*Organic chemistry*', 8th Edition, International Edition, 2012.
- 10 Paula Yurkanis Bruice, '*Organic chemistry*', 8th Edition, Pearson Education Ltd.
- 11 Robert Thornton Morrison, Robert Neilson Boyd, Saibal Kanti Bhattacharjee, '*Organic Chemistry*', 7th Edition, Pearson Education India, Chennai, 2011.

(For Candidates admitted from June 2015 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2
PG AND RESEARCH DEPARTMENT OF CHEMISTRY
Second Year – Semester - IV

Course Title	MAJOR ELECTIVE – 1: THEORY CUM LAB – II (LABORATORY TECHNIQUES AND VIRTUAL LAB EXPERIMENTS)
Total Hours	75
Hours/Week	5Hrs /Wk
Code	U17CH4MEP01
Course Type	LCT
Credits	5
Marks	100

General Objective:

To enable the students to learn about adsorption, adulteration, colligative properties of dilute solutions, Nernst distribution law and to develop practical skills.

Course Objectives:

CO No.	Course Objectives
CO-1	compare physical and chemical adsorption and explain the application of adsorption.
CO-2	distinguish different types of adsorption isotherms.
CO-3	detect the food adulterants in different food items.
CO-4	apply distribution law to some chemical concepts.
CO-5	solve the problems under different colligative properties.

1. analyze the applications of adsorption and detection of adulterants in food items.
2. discuss the different Colligative properties and solves the problems.

UNIT 1 - ADSORPTION AND FOOD ADULTERATION

15 Hrs

- 1.1 Adsorption by solids: Adsorption – Types of adsorption – physical adsorption, chemical adsorption. Some important applications of adsorption.
- 1.2 Adsorption isotherms: Langmuir adsorption isotherm, Freundlich adsorption isotherm and Gibbs adsorption isotherm. (Derivations not needed)
- 1.3 Adulteration – definition. Common food adulterants – it's effects. Incidental adulterants. Metallic contamination. Contamination by pest and pesticide residues.
- 1.4 Simple physical tests and chemical tests for detection of food adulterants. Detection of food additives: Detection of saccharin, Dulcin, flavours, lead chromate, water in milk, streptomycin, pesticides.

Extra reading/Keywords: *Techniques to estimate adulterants.*

UNIT 2 – SOLUTIONS II AND DISTRIBUTION LAW

15 Hrs

- 2.1 Lowering of vapour pressure by non-volatile solute, relationship between relative lowering of vapour pressure and mole fraction, experimental determination of molecular weight of non-volatile solute.
- 2.2 Osmosis and osmotic pressure, relationship between osmotic pressure and lowering of vapour pressure of an ideal solution, isotonic solutions, measurement of osmotic pressure, reverse osmosis.
- 2.3 Elevation in boiling point and depression in freezing point by a non volatile solute – thermodynamic derivation and experimental determination.
- 2.4 Abnormal molecular weights – Van't Hoff factor, association and dissociation.
- 2.5 Nernst distribution law & its applications.

Extra reading/Keywords: *Application of Colligative Properties and Distribution Law.*

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

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	compare physical and chemical adsorption and explain the application of adsorption.	PSO 1	U
CO-2	distinguish different types of adsorption isotherms.	PSO 2	U
CO-3	detect the food adulterants in different food items.	PSO 2	An
CO-4	apply distribution law to some chemical concepts.	PSO 3	Ap
CO-5	solve the problems under different colligative properties.	PSO 2	An

Text Books:

1. Puri B.R., Sharma L.R. and Madan S. Pathania, *Principles of Physical Chemistry*, New Delhi: 35th edn. Shobanlal Nagin Chand and Co., 2003.
2. Negi A.S. and Anand S.C., *A Text book of Physical Chemistry*, 3rd Edition, Wiley Eastern Ltd., 1994.
3. Arun Bahl, B.S. Bahl and G.D. Tuli, *Essentials of Physical Chemistry*, New Delhi: S. Chand & company Pvt. Ltd., 2014.

BOOKS FOR REFERENCE:

1. Atkins, P. W. and Paula, J. *Physical Chemistry*, Oxford Publications, 8th edn., 2009.
2. Silbey, R. J. Albert, R. A. and Bawendi, M. G. *Physical Chemistry*, Wiley, 4th edn., 2004.
3. Levine, I. N. *Physical Chemistry*, McGraw-Hill Science/Engineering/Math, 6th edn., 2008.

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

Course Title	ALLIED – 5 : Allied Chemistry Paper II (For Physics Main)
Total Hours	60
Hours/Week	4 Hrs /Wk
Code	U15CH3AOT02
Course Type	Theory
Credits	4
Marks	100

General Objective:

To learn about the basic concepts in solid state, photochemistry, electrochemistry and chemical kinetics.

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 sodium chloride
CO-2	explain the photochemical and photophysical processes and their mechanisms.
CO-3	identify the different terms in electrochemistry and different conductometric titrations.
CO-4	understand the working of galvanic cell and explains the emf series, corrosion and overvoltage.
CO-5	describe the general forms of rate equations and state the Arrhenius equation.

UNIT 1- THE SOLID STATE

12 Hrs

- 1.1 Structure of solids – classification, isotropy and anisotropy, interfacial angle. Symmetry in crystals – cubic system, space lattice and unit cell, law of rational indices, Miller indices.
- 1.2 Packing arrangements in crystals – hexagonal and cubic close packing. Simple, body centered and face centered cubes.
- 1.3 Structure of NaCl - rotating crystal technique.
- 1.4 Defects in solid state, conductors, semi conductors and super conductors.

Extra reading/Keywords : *Structure of zinc oxide and cesium chloride*

UNIT 2- PHOTOCHEMISTRY

12 Hrs

- 2.1 Photochemical reactions – Differences between thermal and photochemical reactions. Stark-Einstein law of photochemical equivalence, Lambert – Beer's law.

- 2.2 Quantum yield – definition, classification of photochemical reactions based on quantum yield, reasons for high and low quantum yield with one example for each.
- 2.3 Photosensitized reactions, photo processes – fluorescence, phosphorescence and chemiluminescence.

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

UNIT 3-ELECTROCHEMISTRY – I

12 Hrs

- 3.1 Electrical conductance, Ohm's law, specific conductance, equivalent conductance, molar conductance. Determination of conductance, variation of equivalent conductance with dilution.
- 3.2 Kohlrausch's law and its application – Calculation of molar conductance at infinite dilution for weak electrolyte. Conductometric titrations - HCl with NaOH, CH₃COOH with NaOH, CH₃COOH with NH₄OH and KCl with AgNO₃.

Extra reading/Keywords : *Conductance determination by experiments*

UNIT 4-ELECTROCHEMISTRY – II

12 Hrs

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

Extra reading/Keywords : *Fuel cells and batteries*

UNIT 5- CHEMICAL KINETICS

12 Hrs

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

Extra reading/Keywords : *Dilatometry and polarimetry*

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

Course Outcomes:

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explains the structure of solids on the basis of packing and discuss crystal defects and their influence on materials properties	PSO 1	R, U
CO-2	Explains theory and practice of common photochemical and photophysical methods	PSO 2	U
CO-3	Explains the different types of conductometric titrations	PSO 2	U
CO-4	Calculates the reduction potential for various metals	PSO 3	Ap
CO-5	Derives the rate equation for first order and second order equations	PSO 4	An

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

TEXT BOOKS

1. Puri B.R. and Sharma L.R., '*Principles of Inorganic Chemistry*', Shoban Lal Nagin Chand and Co., 2002.
2. Vasudevan A.N.S., *Ancillary Chemistry*, Part I and Part II, 1981.
3. Dr. V. Veeraiyan, *Text Book of Allied Chemistry*, Volume I and Volume II, 1997.

BOOKS FOR REFERENCE

1. Cotton F.A. and Wilkinson. G. *Advanced Inorganic Chemistry*, 4thEdn., London: John Wiley and Sons Inc., 1999.
2. Huheey, J.H..*Inorganic Chemistry*, 4th Edn.. London: Pearson Education Pvt., Ltd., 2002.
3. Puri B.R. Sharma L.R and Madan S. Pathania, *Principles of Physical Chemistry*, 35th edition, shoban Lal Nagin Chand and Co., 1994.
4. Soni P.L. and Chawla H.M., '*Text Book of Organic Chemistry*', 27th Edition, Sultan Chand and sons, 1997.

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

Course Title	ALLIED 6: ALLIED CHEMISTRY PRACTICAL PAPER III
Total Hours	60
Hours/Week	4 Hrs /Wk
Code	U15CH4AOP03
Course Type	Practical
Credits	3
Marks	100

General Objective:

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

Course Objective(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the terminologies and principle involved in volumetric analysis
CO-2	Define a primary standard, standard solution and determine the equivalence point
CO-3	determine the concentration of solution in various units and Prepare standard solution and dilute solution
CO-4	determine the strength of the given solution from different types of titrations like acid base, redox, precipitation and complexometric titration
CO-5	Solve volumetric problems using formula method

UNIT1 - VOLUMETRIC ANALYSIS

12Hrs

- 1.1 Terminology, Basic requirement of a titration, standard solution – primary standard, preservation of standard solution, expressing concentration of standard solution, simple correlation for quick and convenient volumetric calculation, p-functions.
- 1.2 Volumetric Titrations: Acid base titration – acid base titration and use of indicators, titration of a strong acid against a strong base, titration of a weak acid with a strong base, titration of a weak base with strong acid, titration of Na_2CO_3 with HCl, the theory of acid base indicators, action of phenolphthalein and methyl orange.

- 1.3 Redox titration – theory – titration of Mohr salt against KMnO_4 , oxalic acid against KMnO_4 , FeSO_4 against $\text{K}_2\text{Cr}_2\text{O}_7$, internal indicator, external indicator, starch, iodimetry and iodometry. Precipitation titrations – conditions for precipitation titration and indicators.
- 1.4 Complexometric titration:-EDTA titrations, indicators of EDTA titrations, complexometric titration curves, EDTA – titration methods – masking of ions, precautions to avoid errors in titrimetric analysis, corrections for unavoidable errors.

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

VOLUMETRIC ANALYSIS:

1. Acidimetry
Estimation of Oxalic acid.
2. Permanganometry:
 - i. Estimation of FeSO_4 .
 - ii. Estimation of Calcium. (Direct Method).
3. Iodimetry&Iodometry:
 - i. Estimation of copper.
 - ii. Estimation of Arsenious oxide.
4. Dichrometry:
Estimation of Ferrous ion.
5. EDTA Titrations:
 - i. Estimation of Magnesium.
 - ii. Estimation of Zinc.

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

Course Outcomes(CO):

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understands the procedures in order to define the common methods of analysis..	PSO 2	U
CO-2	Uses correct titrimetric procedure when carrying out titrations	PSO 5	An
CO-3	Prepares the standard solution of different strength.	PSO 5	U
CO-4	Explains the acid base, redox and complexometric titrations with examples.	PSO 6	An
CO-5	Applies knowledge of concentrations of solutions to everyday examples and estimate the strength of the given unknown solution	PSO 6	Ap

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

TEXT BOOKS

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 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.
3. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.

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

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

General objective:

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

Course Objectives (CO):

The learner will be able to

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

UNIT 1 - CO-ORDINATION CHEMISTRY I

12Hrs

- 1.1 Double salts, co-ordination compounds, co-ordination complexes and complex ions, co-ordination number, classification of ligands, chelates, physical methods in the study of complexes.
- 1.2 Nomenclature of co-ordination compounds, Werner's theory, Effective atomic number (EAN) and 18 electron rule.
- 1.3 Structural isomerism – hydrate isomerism, co-ordination isomerism, linkage isom

erism, coordination position isomerism, ionization isomerism and polymerization isomerism.

- 1.4 Stereoisomerism – Geometrical isomerism and optical isomerism in 4 and 6 co-ordinated complexes.

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

UNIT 2 -CO-ORDINATION CHEMISTRY II

12Hrs

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

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

UNIT 3 -SOLID STATE

12Hrs

- 3.1 Structure of solids – Classification, isotropy and anisotropy, interfacial angle, symmetry in crystals – cubic and hexagonal systems. Space lattice and unit cell, Bravais lattices, designation of planes in crystals – Miller indices. Diffraction of X-rays by crystals – Bragg's equation – derivation, rotating crystal technique.
- 3.2 Types of crystals, close packing of identical solid spheres - interstitial sites, limiting Radius ratios (derivation not needed), radius ratio rule and shapes of ionic crystals. Structures of NaCl, CsCl, ZnS, CaF₂ and Rutile.
- 3.3 Defects in stoichiometric crystals – Schottky and Frenkel defects. Defects in Non-stoichiometric crystals – metal excess and metal deficiency defects. Impurity defects – semi conductors – n-type and p-type semi conductors.

Extra reading/Keywords:*Applications of semiconductors.*

UNIT 4 -NUCLEAR CHEMISTRY

12Hrs

- 4.1 Subatomic particles, nuclear size, nuclear forces – Meson theory of nuclear forces. Magic number, nuclear shell structure - Liquid drop model.
- 4.2 Mass defects in atomic nucleus, nuclear binding energies. Nuclear stability – n/p ratio, the whole number rule and packing fraction. Isotopes, Isobars, Isotones and isomers – definition and examples.

- 4.3 Definition of nuclear transformation, Bohr's theory of nuclear reactions. Classification of nuclear reactions, Q value of nuclear reactions, Nuclear fission - controlled nuclear fission. Nuclear fusion - stellar energy.
- 4.4 Artificial transmutation of elements, induced radioactivity, applications of radioisotopes in medicine, agriculture and industry, carbon dating.

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

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

- 5.1 The porphyrin ring system –Oxygen transport- Hemoglobin and Myoglobin- biological functions only. Cytochrome-C - structure and biological functions. Blue copper proteins, Fe-S protein – Ferridoxin and vitamin B₁₂- biological functions only.
- 5.2 Lanthanide series - Properties of lanthanides – electronic configuration, oxidation states, ionic radii, lanthanide contraction, colour, magnetic properties, basic character, solubility of compounds and chemical reactivity, separation of lanthanides.
- 5.3 Actinide series – electronic configuration, oxidation states, ionic radii, colour and formation of complexes, Transuranic elements. Comparison between actinides and lanthanides.

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

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

Course outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Classifies the various types of isomerism of coordination compounds.	PSO1	R
CO-2	Analyzes the stability of complex based on EAN and 18 electron rule.	PSO4	An
CO-3	Compares the various theories of coordination complexes.	PSO2	U
CO-4	Categorizes the different types of crystals and its defects,	PSO1	U
CO-5	Sketches and explains the packing arrangements of atoms and the structures of few ionic crystals	PSO6	U
CO-6	Classifies the subatomic particles and explain the nuclear shell and liquid drop model.	PSO1	U
CO-7	Evaluates the nuclear stability based of n/p ratio, whole number rule, mass defect and packing fraction	PSO4	E
CO-8	Categorizes the various nuclear reactions and summarize the applications of radio isotopes.	PSO6	U
CO-9	Sketches and explain the biological functions of few bio inorganic compounds.	PSO5	U
CO-10	Summarizes the chemistry of inner transition elements.	PSO4	An

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

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

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B.Sc. CHEMISTRY
Third Year - Semester – V

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

General Objectives:

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

Course Objectives(CO):

The learner will be able to

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

UNIT 1 -ORGANIC ACIDS AND DERIVATIVES

12Hrs

- 1.1 General methods of preparation and properties of aliphatic and aromatic mono carboxylic acids.
 Ionization of carboxylic acids. Acidity constant. Comparison of acid strengths of substituted halo acids and substituted benzoic acids.
- 1.2 Aromatic sulphonic acid – preparation and properties. Aliphatic hydroxy acids – Action of heat on α , β , γ hydroxy acids. Acyl substitution.
- 1.3 Aliphatic dicarboxylic acid – Blanc's rule. Problems related to mono and dicarboxylic acids.
- 1.4 Malonic and aceto acetic ester – characteristics and synthetic uses.

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

UNIT 2- NITRO COMPOUNDS AND AMINES

12Hrs

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

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

UNIT 3- AMINO ACIDS, PROTEINS AND NUCLEIC ACIDS

12Hrs

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

Extra reading/Keywords:*Nuclear bases*

UNIT 4-OXYGEN AND SULPHUR CONTAINING COMPOUNDS

12Hrs

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

Extra reading/Keywords:*Harmful effects of Resorcinol*

UNIT 5-CARBOHYDRATES

12Hrs

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

5.4 Polysaccharides : Starch and cellulose – properties and uses.

Extra reading/Keywords:*Deficiency of Carbohydrates*

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

Course Outcomes(CO)

The learner

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

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

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

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

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

General Objectives:

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

Course Objectives(CO):

The learner will be able to

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

UNIT 1 - ELECTROLYTIC CONDUCTION – I

12 Hrs

- 1.1 Specific conductance, equivalent conductance, relation between specific conductance and equivalent conductance, molar conductance, variation of molar conductance with dilution.
- 1.2 Determination of conductance and cell constant. Ionic mobility and its determination, discharge of ions on electrolysis – Hittorf's theoretical device.
- 1.3 Transport number, determination of transport number – Hittorf's method and moving boundary method, effect of concentration on transport number.

Extra reading/Keywords: *Conductance determination by experiments*

UNIT 2- ELECTROLYTIC CONDUCTION – II

12Hrs

- 2.1 Kohlrausch's law – statement, applications of Kohlrausch's law – calculation of molar conductance at infinite dilution for weak electrolyte and determination of transport number.

- 2.2 Applications of conductance measurements – determination of degree of dissociation of weak electrolyte, ionic product of water, solubility of sparingly soluble salt and conductometric titrations.
- 2.3 An elementary treatment of Debye Huckel theory of strong electrolytes, significance of Debye - Huckel - Onsagar equation. Conductance at high field and high frequencies - Wein & Debye – Falkenhagen effects.

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

UNIT 3- ELECTROCHEMICAL CELLS – I

12 Hrs

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

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

UNIT 4 - ELECTROCHEMICAL CELLS – II

12 Hrs

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

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

UNIT 5- PHASE EQUILIBRIA AND PHASE RULE

12Hrs

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

Extra reading/Keywords: *Three component systems*

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

Course Outcomes(CO):

The learner

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

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

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

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HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002
PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
Third Year – Semester- V

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

General objective:

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

Course Objectives(CO):

The Learner will be able to

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

UNIT 1 - CARBOHYDRATES

15 Hrs

- 1.1 Definition, Biological Significance, Digestion and absorption of carbohydrates, Chemical and Physical changes of glucose after absorption (Preliminary idea).
- 1.2 Intermediary metabolism of carbohydrates – glycogenesis, glycogenolysis, glycolysis, gluconeogenesis.
- 1.3 Regulation of blood sugar – Regulation by liver and regulation by kidney, Glucose Tolerance Tests. Diabetics – types, pathological condition and treatment, glycosuria.

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

UNIT 2 – LIPIDS

15 Hrs

- 2.1 Introduction, Biological significance of fats, classification, Blood lipids.
- 2.2 Oxidation of fatty acids – 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 3 – PROTEINS

15 hrs

- 3.1 Absorption, metabolic pool, general pathway of protein metabolism, nitrogen metabolism. Diseases due to abnormal composition of urine.
- 3.2 Anabolism of protein – protein turnover and Biosynthesis of protein.
- 3.3 Catabolism of proteins – Removal of amino group, Fate of amino group and fate of Carbon 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 4 - ENZYMES AND THYROXINE

15 Hrs

- 4.1 Enzymes – properties, classification, mechanism of enzyme action, Factors influencing enzyme action, enzyme inhibitors, introduction to co-factors.
- 4.2 Digestive enzymes and their action – salivary digestion, gastric digestion, pancreatic and intestinal digestion.
- 4.3 Intestinal fermentation and putrefaction – Action of Bacteria on 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 5 - BLOOD, BILE ACIDS AND PIGMENTS

15 Hrs

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

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

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

Course Outcomes(CO):**The learner**

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

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

An – Analyse

TEXT BOOKS

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

BOOKS FOR REFERENCE

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

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

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

General objective:

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

Course Objectives(CO):

The learner will be able to

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

UNIT I: NUTRIENTS –I

15 Hrs

- 1.1 Protein – functions, sources, deficiency diseases, daily allowances.
- 1.2 Carbohydrates – functions, sources, deficiency diseases, daily allowances.
- 1.3 Fats and oils – functions, sources, deficiency diseases, daily allowances, disorders due to excess of fat.
- 1.4 Minerals – Ca, P, Fe, I, Na – functions, sources, deficiency diseases and disorders of taking excess. Importance of micronutrients.

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

UNIT II: NUTRIENTS –II

15 Hrs

- 2.1 Vitamins – H₂O soluble and fat soluble vitamins – sources, functions, deficiency and disorders of taking excess of vitamins.
- 2.2 H₂O – functions, sources, deficiency diseases.

- 2.3 Fibre – functions, requirements and sources. Effects of deficiency of fibre.
 2.4 Algae and fungi as foods, Toxicants naturally present in foods. Fermented foods and pickles.

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

UNIT III: FOOD PREPARATION

15 Hrs

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

Extra reading/Keywords:*Obesity*

UNIT IV: FOOD PRESERVATION

15 Hrs

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

Extra reading/Keywords:*Organic insecticides*

UNIT V: FOOD ADULTERATION AND TASTE SENSATION

15 Hrs

- 5.1 Food Adulteration – Types, international, Metallic, incidental adulteration and their ill effects.
 5.2 Simple physical and chemical tests for detection of food adulterants, consumer protection.
 5.3 Packaging hazards, Food borne diseases. Control of insects and rodents.
 5.4 Physiological and chemical aspects of taste sensation – mechanism of sensation of taste, factors affecting taste response. Relation between chemical structure and taste.

Extra reading/Keywords:*Adulteration in Maida*

Course Outcomes(CO):

The learner

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

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

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

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HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002
PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
III Year- Semester V/VI

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

General Objective:

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

Course Objectives(CO):

The learner will be able to

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

UNIT 1- DIETETICS AND FOOD NUTRITION

6 Hrs

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

Extra reading/Keywords: *Nutraceuticals*

UNIT 2- MARRIAGE AND FAMILY

6 Hrs

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

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

UNIT 3-FIRE PREVENTION

6 Hrs

Major causes of fire in homes, Fire prevention and fire fighting in homes, Methods of extinguishing fire – starvation, cooling and smothering. Simple extinguishing agents. Chemical fire extinguisher – CO₂ extinguisher.

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

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

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

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

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

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

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

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

Course Outcomes(CO):

The learner

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

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

TEXT BOOKS

1. Swaminathan M., 'Essentials of food and *nutrition*' the Bangalore printing & publishing Co., Ltd. 1985.
2. Sumati Mudambi R. and Rajagopal M.V., *Fundamentals of food and nutrition*, third edition.
3. Thankamma Jacob 'A Text Book of Applied Chemistry' Macmillan India Ltd. 1987.
4. Matin Khan, 'Consumer Behaviour' New age international (p) Ltd., publishing 2008.
5. Raheena Begum, "A Text Book of applied Chemistry' Sterling publishers private Ltd, 1991.

BOOKS FOR REFERENCE

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

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

Course Title	NON MAJOR ELECTIVE – 2: COSMETOLOGY
Total Hours	30
Hours/Week	2Hrs /Wk
Code	U15CH6NMT02
Course Type	Theory
Credits	2
Marks	100

General Objective:

To expose the students to the study of skin, hair, facial, cosmetics and hazards of cosmetics.

Course Objectives(CO):

The learner will be to

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

UNIT 1 -SKIN

6 Hrs

Study of Skin: Types, functions, diet and skin, threats to skin, effects of summer, winter, wind and rain on skin. Common skin disease – acne and warts.

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

UNIT 2-HAIR

6 Hrs

Types of hair, problems of hair – Hair falling, baldness, graying of hair, problems with lice, dandruff, hair care conditioning.

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

UNIT 3 - FACIAL

6Hrs

Manual massage – advantages, disadvantages. Mask treatment – setting and non-setting masks and uses.

Extra reading/Keywords:*Ayurvedic Massage Techniques*

UNIT 4 – COSMETICS

6 Hrs

Face creams, toilet powders – ingredients, preparations. Preparation of facial packs for different types of skin, Dentifrices.

Extra reading/Keywords: *Herbal Facial Packs*

UNIT 5- STEPS IN FACIAL

6 Hrs

Hazards due to cosmetics, skin – cleansing, toning, moisturizing, exfoliation – types, preparation, applications and uses.

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

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

Course Outcomes:

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

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

TEXT BOOKS

1. Thankamma Jacob ‘A Text Book of Applied Chemistry’ Macmillan India Ltd. 1987.

BOOKS FOR REFERENCE

1. ParveshHanda, “ A complete book on Beauty, Body, Make-up and Hairstyles, Goodwill publishing House, New Delhi.
2. ParveshHanda, “ Herbal Beauty Care”, Orient paperbacks, New Delhi 2004

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

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

General objective:

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

Course Objectives(CO):

The learner will be able to

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

UNIT 1-STEREOCHEMISTRY I

15 Hrs

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

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

UNIT 2-STEREOCHEMISTRY II

15 Hrs

- 2.1 Geometrical Isomerism- Nomenclature of geometrical isomers (E and Z, syn and anti system for aldoximes and ketoximes)

- 2.2 Cycloalkanes: Introduction – preparation and reactions, Baeyer’s strain theory and theory of strainless rings, Coulson and Moffit’s concept, orbital picture of angle strain.
- 2.3 Conformational analysis: Introduction of terms – conformers, configuration, dihedral angle, torsional strain. Conformational analyses of ethane and n - butane. Conformation of 1,3-butadiene.
- 2.4 Conformers of cyclohexane – axial and equatorial bonds, ring flipping showing axial and equatorial bonds and their inter-conversions. Conformations of mono substituted cyclohexanes – 1,3-diaxial interaction.

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

UNIT 3- MOLECULAR REARRANGEMENTS

15 Hrs

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

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

UNIT 4- HETEROCYCLIC COMPOUNDS

15 Hrs

- 4.1 Aromatic characteristics of heterocyclic compounds. Importance of Heterocyclic compounds.
- 4.2 Five membered Hetero cyclics- Furan, pyrrole, thiophene- Preparation and properties .
- 4.3 Six membered heterocyclics – pyridine- Preparation and Properties. Comparison of basicity of pyrrole and aniline with pyridine.
- 4.4 Condensed Heterocyclics - Indole, Quinoline, Isoquinoline – properties only. Examples of condensed heterocyclics containing more than one hetero atom.

Extra reading/Keywords: *Nonaromatic Heterocyclics*

UNIT 5- NATURAL PRODUCTS

15 Hrs

- 5.1 Alkaloids: Introduction, General methods of structural elucidation. Structural elucidation of Coniine, Piperine and Nicotine.
- 5.2 Terpenes: Introduction, classification, Isoprene rule. Structural elucidation of Menthol and α – terpineol.
- 5.3 Vitamins: Introduction, classification and structural elucidation of Ascorbic acid and Pyridoxine.

Extra reading/Keywords: *Terpenes are the volatile constituents of palanresins and essential oils*
Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	identify the chirality and configuration in various organic compounds.	PSO-1	U
CO-2	predict the nomenclature of geometrical isomers.	PSO-3	An

CO-3	analysis the conformers of alkanes, cycloalkanes and their stability.	PSO-3	An
CO-4	discuss the mechanisms of various molecular rearrangements.	PSO-1	U
CO-5	list out the preparation and properties of heterocyclic compounds.	PSO-1	U
CO-6	elucidate the structure of terpenes and alkaloids.	PSO-2	U

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

1. Jain M.K. “*Organic Chemistry*”, 12th edition, Shoban Lai Nagin Chand and Co.
2. Jerry March, “*Advanced Organic Chemistry*” Reactions, Mechanisms and Structure”, 4th Edition, John Wiley and Sons(Asia)Pte. Ltd, New delhi, 1997.
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, Dorling Kindersly (India) Pvt.Ltd., 1975.
5. Subhash Chandra Rastogi, Satis Kumar Agarwala, Ashok Kumar Sharma, “*Chemistry of Natural Products*”, Vol I & Vol. II, I Edition 1974-75. Jai Prakash Nath & Co., Leading Educational Publishers.

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PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
Third Year-SEMESTER VI

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

General objective:

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

Course Objectives(CO):

The learner will be able to

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

UNIT 1- ROTATIONAL SPECTROSCOPY

15Hrs

- 1.1 Properties of electromagnetic radiation, electromagnetic spectrum, Molecular energies, interaction of electromagnetic radiation with matter.
- 1.2 Microwave spectroscopy – rotation of molecules, rotational spectra – diatomic molecules.
- 1.3 Rotational spectra of polyatomic molecules – linear molecules, symmetric top molecules. Applications to simple molecules.

Extra reading/Key words: *Microwave assisted synthesis*

UNIT 2 - VIBRATIONAL SPECTROSCOPY

15Hrs

- 2.1 Infra – red spectroscopy – energy of a diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator – fundamental absorption, overtones and hot bands.

- 2.2 The diatomic vibrating rotator, the vibrations of polyatomic molecules – CO₂ and H₂O, combination and difference bands.
- 2.3 Analysis by infrared techniques – finger print region, group frequencies, hydrogen bonding, structure of thio acetic acid.

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

UNIT 3- RAMAN SPECTROSCOPY

15Hrs

- 3.1 Raman spectroscopy – Occurrence of Raman lines, Stokes and anti-Stokes lines, classical theory of Raman effect, Quantum theory of Raman effect.
- 3.2 Pure rotational Raman spectrum of linear molecules, symmetric top molecules, Raman activity of vibrations of CO₂ and water, Rule of mutual exclusion.
- 3.3 Structure determination from Raman and infrared spectroscopy – CO₂, N₂O, H₂O, SO₂, NH₃, NO₃⁻, ClO₃⁻ and ClF₃.

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

UNIT 4 - ELECTRONIC AND MASS SPECTROSCOPY

15Hrs

- 4.1 Electronic spectroscopy of molecules – Electronic spectra of diatomic molecules, Born-Oppenheimer Approximation, Vibrational course structure, Intensity of vibrational electronic spectra - Franck-Condon principle.
- 4.2 Dissociation energy – determination from electronic spectrum, V_{\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 – nitrogen rule – Modes of fragmentation of simple organic compounds - n-butane, 2& 3 pentanone.

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

UNIT 5 - NMR AND ESR SPECTROSCOPY

15Hrs

- 5.1 Nuclear Magnetic Resonance spectroscopy – spin of nucleus – Theory of NMR spectroscopy.
- 5.2 Chemical shift – spin-spin splitting – NMR spectrum of ethanol – Applications to simple organic molecules like simple alkanes, alkenes, alkyl halides, aldehydes, ketones and benzene.
- 5.3 Electron Paramagnetic Resonance spectroscopy – Theory of EPR spectroscopy – presentation of the spectrum – Hyperfine splitting in some simple systems – proton, methyl free radical. General rules governing hyperfine splitting – applications to simple organic radicals like methyl, ethyl, benzene, naphthalene, anthracene and para semibenzoquinone.

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

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

Course Outcomes(CO):**The learner**

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

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

TEXT BOOKS

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.

BOOKS FOR REFERENCE

1. Russell S. Drago, *Physical methods for chemists*, Saunders, 1992.
2. Manas Chanda, *Atomic structure and Chemical Bond Including Molecular Spectroscopy*, Tata McGraw-Hill Publishing Company Ltd, 1972.
3. McHale, J.L “*Molecular spectroscopy*”, Prentice Hall Publishers, 1999.
4. Sindhu, P.S “*Fundamentals of Molecular spectroscopy*” 1st edition, New Age International publishers, 2006.
5. William Kemp “*Organic Spectroscopy*”, 3rd edition, ELBS publishers, 1991.
6. Russell S. Drago, *Physical methods in Inorganic Chemistry*, East West student edition, 1978.
7. Manas Chanda, *Atomic structure and Chemical Bond Including Molecular Spectroscopy*, Tata McGraw-Hill Publishing Company Ltd, 1972.
8. Levine, I.N “*Molecular spectroscopy*”, John Wiley and Sons, 2000.

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PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY

Third Year – Semester- VI

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

General objective:

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

Course Objectives(CO):

The learner will be able to

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

UNIT 1 - LABORATORY, HYGIENE AND SAFETY

15Hrs

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

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

UNIT 2 - DATA ANALYSIS

15Hrs

- 2.1 The mean, The median, significant numbers, confidence limits, data ethics, precision and accuracy, standard deviation.

- 2.2 Errors – Types of errors, correction of determinate errors. Methods for improving accuracy – Rejection of data – Q test. Presentation of tabulated data – Scatter diagram – Method of least squares, S.I. units.

Separation Techniques:

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

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

UNIT 3 - DIPOLE MOMENT AND MAGNETIC PROPERTIES

15Hrs

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

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

UNIT 4 - GRAVIMETRIC ANALYSIS AND THERMO ANALYTICAL METHODS

15Hrs

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

Extra reading/Key words: *Electrogravimetry.*

UNIT 5 - VISIBLE SPECTROPHOTOMETRY AND COLORIMETRY

15Hrs

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

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

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

**Course Outcomes(CO):
The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Categorizes the various chemicals and recognizes the precautions to handle poisonous chemicals and to avoid the accidents.	PSO1	An
CO-2	Summarizes the principles and applications of various chromatographic techniques.	PSO5	A
CO-3	Explains the different types of polarization and differentiate the magnetism.	PSO2	U
CO-4	Evaluates the determination, application of dipole moment and magnetic susceptibility of molecules.	PSO4	E
CO-5	Categorizes the various types of precipitation and analyze the theories of precipitation.	PSO2	An
CO-6	Summarizes the principle, instrumentation and application of thermogravimetric analysis.	PSO4	An
CO-7	Sketches the schematic instrumentation of various photometric methods.	PSO4	An

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

TEXT BOOKS

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

BOOKS FOR REFERENCE

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

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HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002
PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
UG COURSE PATTERN – B.Sc. CHEMISTRY
Third Year – Semester- V&VI

Course Title	MAJOR CORE – 10: PRACTICAL PAPER II/III
Total Hours	
Hours/Week	8 Hrs Wk
Code	U15CH5MCP10/ U15CH6MCP11
Course Type	PRACTICAL PAPER
Credits	5
Marks	100

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Analyse the organic compounds qualitatively and quantitatively.
CO-2	Prepare the derivative of analysed compound
CO-3	Prepare the different organic compounds and check their purity .
CO-4	Identify various types of organic compounds and confirm them by different tests.
CO-5	Understand, apply and analyze the principles of gravimetric analysis

Gravimetric analysis:

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

Organic Preparation:

1. Preparation involving oxidation, hydrolysis, nitration and halogenation (Internal valuation only).
2. Characterization of organic compounds by their functional groups and confirmation by preparation of derivative.

Substances for organic analysis:

Urea, Nitrobenzene, Glucose, Phthalic acid, m-dinitro benzene, aniline, benzoic acid, cinnamaldehyde, resorcinol, acetanilide, benzamide, succinic acid, sucrose, ethyl benzoate, acetophenone, benzaldehyde, phenol, cinnamic acid.

Course Outcomes(CO):**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recalls the procedure to analyse an organic compound	PSO5	Ap
CO-2	Develops the skill to prepare different organic compounds	PSO1	U
CO-3	Applies the techniques of gravimetric analysis to find out the quantity of an ion in a given solution.	PSO4	Ap
CO-4	Purifies the crude sample.	PSO4	An
CO-5	Records and analyse the results of the experiments	PSO5	Ap

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

TEXT BOOKS

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R. *Basic Principles of Practical Chemistry*. New Delhi: 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.
3. Puri B.R. and Sharma L.R. *Principles of Inorganic Chemistry*. New Delhi: Shoban Lal Nagin Chand and Co., 2002.

For Students Admitted in the Academic year 2015 onwards
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UG COURSE PATTERN – B.Sc. CHEMISTRY
Third Year – Semester- V & VI

Course Title	MAJOR CORE – 13: MAIN PRACTICAL III/II
Total Hours	
Hours/Week	8hrs./wk
Code	U15CH5MCP11/ U15CH6MCP10
Course Type	Practical
Credits	5
Marks	100

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Determine the equivalence point of titration using the conductometric and electric potential method
CO-2	Determine the colored compounds in solutions by colorimetrically
CO-3	Measure the pH of various solution using pH meter
CO-4	Determine the rate constant of chemical reaction changes as function of time
CO-5	Understand the interaction of plane polarized light with a solution of chiral substances

Conductivity:

1. Determination of cell constant.
2. Determination of equivalent conductance of a strong electrolyte.
3. Determination of dissociation constant of a weak electrolyte.

Conductometric titrations:

4. Strong acid versus strong base. (HCl Vs NaOH)
5. Weak acid versus strong base. (CH₃COOH Vs NaOH)

Potentiometric Titrations:

6. To find the strength of HCl potentiometrically using quinhydrone electrode.
7. To determine the strength of Ferrous ammonium Sulphate potentiometrically.

Colorimetry:

8. To verify Beer's law for K₂Cr₂O₇ solution using photoelectric colorimeter and determine the unknown concentration.
9. Estimation of Fe (III) as ferric thiocyanate complex.

PH Meter:

10. To determine the strength of the given CH₃COOH by titrating with given NaOH.

Polarimetry:

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

Chemical Kinetics:

12. I order - Acid catalysed hydrolysis of ester.
13. II order - Saponification of ester.

Nernst Distribution law:

14. Determination of partition coefficient of iodine between CCl_4 and H_2O .

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recognises the principles involved in the experiments	PSO5	Ap
CO-2	Calibrates the conductometry and potentiometry	PSO1	U
CO-3	Applies the techniques of conductometry, potentiometry, pH, colorimetry to solve chemical problems	PSO4	Ap
CO-4	Determines the strength of the given unknown solution	PSO4	An
CO-5	Analyses the results of the experiments	PSO5	Ap

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

TEXT BOOKS

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

For Students Admitted in the Academic year 2012 onwards
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PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY

Course Title	Skilled based elective – 4: Forensic Science
Total Hours	30 HRS
Hours/Week	2 hrs./wk
Code	U15CH5SBT04
Course Type	Theory
Credits	2
Marks	100

General Objectives:

To make the students learn about the basics of forensic science, poisons and its treatment, Examination of blood, handwriting, comparison and drugs.

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	understand the history and basics of forensic science and the services provided by the forensic science laboratories
CO-2	understand and identify the different types of poisons and suggests treatments
CO-3	attaches forensic importance to the samples at the site of crime
CO-4	compare the different type of handwritings and signatures and analyse the forgeries involved in the signatures and documents
CO-5	categorizes drugs and briefs their dependence

UNIT 1 - HISTORY OF FORENSIC SCIENCE LABORATORIES

6 hrs

Definition and scope of Forensic Science – History and development of Forensic Science - Basic services provided by Forensic science Laboratories.

Extra Reading / Keywords : *History and origin of Indian Forensic Science Laboratories*

UNIT 2 - POISONS

6 hrs

Poison – classification – General treatments - causes modifying the action of poison - Gastric lavage – uses of antidote –Isolation, purification and identification of organophosphorus, organochlorine, vegetable and metallic poisons from viscera.

Extra Reading / Keywords : *Chemical and gaseous poisons*

UNIT 3 - BLOOD AND DNA TYPING

6 hrs

Nature of blood – Characterization of blood – Forensic importance of Hairs, fibers, Saliva and seminal stains – DNA – DNA typing

Extra Reading / Keywords : *Gene Technology*

UNIT 4 - DOCUMENT EXAMINATION

6hrs

Handwriting comparison – Handwriting characteristic of an individual –signature forgeries - Anonymous letters - Procedure for obtaining suitable standards for comparison –Alteration, Erasures and Obliteration – Decipherment of charred documents – Cryptography.

Extra Reading / Keywords : *Applications of Cryptography in Army*

UNIT 5 - DRUGS

6hrs

Drugs – Drug Dependence – Narcotic drugs – Hallucinogens –Depressants – Stimulants – Anabolic steroids.

Extra Reading / Keywords : *Prepare a list of various drugs with commercial names*

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

Course Outcomes(CO):
The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describes the history and development of forensic science.	PSO1	U
CO-2	Lists the types of poison and their treatment methods.	PSO2	An
CO-3	Explains the forensic importance of hair and fibre.	PSO2	U
CO-4	Recalls the forgeries involved in document examination.	PSO4	Ap
CO-5	Recognises the types and characteristics of drugs	PSO4	An

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

BOOKS FOR REFERENCE

1. Singhal S.K. *Toxicology at a Glance*.
2. Richard Saferstein *Criminalistics an Introduction to Forensic Science*.
3. Majr. Narayanan T.V. (Retd.) *Modern techniques of Bomb detection and Disposal*.
4. Dr. Sharma B.R. *Foot prints Tracks and Trails in Criminal Investigation and Trials*.
5. Kumar K. *Identification of disputed documents, finger prints and ballistics*

(for candidates admitted from 2017 onwards)
HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002
PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
B.Sc. CHEMISTRY
THIRD YEAR - SEMESTER VI

Course Title	SBE – 5 Computer Literacy for Chemistry Students
Total Hours	30
Hours/Week	2
Code	U19CH6SBT05
Course Type	Theory
Credits	2
Marks	100

Course Objectives(CO):

The student will be able to

CO 1	apply the office packages to gain a better understanding of the computer.
CO 2	understand the functions of smart devices and online transactions
CO 3	Analyse the purpose of social networking and cyber security in the e-world
CO 4	Understand the C programming tools used
CO 5	Apply the C language tools to write the programs

Unit I:Office Packages:

(6hrs)

MS- Word :Creation of Documents (letters, Bio- data, etc).Creation of Tables, Formatting Tables (Time table, Calendar,etc).Working with Mail Merge(Circular letters).

MS – Excel: Creation of Worksheet (Mark Sheet, Pay Slip, PF Contribution list, etc). Excel Function (Date, Time, Statistical, Mathematical, Financial Functions). Creating charts (Line, Pie, Bar, etc).

MS- PowerPoint: Creation of Presentations(Duplicate and New slides, Layouts, View, Slide show, etc.). Working with objects (Movie, Sound, Word, Excel, etc.) Working with Transition and Animation effects(Text, Object, Pictures)

Extra Reading/Key words:*Units of Data Storage.*

Unit II: Smart Devices and Online Transactions:

(6hrs)

Smart phone – Types : Tablet PC , Smart TV, Smart Camera, Smart Watch and Smart Oven.Operating system for Smart phones- Apple iOS, Android, Windows 10, Blackberry, Synbian and Bada. Benefits of Smart Phones.

E-Commerce and M-Commerce: Components of E-Commerce- history, types, and benefits of each (B2B, B2C, C2B, C2C). Business to Government E-Commerce.M-Commerce-History, customers point of view and the provider point of view. Applications of M-Commerce- Mobile ticketing, mobile money transfer, mobile banking, mobile marketing and advertising. Payment methods in M-Commerce- Premium rate telephone numbers, Direct mobile dealing , Macro, Micro payment services and mobile wallets.

Extra Reading/Key words: *Google play for Android Phones.*

Unit III: Social Networking and Cyber Security**(6hrs)**

Social Networking Sites: Characteristics of Social Networking Website- Examples of Social Networking Services (Facebook, SnapChat, Instagram, Whatsapp, Pinterest, Tumblr, LinkedIn, Twitter, Quora and Patreon). Advantages and Disadvantages of Social Network.

Cyber law: Evolution and Historical events in cyber law. Case studies- Article taken from Media. Building blocks of cyber law(Netizens, Cyber space and Technology). Cyber Crime, Electronic and Digital devices, Intellectual Property, Data Protection and Privacy. Merits and Demerits of Cyber crime.
Extra Reading/Key words: *How to stay out of trouble from Social Network.*

Unit IV: Fundamentals of C**(6hrs)**

C programming: Introduction – character set – keywords – constants – operators, input and output in C – control statements – functions of C.

Chemsketch: Introduction – modes of applications – templates – drawing structures of simple molecules – 3D viewer – IUPAC naming and calculated properties.

Extra Reading/Key words: *How to draw the structures of organic compounds*

Unit V: C programming in Chemistry**(6hrs)**

C programming in Chemistry: Basic structure of C programming – conversion of temperature from Kelvin to Celsius – calculation of pH of a buffer solutions using Henderson equation – calculation of Molarity, molality – calculation of electronegativity of an element – calculation of empirical formula of a hydrocarbon – calculation of RMS and Average velocities.

Extra Reading/Key words: *How to write simple programs to solve problems in chemistry*

Course Outcomes(CO):**The learner**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Gains knowledge to work in MS office	PSO2	R
CO-2	Describes the importance of smart devices and online transactions	PSO1	Ap
CO-3	Analyses the merits and demerits of social networking.	PSO1	U
CO-4	Explains fundamentals of C	PSO6	An
CO-5	Applies C programming to solve chemistry problems	PSO3	An
CO-6	Gains computer skills to overcome day to day needs.	PSO3	Ap

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

BOOKS FOR REFERENCE

1. Mastering Ms-Office by Bittu Kumar
2. https://www.webopedia.com/DidYouKnow/Hardware_Software/mobile-operating-systems-mobile-os-explained.html
3. <https://makeawebsitehub.com/social-media-sites/>
4. https://www.tutorialspoint.com/information_security_cyber_law/information_security_cyber_law_tutorial.pdf
5. https://www.tutorialspoint.com/information_security_cyber_law/information_security_cyber_law_tutorial.pdf
6. <https://www.irjet.net/archives/V4/i6/IRJET-V4I6303.pdf>
7. K.V. Raman, "Computers in Chemistry", Tata McGraw Hill Education Private Limited, 2004
8. <http://www.acdlabs.com/download/chemsketch/download.html>
9. <http://www.acdlabs.com/chemsketch/>



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 <i>Upon completion of the M.Sc. Degree Programme, the graduate will be able to</i>
PO-1	acquire knowledge and understanding of essential facts, concepts, principles and theories of Chemistry.
PO-2	develop Skills to evaluate, analyze and interpret the chemical information and data
PO-3	solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem
PO-4	use standard laboratory equipments, modern instrumentation and classical techniques to carry out experiments and develop skills to interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory
PO-5	think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solution to the problems
PO-6	collaborate effectively as part of a team to solve problems, and interact productively with a diverse group of team members

PSO No.	<i>Upon completion of these courses the student would</i>
PSO-1	acquire the basic principles of research and apply in chemical reactions
PSO-2	obtain knowledge about recent analytical and scientific advancements
PSO-3	envisage the structure of new novel Chemical compounds
PSO-4	investigate and interpret the mechanism for unknown chemical reactions using spectroscopic principles
PSO-5	explore the various teaching methodologies which enhance outcome based learning
PSO-6	contribute to the generation of new scientific insights or to the innovation of new applications of chemical research

For Students admitted from June 2016 onwards
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
CHOICE BASED CREDIT SYSTEM
M.SC. CHEMISTRY COURSE PATTERN

SEMESTER	COURSE	TITLE OF THE COURSE	CODE	HOURS WK.	CREDITS	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	P16CH2MCT06	6	5	100
	VII	Major Core 7 Organic Chemistry – II	P16CH2MCT07	5	5	100
	VIII	Major Core 8 Organic Chemistry Practical I	P16CH2MCP08	6	5	100
	IX	Major Core 9 Organic Chemistry Practical II	P16CH2MCP09	6	5	100
		Non- Major Elective 1 Food Science	P16CH2NMT01	5	3	100
		Value Education		1		
		Library		1		
		Total		30	23	500

SEMESTER	COURSE	TITLE OF THE COURSE	CODE	HOURS WK.	CREDITS	TOTAL
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						MARKS
III	X	Major Core10 Inorganic Chemistry – II	P16CH3MCT10	4	4	100
	XI	Major Core 11 Physical Chemistry – III	P16CH3MCT11	4	4	100
	XII	Major Core 12 Physical Chemistry Practical – I	P16CH3MCP12	6	3	100
	XIII	Major Core 13 Physical Chemistry Practical II	P16CH3MCP13	6	3	100
		Major Elective 1 Organic Chemistry	P16CH3MET01	5	5	100
		Non-Major Elective 2 Chemistry In Every Day Life	P16CH3NMT02	5	3	100
		Total		30	22	600
IV	XIV	Major Core14 Inorganic Chemistry- III	P16CH4MCT14	6	6	100
		Major Elective 2 Physical Chemistry	P16CH4MET02	6	6	100
		Major Elective 3 Green And Nano Chemistry	P16CH4MET03	6	6	100
		Self Study Paper- Applied Chemistry	P17CH4SST01	-	2	100
		Project Work	P16CH4DIS01	10	5	100
		Library		2	-	
		Total		30	23	400
		Grand Total		120	92	2000

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

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

GENERAL OBJECTIVES:

To learn quantum mechanics and group theory. To understand the theory of IR, Raman, Electronic, Photoelectron, NMR and ESR spectroscopies

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	understand the elementary principles, postulates of quantum mechanics and perform quantum mechanics common problems such as particles in 1D and 3D bo
CO-2	understand necessary mathematical basics needed for group theory and apply it for HMO calculations, derive hybridization schemes and explain the vibrational, raman and electronic spectra of different compounds based on it.
CO-3	understand and analyse the spectroscopic techniques of IR and Raman
CO-4	explain electronic spectra of diatomics, photoelectron spectroscopy and its application in the study of complexes
CO-5	understand the basic principle of NMR and ESR and infer structural information from it

UNIT: I

18Hrs

Quantum Mechanics

- 1.1 Fundamental principles of quantum mechanics – wave particle duality of particles, deBroglie hypothesis, Uncertainty principle . The Schrodinger equation for particle wave – the wave function and its physical significance , conditions for acceptable wave functions, normalization of wave function and orthogonality – ortho normal set.
- 1.2 Basic postulates of quantum mechanics – Eigen values, Eigen functions, Hermitian operator, Linear momentum operator, Hamiltonian operator and Angular momentum operator, commutation of operators, expectation values (postulates) and Stationary state.

- 1.3 Applications to simple systems – particle in a box ,one dimensional box , normalization of the wave function , orthogonality of the wave function, forms of wave function, one dimensional box with origin at the centre , utility of the particle in a box model.Three dimensional box, cubical box , distortion of the cubical box and lifting of degeneracy.

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

UNIT: II

18Hrs

Group Theory

- 2.1 Properties of a group – sub groups and classes, symmetry elements and operations, product of symmetry operations, point groups , some properties of matrices and vectors and representation of group. Great orthogonality theorem and its consequences – Character table, Reducible and irreducible representations.
- 2.2 Direct products and Correlation tables, Application of group theory to IR (non linear molecules), Raman and electronic spectra, Projection operators ,SALC Procedure – Variation theorem – Variation method.
- 2.3 Huckel MO calculations – Huckel MO method , Bond order and charge density , Evaluation of Energies and MO's for systems like ethylene, butadiene and planar monocyclic aromatic compounds. Hybridisation schemes – central atom in a molecule of definite geometry (non linear molecules).

Extra reading/keywords:*Symmetric properties of extended arrays (crystals)*

UNIT: III

18Hrs

Rotational, Vibrational and Raman Spectroscopy

- 3.1 Rotational Spectroscopy: Basic principles - Classification of Molecules – Rigid and Non- rigid rotator.
- 3.2 Infrared Spectroscopy: Vibrating diatomic molecules – Harmonic and Anharmonic oscillators – Diatomic vibrating rotator – vibration-rotation spectrum of Carbon monoxide. Vibrations of Polyatomic molecules –overtones, combination frequencies and Fermi resonance, influence of rotation on the spectra of polyatomic molecules- Linear molecules, influence of nuclear spin and perpendicular vibrations. Analysis by infrared techniques –skeletal vibrations, group frequencies.
Techniques and instrumentation-outline. Fourier transform spectroscopy.
- 3.3 Raman Spectroscopy - Raman Effect , Quantum and Classical theory of Raman effect ,Pure rotational Raman Spectra , Vibrational Raman Spectra , Polarization of light and the Raman effect – vibrations of spherical Top molecules. Structure determination from Raman and IR spectroscopy. Laser Raman spectroscopy.

Extra reading/keywords:*Vibrational spectra of metal carbonyls, Resonance Raman spectroscopy*

UNIT: IV

18Hrs

Electronic Spectra and Photo Electron Spectroscopy

- 4.1 Electronic spectra of diatomic molecules, Born Oppenheimer approximation, Vibrational coarse structure, Franck Condon principle, Dissociation energy.
- 4.2 Rotational fine structure of electronic vibration transitions. The Fortrat diagram, Predissociation.
- 4.3 Photoelectron Spectroscopy-Introduction, Chemical information from photoelectron spectroscopy. X-ray photoelectron spectra – chemical shifts in XPS and applications of XPS in the study of complexes.

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

UNIT: V**18Hrs****NMR and ESR Spectroscopy**

5.1 NMR Spectroscopy - spin and applied magnetic field, Larmor precession, relaxation processes. Chemical shift, Spin-Spin interaction. FT NMR, Multiple pulse NMR, C¹³ NMR – Chemical exchange.

5.2 ESR Spectroscopy- Basic principles, Presentation of the spectrum, Factors affecting 'g' value, unpaired electron density on an atom in a delocalized system – McConnell relation. Structure and other useful information about simple systems, Zero field splitting, Kramer's degeneracy.

Extra reading/keywords: 2D NMR techniques, NMR of different nuclei (H¹, F¹⁹, P³¹) applications of ESR to biological molecules containing Cu(II) and Fe(III) ions.

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Solve the Schrödinger equation for one and three dimensional box	PSO 1	U
CO-2	Classify the molecules into point groups and apply group theory in studying vibrational spectra of different inorganic compounds	PSO 1	U
CO-3	Construct the hybridization scheme for non linear molecule using group theory	PSO 2	Ana
CO-4	Generate the structure using IR and Raman spectroscopy	PSO 3	App
CO-5	Compare and contrast IR and RAMAN spectroscopy	PSO 3	App
CO-6	Explain the application of XPS in the study of complexes	PSO 4	App
CO-7	Discuss the theory and interpret the structure using C ¹³ NMR spectra	PSO 5	App
CO-8	Explain the ESR spectra of simple systems	PSO 5	Ana
CO-9	Gain knowledge to explain Group theory	PSO 5	App

BOOKS FOR REFERENCE

- Colin Bannwell N and Elaine McCash M (1994), Fundamentals of molecular spectroscopy, 4th edition, McGraw hill Publishing company limited.
- Barrow, G.M. (1992). Introduction to Molecular Spectroscopy (5th Ed.). New Delhi: Mc Graw Hill.
- Levitt, M.H. (2008). Spin Dynamics: Basics of Nuclear Magnetic Resonance (2nd Ed.). Wiley
- Straughan, B.P. & Walker, S. (1976). Spectroscopy, Vol. 1, 2 & 3. London: Chapman & Hall.
- Atkins, P., & Paula, J. (2002). Physical Chemistry (7th Ed.). Oxford University Press.
- Prasad, R.K. (1993). Quantum chemistry. (1st Ed.). New Delhi: Wiley Eastern Limited.
- Raman, K. (1990). Group theory and its application to Chemistry. New Delhi: Tata McGraw -Hill.
- Levine, I.N (2000) "Molecular spectroscopy", John Wiley and Sons.
- McHale, J.L (1999) "Molecular spectroscopy", Prentice Hall Publishers.

(For Students admitted from June 2016 onwards)

HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2

PG & RESEARCH DEPARTMENT OF CHEMISTRY
First Year - Semester – I

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

General Objective:

To enable the students to learn the mechanism of different organic reactions, analyzing the products based on stereochemical approach.

COURSE OBJECTIVES:

The learner will be able to

CO No.	Course Objectives
CO-1	understand the different reactive intermediates of organic reactions and analyze the methods involved in the determination of reaction mechanism.
CO-2	recall and understand the free radical substitution reactions and apply the mechanism for various naming reactions
CO-3	apply the knowledge of reaction mechanism to aliphatic substitution and elimination reactions
CO-4	understand the terms involved in stereochemistry and evaluate the conformational analysis of cyclocompounds
CO-5	understand and apply the concepts of stereochemistry in stereo selective and stereospecific reactions and analyze the asymmetric synthesis using chiral catalyst and reagent

UNIT: I

18 Hrs

Methods of Determining Reaction Mechanism and reactive intermediates

- 1.1 Methods of determining reaction mechanism- identification of products, study of catalysis, spectroscopic studies, isotopic effects. Energy profile diagrams- intermediate vs transition state, cross over experiment, kinetic and thermodynamic control of chemical reactions, Hammond's postulate.
- 1.2 Stereochemical studies, substituent effects- Application of Hammett equation and Taft equation.
- 1.3 **Reactive Intermediates:** Classical and non-classical carbocation, radical cation, radical anion, Carbenes, arynes, nitrenes, and ylides - General methods of generation, detection and reactivity of these intermediates. Singlet oxygen, its generation and reactions with organic substances.

Extra Reading/ Keywords : *Kinetic and non- kinetic reaction mechanism*

UNIT: II**18 Hrs****Free Radical Reactions**

- 2.1 Free Radical Reactions: Free radical substitution reactions- Mechanisms in aliphatic and aromatic substrates
- 2.2 Neighbouring group assistance - Orientation and reactivity, Reactivity of free radicals for aliphatic, aromatic substrates and at bridge head. Effect of solvent on reactivity.
- 2.3 Some selected reaction – Oxidation of aldehydes to carboxylic acids, Auto oxidation and formation of cyclic ethers. Name reactions - Sandmeyer, Gomberg – Beckman, Ullmann, Pschorr and Hunsdiecker reactions, Kolbe, Meerweinylation and Hofmann- Loffier-Fetag.

Extra Reading/ Keywords: Anchimeric Assistance

UNIT: III**18 Hrs****Aliphatic Nucleophilic Substitution and Elimination Reactions**

- 3.1 Aliphatic Nucleophilic Substitution: SN_1 , SN_2 and SN_i mechanism – Stereo chemical factors – Reactivity of substrates structure, attacking nucleophile, leaving group and reaction medium. Neighbouring group participation- substitution at allylic and vinyl carbons, correlation of structure with reactivity.
- 3.2. Aliphatic Electrophilic Substitution: SE_1 , SE_2 mechanism, reactivity in SE reactions. Typical electrophilic substitution reactions -halogenation of carbonyl compounds, Friedel-Crafts acylation at olefinic carbon, Stark- enamine reaction.
- 3.3 Elimination Reactions: E_1 , E_2 and E_1CB mechanism - Stereo chemical factors, Orientation of the double bond, Hoffman and Saytzeff rules. Competition Between elimination and substitution. Typical eliminations reactions - dehydration, dehydrohalogenation and dehalogenation. Mechanism of pyrolytic eliminations–Chugaev and Cope eliminations.

Extra Reading/ Keywords: Aromatic Nucleophilic Substitution Reactions and Aromatic electrophilic Substitution Reactions

UNIT: IV**18 Hrs****Stereochemistry and Conformational Analysis**

- 4.1 Optical activity and chirality- Classification of chiral molecules as asymmetric and dissymmetric. Inter conversion of Sawhorse, Newmann and Fischer projections. D-L, erythro–threo, R-S, E-Z nomenclature. Chirality in molecules with non carbon stereocenters (N, S and P).
- 4.2 A brief study of dissymmetry of allenes, biphenyls, spiro compounds. Methods of determining configuration – Separation of enantiomeric mixtures.
- 4.3 Geometrical isomerism in acyclic, cyclic and bridged systems. Conformational analysis of cyclopentane, cyclohexane, 1,2 – 1,3 and 1,4 disubstitution cyclo hexanes and decalins.

Extra Reading/ Keywords :Stereochemistry of Drugs

UNIT: V**18 Hrs****Prochiral relationships and Asymmetric synthesis**

- 5.1 Prochirality and topicity -enantiotopic and diastereotopic ligands and faces. Basic principles of asymmetric synthesis - stereoselective and stereospecific reactions- methods for determining enantiomeric excess.
- 5.2 Asymmetric synthesis on Chiral substrate :Nucleophilic addition to α - chiral carbonyl compounds; Prediction of Stereochemistry -Cram's rule, Prelog's rule.
- 5.3 Asymmetric synthesis using chiral reagent – BINAL-H, Asymmetric synthesis using chiral auxiliary derived from camphor, Asymmetric synthesis using chiral catalyst – Noyori's BINAP and Jacobson catalyst.

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

COURSE OUTCOMES:**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discuss the stability of reactive intermediates	PSO 1	U
CO-2	Predict the mechanism for free radical substitution reaction	PSO 2	Ana
CO-3	Differentiate the aliphatic nucleophilic substitution and elimination reaction	PSO 3	App
CO-4	Identify the optical activity of organic molecules	PSO 4	App
CO-5	Discuss the asymmetric synthesis using chiral catalysts and chiral reagents	PSO 5	App
CO-6	Obtain knowledge about various chemical reactions and stereochemistry	PSO 5	App

BOOKS FOR REFERENCE

1. March, J. (1999). *Advanced Organic Chemistry*. (4th Ed.). New York: Wiley Eastern Ltd.
2. Mukherji, S.M and Singh. S.P., (1978). *Reaction mechanism in Organic Chemistry*. (3rd Ed.). New Delhi: McMillan.
3. Sykes, P. (1997). *Guide Book to Mechanism in Organic Chemistry*. (6th Ed.). New Delhi: ELBS and Longmann Ltd.
4. Francis A. Carey and Richard J. Sundberg, *Advanced Organic Chemistry: Part-A, Structure and Mechanisms*. (4th Edition), Kluwer Academic Publications, New York.
5. Eliel, E.L. (2004). *Stereo Chemistry of Carbon Compound*. New Delhi: Tata McGraw Hill
6. Patapov, V.M. (1979). *Stereo Chemistry*. Moscow: Mir publishers.
7. Cahn, R.S. and Dermer, O.C. (1979). *Introduction to Chemical Nomenclature*. (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 Age International (P). Ltd

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

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

General Objective:

To learn about covalent bond and ionic bond, structure of cages, clusters and inorganic polymers, acid – base concepts, various concepts behind magnetic properties of lanthanides and actinides

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	analyse the different theories of covalent and ionic bonds.
CO-2	understand the periodicity, halogen and behaviors of noble gases and its bonding
CO-3	understand the chemistry of some solvents and various acid base concepts
CO-4	apply Wades rules and STYX notation to boranes and carbonanes, di and polynuclear clusters
CO-5	understand, analyse and apply magnetic properties & properties of lanthanides and actinides

UNIT : I

18 Hrs

Covalent Bond and Ionic Bond

- 1.1 Introduction – Lewis theory, Sidgwick – Powell theory, VBT- Hybridization – the extent of d – orbital participation in molecular bonding – concepts of resonance and hybridization – application to simple molecules. Lattice energy – Born Lande equation and its derivation – Kapustinskii equation – Born-Haber cycle – applications.
- 1.2 MOT-LCAO method – Geometry of orbitals – Symmetry and overlap, symmetry of molecular orbitals – construction of molecular orbitals in diatomic molecules – Molecular orbital in molecules like CO, NO, HCl & HF – molecular orbital equivalence of hybridization – comparison of VB & MO methods.
- 1.3 VSEPR theory – methane, ethylene, acetylene, ammonia, water, PCl₃F₂ (Bent's rule), SF₄, BrF₃, TeF₅⁻, ICl₂⁻, ICl₄⁻, XeF₂, XeF₄, XeF₆, XeO₃, XeO₄, phosphorus trihalides, bond angle – NH₃ and NF₃, Dipole moments- H₂O, OF₂

Extra reading/keywords: Derivation of Kapustinskii equation

Unit II**18 Hrs****Periodicity, Halogens and Noble Gases**

- 4.1 Periodicity - The use of p -orbitals in π -bonding – $p\pi - p\pi$ bonding in heavier non-metals – the use of d orbitals by non-metals – experimental evidence of $p\pi - d\pi$ bonding.
- 4.2 Comparison of $p\pi$ bonding in phosphine complexes and oxides – experimental evidences for d -orbital contraction and participation
- 4.3 Chemistry of halogens and noble gases - polyhalide ions – oxyacids of heavier halogens – anomalous behaviour of fluorine – bonding in noble gas fluorides and their reactivity

Extra reading/keywords: Application on d & f block elements bonding

UNIT: III**18 Hrs****Acid – Base Concepts and Applications of Redox Potential**

- 3.1 Acid base concepts. Bronsted, Lowry, Lux-Flood, Usanovich, Lewis, solvent system and generalised acid base concepts - Measures of acid - base strength - steric effect and solvation effects
- 3.2 Hard and soft acids and bases (HSAB)- acid base strength and hardness and softness – symbiosis. Types of solvents, Liq. NH_3 , SO_2 , HF and H_2SO_4 as solvents.
- 3.3 Variable valency and Oxidation states - standard electron potential and electrochemical series – relationships of free energy change and equilibrium constants. Oxidation-reduction reactions – Oxidation states of transition metals in aqueous media. Use of reduction potential – Potential diagrams – stabilization of electrode potentials – factors determining the magnitude of reduction potentials.

Extra reading/keywords: Latimer diagram of some redox systems

UNIT: IV**18 Hrs****Cages, clusters and Inorganic polymers**

- 2.1 Structure and bonding in polyhedral boranes and carboranes; STYX notation, Wade's rule-Classification of Closo, Nido, Arachno types, Synthesis and structure of polyhedral boranes.
- 2.2 Dinuclear clusters- Preparation, Structure & Bonding $[\text{Re}_2\text{Cl}_8]^{2-}$, $[\text{MoCl}_8]^{2-}$ Poly nuclear clusters: $[\text{Re}_3\text{X}_{12}]^{3-}$, $[\text{W}_4(\text{OR})_{16}]$, and quintuple bond Cryptands and crown ethers.
- 2.3 Silanes, Silicone halides, Silicates, Silicones, Silenes, germenenes, Stannenes and phosphazenes.

Extra reading/keywords: Reactivity of polyhedral boranes

UNIT: V**18 Hrs****Magnetic properties, Lanthanides and Actinides**

- 5.1 **Magnetic properties:** Paramagnetism – calculation of magnetic moments – spin only value - magnetic susceptibility – spin orbit coupling – variation of magnetic moments with temperature – Curie-Weiss Law – ferromagnetism and antiferromagnetism.
- 5.2 **Lanthanides:** Position in the periodic table - electronic configuration – oxidation states – size relationships – lanthanide contraction, gadolinium break – spectral and magnetic properties – coordination compounds - lanthanide shift reagents in NMR – MRI contrasting agents.
- 5.3 **Actinides:** Electronic configuration - oxidation states of actinides – spectral and magnetic properties – comparative account of lanthanides and actinides

Extra reading/keywords: Special properties of radioactive elements

Course Outcomes:**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Outline the concepts of VBT, MOT and VSEPR theories	PSO 1	R, U
CO-2	Examine the different types of π bonding and its uses in p and d-block elements.	PSO 2	R
CO-3	Explain the various types of acid and bases	PSO 2	U
CO-4	Describe the chemistry of few aqueous and non aqueous solvents	PSO 3	R
CO-5	Summarises the concepts and applications of redox potential	PSO 4	An
CO-6	Sketch the structure and bonding of Dinuclear clusters, polyhedral boranes and carboranes.	PSO 4	U
CO-7	Compare the properties of Lanthanides and Actinides.	PSO 5	R, An
CO-8	Discuss the magnetic properties of inner transition elements.	PSO 5	U
CO-9	Gain knowledge to teach various Concepts of inorganic chemistry	PSO 5	Ap

. BOOKS FOR REFERENCE

1. Huheey, J.E., Ellen. A. Keiter & Richard .L. Keiter. (2003). *Inorganic Chemistry* (4th Ed.). London: Addison & Wesley.
2. Lee, J.D. (1995). *A New Concise Inorganic Chemistry* (4th Ed.). London:ELBS.
3. Miessler Paul .J, Fischer, Donald A. Tarr. *Inorganic Chemistry*, fifth edition
4. Cotton F.A and Wilkinson, G. (1985). *Advanced Inorganic Chemistry* (6th Ed.). New Delhi: East West student.
5. Day, M.C. & Selbin. (1972). *Theoretical Inorganic Chemistry* (3rd Ed.) . London: Butterworth.
6. Friedlander, G. (1990). *Nuclear and Radiochemistry* (3rd Ed.). London: John Wiley & Sons.
7. H. J. Arnikar Essentials of *Nuclear Chemistry*., Second Edition.. Wiley: New York. NY. 1987.
8. Singh, A.& Singh, R. (2006). *Text book of nuclear Chemistry* (1st Ed.). London: Campus Books

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

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

GENERAL OBJECTIVES:

To acquire the practical skills in the qualitative and quantitative analysis of metal ions.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the principle of colorimetric estimation
CO-2	Fine the measurement of change in absorbance of the solution colorimetrically
CO- 3	Identify the common and rare radicals in the given mixture systematically
CO-4	Prepare standard solution and different concentrations from given concentration
CO-5	Calibrate the colorimetric instrument

I COLORIMETRIC ESTIMATION:

1. Estimation of Chromium.
2. Estimation of Copper.
3. Estimation of Nickel.
4. Estimation of Ferric ion.
5. Estimation of Manganese.

II SEMI MICRO QUALITATIVE ANALYSIS:

Mixture analysis of common and rare cations such as lead, copper, bismuth, cadmium, nickel, cobalt calcium, strontium, magnesium, ammonium, molybdenum, selenium, tungsten, zirconium, cerium, vanadium, thorium, lithium.

Course Outcomes:**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Estimate the amount of metal ions present in the given sample photocolometrically	PSO3	Ap
CO-2	Identify the common and rare radicals present in the given inorganic salt mixture	PSO2	U
CO-3	Separate the radicals into groups	PSO1	U
CO-4	Prepare stock solution in ppm units	PSO1	U
CO-5	Draw the standard calibration graph	PSO4	An
CO-5	Acquire skill to analyze the given sample qualitatively and quantitatively.	PSO3	Ap

TEXT BOOKS:

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

BOOKS FOR REFERENCE:

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

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HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
First Year - Semester – I

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

GENERAL OBJECTIVES:

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

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the principle of quantitative analysis.
CO-2	Demonstrate the laboratory techniques applied for gravimetric analysis.
CO- 3	Apply the precipitation and filtration techniques involved in gravimetric estimation.
CO-4	Learn the method of preparation of Inorganic complexes.
CO-5	Understand the chemistry behind the formation of Inorganic complexes.

INORGANIC ESTIMATION:

1. ESTIMATION OF COPPER AND NICKEL
2. ESTIMATION OF COPPER AND ZINC
3. ESTIMATION OF CALCIUM AND MAGNESIUM
4. ESTIMATION OF HARDNESS OF WATER

PREPARATION:

1. PREPARATION OF TRIS THIOUREA COPPER (I) CHLORIDE
2. PREPARATION OF POTASSIUM TRIS OXALATO CHROMATE (III)
3. PREPARATION OF PRUSSIAN BLUE
4. PREPARATION OF TETRAMMINE COPPER (II) SULPHATE
5. PREPARATION OF POTASSIUM TRIS OXALATO ALUMINATE (III)
6. PREPARATION OF TRIS THIOUREA COPPER (II) SULPHATE

7. PREPARATION OF HEXAMINE COBALT (III) CHLORIDE
8. PREPARATION OF CHROME ALUM

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Estimate the amount of ions present in the given solution.	PSO3	Ap
CO-2	Estimate the hardness of water	PSO3	Ap
CO-3	Separate the ions through proper techniques	PSO1	U
CO-4	Prepare the Inorganic complexes	PSO4	Ap
CO-5	Understand the method of preparation of complexes	PSO1	U
CO-6	Gain analytical skill to analyse the sample using quantitative methods.	PSO3	Ap

TEXT BOOKS:

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

BOOKS FOR REFERENCE:

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

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HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
First Year - Semester – II

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

GENERAL OBJECTIVES:

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

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	think critically about, explain, integrate, and apply physical models to describe wave function and energy levels associated with atoms
CO-2	identify the applications of quantum chemistry in explaining MO, VB and HMO theories and construct hybridization schemes
CO-3	calculate partial molar quantities from experimental data, understand thermodynamic properties of real gases and explain the application of phase rule to three component systems
CO-4	recalls the concepts of kinetics and explain the theories of unimolecular and bimolecular reactions
CO-5	appraise the effects of few variable of solution kinetics

UNIT: I

18Hrs

Quantum Chemistry – II

1. Rigid rotator, Harmonic Oscillator – occurrences of rotational and vibrational quantum numbers and selection rule for rotational and vibrational transitions, Bohr's Correspondence principle, Hydrogen atom – Method of solution, Shapes and properties of hydrogenic orbitals, hydrogen like system, Electron spin.
2. Exactly solvable nature of systems – Approximation methods, Many electron atoms wave function, One electron orbitals, Pauli's principle and Slater determinant, Application of Variation method to hydrogen and helium atom, atomic spectra of helium and sodium – Zeeman effect.

3. Perturbation method to non – degenerate systems – Application of perturbation method to helium atom. Hartree – Fock self consistent field methods. Spin orbit interactions – L.S. and J.J. Coupling schemes, Vector model of the atom, term symbols.

Extra reading/keywords: *Application of variation method to lithium*

UNIT: II

18Hrs

Applications of Quantum Chemistry II

- 2.1 The Born – Oppenheimer approximation. MO and VB theories as applied to hydrogen molecular ion (H_2^+) and hydrogen molecule – coulomb integral and exchange integral and an overlap integral. Construction of sp , sp^2 and sp^3 hybrid orbitals.
- 2.2 Huckel molecular orbital theory – principles and applications to ethylene, butadiene and benzene. Huckel calculation of π - electron energies.

Extra reading/keywords: *HMO of allylic system*

UNIT: III

18Hrs

Thermodynamics and Phase equilibria

- 3.1 Thermodynamics of systems of variable composition – partial molar properties, physical significance of partial molar properties, Chemical potential, Relationship between partial molar quantities – Gibbs – Duhem equation, Variation of chemical potential with temperature and pressure – Calculation of partial molar quantities from experimental data.
- 3.2 Thermodynamic properties of real gases – Fugacity concept, Calculation of fugacity of real gas, Activity and activity coefficient concept, Standard states, Experimental determination of activity coefficients of non- electrolytes.
- 3.3 Phase rule to three component systems – systems of three liquids, solids – Liquid systems (Eutectic systems, two salts and water).

Extra reading/keywords: *Phase rule to liquid-liquid system*

UNIT: IV

18Hrs

Chemical Kinetics

- 4.1 Theories of reaction rates –Molecular activation, activated complex, theoretical calculation of activation energy-potential energy surface, Simple collision theory, Absolute Reaction Rate theory (ARRT), comparison of collision and Absolute Reaction Rate theories, physical significance of probability factor, calculation of thermodynamic parameters, Kinetic isotopic effect, theory of termolecular reaction.
- 4.2 Theory of Unimolecular reactions – Lindemann's theory, Hinshelwood theory, Treatment of RRK theory (Kassel, Rice and Ramsperger), the Slater's treatment.
- 4.3 Principle of microscopic reversibility, Chain reactions – Steady state approximation, Thermal reactions between hydrogen and halogens, Gas phase auto oxidations, Explosions – Hydrogen-oxygen reaction.

Extra reading/keywords: *RRKM model and diffusion controlled reactions.*

UNIT: V

18Hrs

Solution Kinetics

- 5.1 Factors determining reaction rates in solution – collisions in solution, Transition state theory, influence of internal pressure and activation.
- 5.2. Reactions between ions- influence of solvent dielectric constant, pre-exponential factor, single –sphere activated complex and influence of ionic strength.
- 5.3 Ion-dipole and dipole-dipole reactions- pre-exponential factors, influence of ionic strength. Influence of external pressure-Van't Hoff equation, Volume of activation.

Extra reading/ keywords: *Substituent and correlation effects*

Course Outcomes:**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identify, describe and explain the quantum mechanical behavior of simple systems, such as the harmonic oscillator and the rigid rotor	PSO 1	U
CO-2	Discuss LS and J.J coupling scheme and derive ground state term symbol for various atoms	PSO 2	U
CO-3	Explain HMO theory and apply it in the calculation of pi – electron energies for simple conjugated systems	PSO 3	App
CO-4	Construct the phase diagram for three component systems	PSO 4	Ana
CO-5	Compare and contrast simple collision theory and ARRT	PSO 1	U
CO-6	Describe the influence of solvent, ionic strength and pressure on the rate of the reaction in solution	PSO 1	U
CO-7	Gain knowledge to teach physical chemistry	PSO 3	App

BOOKS FOR REFERENCE

1. Chandra. A.K., (2004). *Introductory Quantum Chemistry* (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.
5. Rajaram. J.,& Kuriacose. J.C., (1996). *Thermodynamics* . (3rd Ed.). New Delhi: Shoban Lal Nagin Chand and Co.
6. Rastogi, R.P. & Mishra. R.R., (1978). *An Introduction to Chemical Thermodynamics* (3rd Ed.). New Delhi: Vikas Publishing Housing.
7. Samuel Glasstone, (2002). *Thermodynamics for Chemists*, (3rd Ed.). Affiliated East-West press.
8. Atkins, P., & Paula, J. (2002). *Physical Chemistry* (7th Ed.). Oxford University Press

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

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

General Objective:

To enable the students to understand the concepts of aromaticity, substitution reactions, retrosynthesis, rearrangements, redox reactions and the chemistry of heterocyclic compounds, proteins and carbohydrates.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the criteria for aromaticity and differentiate the aromatic electrophilic and nucleophilic substitution reactions.
CO-2	Interpret the reaction mechanism for electrophilic, nucleophilic and free radicals additions to carbon- carbon multiple bonds.
CO-3	Design a detailed mechanism for rearrangement reactions, identify the oxidation and reduction reactions in the organic compounds.
CO-4	Apply the basic principles of retrosynthetic analysis to work out synthetic strategies for organic molecules, discuss the important modern synthetic reactions.
CO-5	Apply the IUPAC nomenclature for naming alicyclic, bicyclic, spiro and heterocyclic compounds and understand the chemistry of carbohydrates and proteins

UNIT 1 – AROMATICITY AND SUBSTITUTION REACTIONS

15 Hrs

1.1 Aromaticity – Concept of Aromaticity, non-aromaticity and antiaromaticity. Huckel's rule and Craig's rule. Effect of aromaticity on bond lengths, resonance Energies and induced ring current. Aromaticity in non-benzenoid compounds – Annulenes, Azulenes, Sydnones and Fullerenes.

- 1.2 Aromatic Nucleophilic substitution - S_NAr, S_{RN}1 and benzyne mechanisms. Reactivity – effect of structure of substrate, leaving group, attacking nucleophile and solvent.
- 1.3 Aromatic Electrophilic Substitution – The Arenium ion mechanism, orientation and reactivity in monosubstituted benzene rings, The effect of the leaving group, Effect of Electrophiles – Hydrogen, Nitrogen, Sulfur and Halogen. Ipso substitution.

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

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

- 2.1 Additions to carbon-carbon multiple bonds- addition reactions involving electrophiles- (Addition of H₂, X₂, HX, H₂O, oxymercuration, epoxidation, ozonolysis), nucleophiles and free radicals. Cyclic mechanism, orientation and stereochemistry.
- 2.2 Addition to conjugated system – orientation and reactivity. Hydration of triple bonds. Addition of alcohols and phenols.
- 2.3 Birch reduction, Michael addition, Diels Alder reaction. Carbenes and their addition to double bonds, addition of O₂ across double bonds. Mannich, Stobbe, Darzen, Thrope, Wittig, Tollen's reactions, Benzoin condensation.

Extra reading/ Key words: Stereo chemistry, Internal and terminal alkynes

UNIT III – REARRANGEMENTS AND REDOX REACTIONS 15 Hrs

- 3.1 Molecular Rearrangements: Mechanism of the following rearrangements – Wagner-Meerwin, Dienone- o Phenol, Demjanov ring expansion, Wolff, Beckmann , Baeyer-Villiger, Dakins, Favorski, Neber , Stevens, Wittig rearrangements. Stereochemical control of reaction products.
- 3.2. Oxidation: alkenes to epoxides (per acids based), Sharpless asymmetric epoxidation, alkenes to diols (Manganese and Osmium based), Sharpless asymmetric dihydroxylation, SeO₂, PCC.
- 3.3 Reduction: Catalytic hydrogenation (Heterogeneous: palladium/Platinum/Rhodium/Nickel etc; Homogeneous: Wilkinson), LiAlH₄, DIBAL.

Extra reading/ Key words: Redox reactions in organometallic compounds

UNIT IV – RETROSYNTHETIC ANALYSIS 15 Hrs

- 4.1 Retrosynthetic Analysis – Basic principles and terminology of retrosynthesis, synthesis of aromatic compounds, one group and two group C-X disconnections (1, 2 difunctionalized disconnections – alcohols and carbonyl compounds) and C-C disconnection of 1, 3 difunctionalized compounds (dicarbonyl and α , β – unsaturated carbonyl compounds).
- 4.2 Protecting groups – Protection and deprotection of alcohols, aldehydes, ketones, phenols, amines in organic synthesis.
- 4.3 Modern Synthetic Methods: Nef reaction, Ritter reaction, Heck reaction, Stille, Suzuki, Negishi and Sonogashira coupling reactions.

Extra reading/ Key words: Disconnection of 1,4 and 1,5 difunctionalized compounds.

UNIT V –HETEROCYCLICS, CARBOHYDRATES AND PROTEINS 15 Hrs

- 5.1 Nomenclature of alicyclic, bicyclic, spirocyclic compounds. Nomenclature of heterocyclic compounds. Chemistry of heterocyclic compounds – pyrimidine, purine, oxazine, imidazole, oxazole and thiazole.
- 5.2 Carbohydrates: disaccharides– Structure and synthesis of disaccharides-maltose, lactose. Polysaccharides-structure and synthesis of starch and cellulose.
- 5.3 Proteins: Synthesis and properties of peptides – primary, secondary and tertiary structure of proteins. Terminal analysis. Nucleic acids: Structure of DNA and RNA and their

importance.Coding and Decoding.

Extra reading/ Key words: Docking of proteins.

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identify the aromaticity in organic compound and discuss the mechanism of substitution reactions in aromatic compounds.	3	Ap
CO-2	Explain the addition mechanism of reagents across carbon-carbon multiple bond.	2	Ap
CO-3	Illustrate the mechanism of the various rearrangement reactions	3	Ap
CO-4	Outline the applications of reducing and oxidizing reagents	1	An
CO-5	Design the target molecule based on retrosynthetic analysis	5	ap
CO-6	Compare ,contrast the structure of nucleic acids and Discuss the structure of proteins and carbohydrates	2	U
CO-7	Gain knowledge to teach important concepts in stereochemistry.	3	App

BOOKS FOR REFERENCE

1. Carey, F.A .and Sundberg R.J.(1990). Advanced Organic Chemistry (Part A& B).New York: springer.
2. Finar, I.L. (1975).Organic ChemistryVolume II. New Delhi: ELBS.
3. Gurdeep , R. Chatwal (2004). Organic Chemistry of Natural Products, Vol.I& II. Meerut: Goel Publications.
4. Warren,S. (1997).Organic Synthesis-The Disconnection Approach. New York: John Wiley & son.
5. Benjamin, W.A. (1972). Modern Synthetic reactions in Organic Chemistry. (2nd Ed.). New York: H.O House.
6. De-Mayo, P. (1963). Molecular Rearrangements. New York: Inter science Publishers.
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.
9. Jonathan Clayden, Nick Greeves,Stuart Warren (2012). Organic Chemistry, (2nd Ed.), Oxford University Press.
10. Agarwal, O.P. (1997). Chemistry of Organic natural products , Vol. I &II.Meerut: Goel Publications.
11. Badger, G. M. (1966). Aromatic Character and Aromaticity. London: Cambridge University Press.

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

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

GENERAL OBJECTIVES:

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

Course Objectives (CO):

CO No.	Course Objectives
CO-1	Identify the separation technique for the given organic mixture through pilot separation
CO-2	Isolate the components present in the given organic mixture
CO-3	Analyze the functional groups present in the components
CO-4	Understand the reactions mechanism of the organic complexes
CO-5	Synthesize and recrystallizes the organic complexes.

I SINGLE STAGE PREPARATION:

1. Microwave assisted synthesis of aspirin.
2. Nitro salicylic acid from salicylic acid (nitration)
3. Phenyl-azo-2-naphthol from aniline (diazotization)
4. Preparation of Benzilic acid from benzyl
5. Preparation of Xanthene compounds
6. Hantz pyridine Synthesis

II ORGANIC MIXTURE ANALYSIS

Course Outcomes:**The learner will be able to**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Diagnose the suitable separation technique	PSO4	An
CO-2	Analyze the given organic mixture	PSO5	An
CO-3	Identify the functional groups and elements present in the organic components	PSO3	U
CO-4	Synthesize the derivatives obtained from the pure organic component	PSO6	C
CO-5	Explain the principles of organic preparation	PSO2	U
CO-6	Acquire analytical skill to analyse the given organic compound qualitatively.	PSO3	Ap

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

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

GENERAL OBJECTIVES:

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

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Prepare the organic compound through double stage
CO-2	Determine the amount of yield obtained
CO-3	Carryout crystallization and recrystallization
CO-4	Detect the melting point of the product obtained
CO-5	Estimate the given organic compound quantitatively

ORGANIC ESTIMATION:

1. Estimation of Glucose (Bertrand's Method)
2. Estimation of Phenol
3. Estimation of Aniline
4. Estimation of Acetone
5. Estimation of Glucose (Lane and Eynon Method)

DOUBLE STAGE PREPARATION:

1. Preparation of Acetylsalicylic Acid From Methylsalicylate (hydrolysis and acetylation)
2. Preparation of p-Bromoaniline From Acetanilide (acetylation and bromination)
3. Preparation of p-Acetanilide From Aniline (nitration and hydrolysis)
4. Preparation of m-Nitroaniline From Nitrobenzene (nitration and reduction)

5. Preparation of p-Nitroaniline From Acetanilide (nitration and hydrolysis)
6. p-bromoaniline from acetanilide (bromination and hydrolysis)

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Characterize the products by physical means including melting point	PSO1	U
CO-2	Perform common laboratory techniques including preparation, crystallization and recrystallization	PSO2	An
CO-3	Critically evaluate data collected to determine the purity and yield of products	PSO2	An
CO-4	Predict the outcome of organic reactions using a basic understanding of the general reactivity	PSO3	An
CO-5	Describe the significance of organic quantitative analysis in organic estimation	PSO1	U
CO-6	Acquire skill to analyse organic compound quantitatively.	PSO3	Ap

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HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
First Year - Semester – III

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

General Objective:

To learn about coordination chemistry, chemistry of organo-metallic compound, the photochemical reactions of transition complexes and to understand the applications of spectroscopic techniques in complexes.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Understand and summarise the stability of complexes. Spectral and magnetic properties of complexes and nature of bonding in terms of VBT and MOT
CO-2	Analyse the electron transfer reactions of complex and macrocyclic ligands
CO-3	Understand the role of metal clusters in catalysis and categories the bonding in organometallic compounds
CO-4	Interpret the various spectroscopic techniques such as electronic absorption, NMR and IR spectroscopy.
CO-5	Apply the laws of photochemistry to transition metal complexes, organometallic compounds containing chromium and ruthenium

UNIT: I

12 Hrs

CO-ORDINATION CHEMISTRY I

- 1.1 Studies of coordination compounds in solution – detection of complex formation in solution - Stability constants, stepwise and over-all formation constants, simple methods (Potentiometric, pH metric and photometric methods) of determining the formation constants. Factors affecting stability, statistical and chelate effects, Forced configurations.

- 1.2 Crystal field theory - splitting of d-orbitals under various geometries, Factors affecting splitting, CFSE and evidences for CFSE (Structural and thermodynamic effects). Spectrochemical series, Jahn-Teller distortion, Spectral and magnetic properties of complexes, site preferences, limitations of CFT.
- 1.3 Ligand field theory, MO theory, sigma and pi-bonding in complexes, Nephelauxetic effect, the angular overlap model.

Extra reading/Keywords: Application of complexes in electroplating, textile, dyeing and medicine

UNIT: II

12 Hrs

CO-ORDINATION CHEMISTRY II

- 2.1 Kinetics and mechanism of reactions in solution – labile and inert complexes. Ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions, trans effect – theory and applications.
- 2.2 Electron transfer reactions – electron exchange reactions, complementary and non-complementary types, inner sphere and outer sphere processes. Application of Electron transfer reactions in inorganic - isomerisation and racemisation reactions of complexes
- 2.3 Molecular rearrangement – Reactions of four and six-coordinate complexes, Interconversion between stereoisomers. Reactions of coordinated ligands – Template effect and its application for the synthesis of Macrocyclic ligands, Unique properties.\

Extra reading/Keywords: Synthesis of new complexes containing macrocyclic ligands

UNIT: III

12 Hrs

CHEMISTRY OF ORGANOMETALLIC COMPOUNDS

- 3.1 Organometallic Compounds of Transition Metals-The 16 and 18 electron rule, Nomenclature of organometallic compounds, sandwich bonded complexes, I-cyclopentadiene metal complexes, bonding in organometallic compounds.
- 3.2 Heterocyclic sandwich complexes – Olefin complexes – preparation, structure and bonding in cyclic unsaturated compounds. Acetylene complexes, allyl metal complexes.
- 3.2 Catalysis by Organometallic Compounds - Catalysis involving organometallic compounds – olefin hydrogenation, the oxo process, polymerization, cyclooligomerisation, olefin isomerisation, Metathesis - metal clusters in catalysis.

Extra reading/Keywords: Synthesis of new organo metallic compounds

UNIT : IV

12 Hrs

APPLICATIONS OF SPECTROSCOPIC TECHNIQUES IN COMPLEXES

- 4.1 Electronic absorption spectroscopy – electronic states and spectra of octahedral and tetrahedral complexes of d-block metal ions, Orgel and Tanabe-Sugano diagrams, ligand field parameters from electronic spectra and the effect of distortion on the electronic states – spectra of Rubidium complex.
- 4.2 NMR spectroscopy – NMR of complexes and application of spin – spin coupling to structural elucidation, variable temperature, behaviour of fluxional molecules – NMR spectra of quadrupole nuclei and paramagnetic complexes - contact and pseudo contact shifts and the applications.
- 4.3 IR spectroscopy - Differentiation of linkage isomers, changes in the spectra of donor molecules upon coordination of metal ions in inorganic complexes.

Extra reading/Keywords: Structural elucidation of new compounds

UNIT: V

12 Hrs

PHOTOCHEMISTRY

- 5.1 Basic laws of Photochemistry- Photo physical processes, Photo chemical primary processes, rate constant and life time of reactive energy states, types of photochemical reactions, photo chemistry of transition metal complexes.
- 5.2 Photo redox, substitution and exchange reactions, light induced isomerisation, dissociation and linkage isomerisation reactions.

5.3 Photochemistry of organometallic compounds and Cr and Ru complexes.

Extra reading/Keywords: Jablonski Diagram

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recall the crystal field and molecular orbital theories.	PSO1	R&U
CO-2	Compare and contrast the inner and outer sphere mechanism of complexes.	PSO2	U
CO-3	Analyze the catalytic applications of organometallic compounds.	PSO4	An
CO-4	Interpret the structure of complexes using spectroscopic techniques.	PSO5	Ap
CO-5	Discuss the photochemistry of organometallic compounds.	PSO6	U&Ap
CO-5	Gain knowledge to teach about various Concepts of inorganic chemistry	PSO5	Ap

BOOKS FOR REFERENCE

1. Cotton F.A. and Wilkinson. G. (1999). *Advanced Inorganic Chemistry*, (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

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HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
Second Year – Semester- III

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

General Objectives:

To learn ionics and electrode kinetics, understand the electroanalytical methods and statistical thermodynamics (both classical and quantum).

Course Outcomes (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	apply the theories in ionic, implement the concepts of solubility products and common ion effects, relate electrode-electrolyte equilibrium, concentration cells and explain electrochemical energy storage systems.
CO-2	execute the theories of electrode-electrolyte interfaces and kinetics of electrochemical reactions and implements the significance of over voltage and corrosion
CO-3	implement the principles, experimental set up and applications of electro analytical techniques.
CO-4	analyse and evaluate the possible states and particles and theories of heat capacity of solids
CO-5	analyse and evaluate the partition function, bosons, fermions and steady state conditions.

UNIT: I
IONICS

12 Hrs

- 1.1 Debye Huckel theory - Radius of ionic atmosphere, Calculations of thickness of ionic atmosphere, Evidences of ionic atmosphere. Asymmetry effect, Electrophoretic effect. DebyeFalkenhagen effect, Wien effect, Debye - Huckel Onsager equation – Modification and verification of the equation.
- 1.2 Debye - Huckel limiting law - Modification and verification. Finite ion size model, Huckel - Bronsted equation, Calculation of activity coefficient. Determination of ion size parameter, Solubility - solubility product of sparingly soluble salt, common ion effect, neutral salt effect and solubility.
- 1.3 Electrode – electrolyte equilibrium, electrode potential, Applications of concentration cells – liquid Junction potentials. Electrochemical energy storage systems – Primary and secondary batteries, Fuel cells.

Extra reading/keywords: Experimental determination of solubility products, verifying Nernst equation

UNIT: II

12 Hrs

ELECTRODE KINETICS

- 2.1 Theories of electrical double layer - Electric double layer at the electrode -electrolyte interface - Helmholtz model of double layer, Law of electro neutrality, Gouy-Chapman diffused charged model, Adsorption theory of double layer, Stern's model, triple-layer theory.
- 2.2 Electro kinetic phenomena – Classification - Electro osmosis, electrophoresis, streaming potential and sedimentation potential, Kinetics of electrode process - Equilibrium and non-equilibrium process, Concentration and activation polarization, Theory of electrochemical over potential - Derivation and verification of Butler - Volmer equation.
- 2.3 Tafel equation – Application of Tafel equation in corrosion process and Pourbaix diagram, Evans diagram. Hydrogen over potential - Mechanism of hydrogen evolution reactions, pH and metal deposition, Application of hydrogen over potential.

Extra reading/keywords: Bioelectrochemistry applying electrode-electrolyte interface

UNIT: III

12 Hrs

ELECTRO ANALYTICAL TECHNIQUES

- 3.1 Polarography - Experimental set up, Advantages of dropping mercury electrode Supporting electrolyte, Maxima suppressor, Residual current, Migration current, Diffusion current, Polarogram, half wave potential , Ilkovic equation (derivation is not required). Outline of applications (Polarogram of Zn^{2+} and Cd^{2+})
- 3.2 Cyclic voltammetry - Principle, Experimental set up, Cyclic voltammogram of Fe^{2+} in H_2SO_4 , Anodic peak current, Cathodic peak current, Electrochemically reversible couple, Cathodic and anodic peak potential, Electrochemically irreversible couple. Outline of applications
- 3.3 Amperometry - Principle of amperometric titration, Different types of current - voltage curves. Amperometric titration between Pb^{2+} and $K_2Cr_2O_7$ -Electrogravimetry - Principle, Experimental set up, Separation of Cu and Ni

Extra reading/keywords: Hands - on training on instrumentations

UNIT: IV

12 Hrs

STATISTICAL THERMODYNAMICS

- 4.1 Statistical mechanics – Calculation of thermodynamic probability of a system Phase space, Ergodic hypothesis, Definition of micro and macro states – Different methods of counting macrostates. Distinguishable and indistinguishable particles .
- 4.2 Classical statistics – Derivation of Maxwell – Boltzmann distribution law, Relationship between entropy and probability
- 4.3 Limitations of classical statistics, Heat capacities of solids – Einstein and Debye's treatments.

Extra reading/keywords: Applications of Maxwell-Boltzmann distribution law

UNIT: V**12 Hrs****QUANTUM STATISTICS**

- 5.1 Definition and calculation of partition functions – Partition function and thermodynamic properties. Applications of partition functions in calculating equilibrium constant, free energy functions, Sackur-Tetrode equation.
- 5.2 Bose-Einstein and Fermi-Dirac statistics – Comparison of them with Boltzmann statistics – Application of BE statistics to photon gas and super fluidity of liquid helium – Application of FD statistics to electron gas and thermionic emission.
- 5.3 Non-equilibrium thermodynamics of irreversible processes-Onsagar's reciprocal relations – Steady state conditions.

Extra reading/keywords: Problems based on Bose-Einstein and Fermi-Dirac statistics

Course Outcomes

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	construct the fuel cells	PSO6	C
CO-2	Classify and explain the electrokinetic phenomenon	PSO2	U
Co-3	Apply Tafel equation in corrosion process	PSO4	Ap
CO-3	Sketch and interpret the cyclic voltagrams of redox systems	PSO3	Ap
CO-4	Illustrate the various methods for counting macro states.	PSO5	An
CO-5	Compare and contrast the Bose-Einstein and Fermi-Dirac statistics.	PSO2	U
CO-6	Explain Onsagar's reciprocal relations.	PSO1	U
CO-7	gain skill to interpret cyclic voltagrams	PSO4	Ap

BOOKS FOR REFERENCE

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)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
Second year- III Semester

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

General Objective: To learn the different spectroscopic techniques - UV, IR, NMR and Mass spectrometry 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 cyclic 1, 2 and 1, 3 – diols. Trans annular reactions in UV. Determination of reaction rates and mechanisms employing UV.
- 1.3 IR Spectroscopy: Instrumentation- Sample preparation, Interpretation of functional groups, Factors influencing group frequencies – both Internal and external, Study of Inter and Intra molecular hydrogen bonding, quantitative studies. Determination of reaction rates and mechanism IR.

Extra reading/keywords: Spectral interpretation of unknown molecules using UV and IR.

UNIT II - NMR SPECTROSCOPY

15 Hrs

- 2.1 H^1 NMR Spectroscopy – Coupling Constant – First order and Second order splitting, spin – Spin splitting, dependence of 'j' on dihedral angle – vicinal and geminal coupling constant – Karplus equation, long range coupling constants, influence of Stereochemical factors on chemical shift of protons, chemical spin decoupling of rapidly exchangeable protons.
- 2.2 Simplification of complex spectra – deuteration, basification and acidification, solvent effects, trifluoro acetylation, Shift reagents, spin decoupling (homonuclear, heteronuclear, broad band off-resonance decoupling), spin tickling. 2D techniques (NOESY, COSY, ROSSY).
- 2.3 C^{13} NMR spectroscopy – Basic theory of FT-NMR – Relaxation times broad band coupling, off resonance decoupling, calculation of chemical shift and correlations. Applications of all the above techniques to structural elucidation of simple organic compounds.

Extra reading/keywords: DEPT, N^{15} , F^{19} and P^{31} NMR,

UNIT II - MASS SPECTROSCOPY, ORD AND CD

15 Hrs

- 3.1 Instrumentation-EI and CI methods and Resolution. Base peak, Parent peak, Fragment peak, Isotopic Peak Meta stable Peak- Uses of metastable peaks. Recognition of parent peak, Determination and use of molecular formula- index of hydrogen deficiency, Nitrogen rule, rule of 13.
- 3.2 Fragmentation – General rules- McLafferty rearrangement, Retro Diels-Alder reactions – factors governing the fragmentation of various classes of organic compounds – saturated hydrocarbons, unsaturated hydrocarbons, Halogen compounds, Hydroxy compounds, Ethers, Thioethers, Aldehydes and Ketones, Carboxylic acids, esters, lactones, Amides, Amines and Nitro compounds.
- 3.3 Optical rotatory dispersion- Introduction, Plain curves, Rotatory Dispersion of Ketones – Axial haloketone rule, Octant rule and their applications to simple decalin system

Extra reading/keywords: GC-MS, LC-MS, ICP-MS and ESI

UNIT IV - CHEMISTRY OF NATURAL PRODUCTS

15 Hrs

- 4.1 Alkaloids : Introduction, structural elucidation of quinine, reserpene and morphine. Steroids – structural elucidation of cholesterol, estrone, 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 – $n-\pi^*$ and $\pi-\pi^*$ 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 Pericyclic Reactions: Molecular orbital symmetry – Frontier orbital of ethylene, 1,3-butadiene, 1,3,5 – hexatriene system. FMO approach, Woodward Hoffmann correlation diagram, PMO approach for explaining thermal and photo chemical reaction.
Electrocyclic reactions – Conrotatory and disrotatory motions (4n) and (4n+2) systems. cyclo addition reactions - notation of cyclo addition (4n) and (4n+2) additions - 1, 3 – dipolar cyclo – additions and cheletropic reactions . Sigmatropic rearrangements –Cope and Claisen rearrangements.

Extra reading/keywords: Problems in photochemistry and pericyclic reactions.

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Interpret the given UV and IR spectra and deduce the structure of the compound.	PSO 2	An
CO-2	Discuss the factors affecting the chemical shift.	PSO 1	K
CO-3	Explain the 2D techniques in NMR.	PSO 1	U
CO-4	Outline the fragmentation patterns for organic compounds using mass spectrometry.	PSO 2	Ap
CO-5	Generate the structure of alkaloids.	PSO 2	Ap
CO-6	Distinguish Norrish type I and type II reactions.	PSO 3	U
CO-7	Discuss the FMO approach for dienes and trienes.	PSO 1	U
CO-8	Acquire skill to interpret all spectroscopic data.	PSO 2	Ap

BOOKS FOR REFERENCE

- Gurdeep Chatwal, (1996). *Chemistry of Natural Products Vol. I & II*. (1st Ed.). Bombay: Himalaya.
- Sharma, Y.R. (2007). *Elementary Organic Spectroscopy*. (4th Ed.). New Delhi: S.Chand.
- Bassler, Morrill and Silver Stein, (1981). *Spectrometric Identification of Organic Compounds*. (4th Ed.). New York: John Wiley.
- Cotton and Halton, (1974). *Organic Photochemistry*. U.K: Cambridge University Press.
- Gurdeep R. Chatwal (2004). *Organic Chemistry of Natural Products, Vol. I & II*. Meerut: Goel Publications.
- William Kemp, (1987). *Organic Spectroscopy*. (2nd Ed.). New Delhi: ELBS.
- Agarwal, O.P. (1997). *Chemistry of Organic natural products, Vol. I & II*. Meerut: Goel Publications.
- 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, 4thEdn., Narosa publishing house Pvt. Ltd., New Delhi.
10. Fleming, Pericyclic Reactions, Oxford University Press, Oxford, 1999.

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

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

General Objective:

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

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	appraise the functions, sources, deficiency diseases, daily allowances of major nutrients and summarize the various techniques of food preparation and recommend steps to retain the nutritive value
CO-2	understand and analyse the nutritive value of food , meal planning and nutritive value
CO-3	understand the effects of the natural and metallic food toxicants and food toxicants
CO-4	understand, apply and analyse the food preservation and adulteration techniques.

CO-5	understand the poisoning of food by microbes, insects rodents , various modern food technologies such as biofortication, nutraceuticals and food packing
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UNIT: I **15Hrs**

FOOD SCIENCE

- 1.1 Terminology, Food groups, Functions of Food, Food in relation to health.
- 1.2 Cooking – Objectives of Cooking, Preliminary preparations and cooking methods – Moist heat methods, dry heat methods, Microwave cooking and solar cooking-Puffing and germination .
- 1.3 Effect of different methods of cooking on nutritive value - Carbohydrates, proteins, `fats, minerals, vitamins pigments, flavour components, Retention of nutritive value during preparation.

Extra reading/Keywords: Harmful effects of junk foods

UNIT: II **15Hrs**

NUTRITIVE VALUES OF FOOD GROUPS AND MEAL PLANNING

- 2.1 Nutritive values of food: Cereals and cereal product, pulses, nuts and oilseeds, milk and milk products, flesh foods, vegetables and fruits, sugar products and fats and oils.
- 2.2 Meal planning: Meal planning for various age groups – Infant nutrition, Nutrition of weaned infants, pre-school children, school children, adolescents, expectant and nursing mothers, geriatric nutrition and obesity.
- 2.3 Therapeutic nutrition- special feeding methods, Diets during anaemia, blood pressure, diabetes, fever and jaundice.

Extra reading/Keywords: Nutrition and Dietetics followed by heart patients

UNIT: III **15Hrs**

CHEMICAL POISONS IN FOOD

- 3.1 Sources of Chemical poisons in food, Natural Organic Toxicants in foods, Toxic factors present in food stuffs – Kesari dhal, mushroom, drumsticks, soybeans, fish, Spices and condiments, cabbage, tea leaves. Toxic minerals and metals —lead, mercury and cadmium.
- 3.2 Food additives – classification of food additives- functions and uses of food additives.

Extra reading/Keywords: Carcinogenic effects of food additives

UNIT: IV **15Hrs**

FOOD PRESERVATION AND ADULTERATION:

- 4.1 Food preservation - Principles and methods, importance of food preservation, Various methods of food preservation- Use of high temperature, low temperature, drying, radiation, Browning reactions – Reasons and preventions.
- 4.2 Food adulteration – Definition, Common adulterants in food and their ill-effects, Intentional adulterants and incidental adulterants. Simple physical and chemical tests for detection of food adulterants.

Extra reading/Keywords: Detection of adulterants in food

UNIT: V **15Hrs**

FOOD SANITATION AND FOOD TECHNOLOGY:

- 5.1 Practical rules for good sanitation of food.
- 5.2 Food poisoning by micro organisms, insects and rodents- prevention and its Control.
- 5.3 Food technology- Bio-technology in food, Biofortification, Nutraceuticals, low cost nutrient supplements, packaging of foods.

Extra reading/Keywords: Phytonutrients present in Herbal drinks

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Summarize the various cooking methods and its effects.	PSO 1	U
CO-2	List the important nutrients of healthy diet	PSO 3	U
CO-3	Outline the meal planning for various age groups	PSO 1	An
CO-4	Prepare a diet chart for hypertension and diabetes	PSO 2	Ap
CO-5	Categorize the various food additives and its functions	PSO 3	Ap
CO-6	Explain the different food preservation techniques	PSO 4	U
CO-7	Evaluate the adulterants present in food	PSO 5	An
CO-8	Discuss the modern concepts of biofortification and nutraceuticals	PSO 5	U
CO-9	Gain knowledge to give awareness about food and nutrition.	PSO 3	Ap

BOOKS FOR REFERENCE

1. Thankamma Jacob, (1979) A Text Book of Applied Chemistry for Home science and Allied Science, 1st edn., Macmillan company of India Limited.
2. Srilakshmi .B (2003) Reprint “Food Science” 3rd edition New Age Internation (P) Ltd., New Delhi.
3. Lillian Hoagland Meyer, (2004) Food Chemistry, 1st edn., CBS Publishers, New Delhi.
4. Mahindru S. N. (2004), Food Safety – Concept and Reality, 1st edn., APH Publishers.
5. Sumathi R, Mudambi, M.V, Rajagopal M.V, Fundamentals of Food and Nutrition 3rd edn., Wiley Eastern Ltd.
6. Swaminathan M., (1982), Handbook of Food and Nutrition, 2nd edition, Bappco Publications.
7. Andrew Schloss and David Joachim with A. Philip Handel,(2009).The Science of Good Food (Paper Back). Oriented Paper Backs.
8. Sharma Avantina, (2010) A Text book of Food Science and Technology, International Book Distribution Company.

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

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

GENERAL OBJECTIVES:

To acquire the practical skills in handling the instruments like conductometry and potentiometry.

Course Objectives (CO):

CO No.	Course Objectives
CO-1	State the principles of conductometry and potentiometry
CO-2	Relate the theoretical and experimental aspects of conductometry and potentiometry
CO-3	Demonstrate the experimental procedures.
CO-4	Analyze the conductance and potential for the given unknown solution

CO-5	Evaluate the conductance and potential graphically.
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CONDUCTIVITY METHOD

1. Precipitation titration
2. Mixture of acids against alkali
3. Strength of Buffer mixture
4. Mixture of halides against silver nitrate

POTENTIOMETRIC METHOD

1. Mixture of halides against silver nitrate
- 2a. Standard single electrode potential of copper and zinc
- 2b. Solubility product of silver chloride
3. Mixture of acids against alkali

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the theoretical concepts of physical experiments	PSO1	U
CO-2	Execute the conductometric and potentiometric titration.	PSO4	Ap
CO-3	Predict the end point through volumetric method	PSO3	E
CO-4	Draw and relate the end point through graphical method	PSO4	An
CO-5	Evaluate the solubility product of silver chloride	PSO5	E
CO-6	Gain knowledge to analyse the given sample.	PSO5	Ap

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

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

GENERAL OBJECTIVES:

To provide the knowledge and acquire the practical skills on non- electricals experiments

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	List the principles of kinetics and phase diagram.
CO-2	Relate the theoretical and experimental aspects of kinetics experiments
CO-3	Demonstrate the experimental procedures.

CO-4	Identify the end points at constant time intervals
CO-5	Evaluate the data graphically.

1. Verification of Freundlich isotherm
2. Comparison of acid strengths – ester hydrolysis
3. Phase diagram of one component system
4. Phase diagram of three component system
5. Association factor of benzoic acid
6. Determination of Arrhenius parameters
7. Iodination of acetone
8. Study of reaction between KI and $K_2S_2O_8$

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the theoretical concepts of non- electrical experiments	PSO1	U
CO-2	Construct the phase diagram for one component and three component systems	PSO5	C
CO-3	Predict the end point through volumetric method	PSO3	E
CO-4	Determine the Arrhenius parameters.	PSO5	An
CO-5	Draw and relate the end point through graphical method	PSO4	An
CO-6	Acquire the practical skills to analyse the given sample using non electrical practical techniques.	PSO5	Ap

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

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

General objective:

To enable the students to learn about common drugs, their Preparation, metals, corrosion of metals, polymers, rubber and chemical food poisons.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Classify the different types of drugs, understand the reactivity of analgesics and analyse the adverse reaction of drugs.

CO-2	Summarize the properties, behaviour and application of various metals.
CO-3	Discuss the prevention and Control of Corrosion
CO-4	Classify and elaborates the preparation, properties and uses of natural and synthetic polymers.
CO-5	Identify the sources of Chemical poisons in food; classify the toxic minerals and metals in food and Food Standard.

Unit-I: 15 hrs

COMMON DRUGS AND MEDICINES

Drug-classification, antibiotics - Applications of Penicillin, streptomycin, chloramphenicol, tetracyclins. Analgesics – Types, narcotic analgesic – morphine, apomorphine – Structure and uses. non-narcotic analgesics – aspirin, paracetamol, analgin – Structure and uses. Burn Preparation- Chemical burn, Sun burn. Drugs in Combination, Prevention and Control of adverse reaction from drugs.

Extra reading/keywords: Pharmaceutical Industrial Applications

Unit-II: 15 hrs

METALS IN THE SERVICE OF MAN

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

Extra reading/keywords: Metals used in Industries

Unit-III: 15 hrs

CORROSION PREVENTION AND CARE OF METALS

Prevention and control of corrosion- material selection, use of corrosion resistant alloys, use of protective coatings and linings, cathodic protection, elimination of corrosive agents. Care of household metals. Metal polishes – functions, composition and mode of action of polish, general rules for cleaning and polishes. Cleaning of aluminium metals, silverware, gold, copper and brasswares.

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

Unit-IV: 15 hrs

POLYMERS AND RUBBER

Polymers - General properties and classification. Preparation, properties and uses of PVC, Teflon and polythene. Rubber - origin and chemical nature of natural rubber, vulcanized rubber and its properties. Synthetic rubbers - neoprene rubber, Styrene Butadiene rubber [SBR] and polyurethane – structure, properties and uses.

Extra reading/keywords: Prepare a chart of polymers used in our daily life

Unit-V: 15 hrs

CHEMICAL POISONS IN FOOD

Sources of chemical poisons in food, toxic minerals and metals- fluoride, nitrate and selenium, natural organic toxicant in food- solanine, gossypol, oxalic acid and erucic acid, toxins in soyabean, spices, flavouring agents and fish, toxins in food from other sources, mercury, cadmium, tin and pesticide residues, food additives (polychlorinated biphenyls, N-nitroso compounds), contaminants of fats and oils. Food standards.

Extra reading/keywords: Methods of Detecting Food Poison

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discuss the applications of antibiotics and analgesics	PSO1	R&U
CO-2	Describe the physical, chemical properties of metals and the applications of metals used in homes	PSO2	Ap
CO-3	Narrate the steps involved in prevention of corrosion in metals.	PSO4	An
CO-4	Distinguish natural and synthetic rubber.	PSO2	R&U
CO-5	Identify the chemical poisons present in flavouring agents and food additives	PSO6	U&Ap
CO-6	Gain knowledge to teach safety measures in daily life	PSO6	U&Ap

BOOKS FOR REFERENCE

1. A Thankamma Jacob (1979), *'A text book of applied chemistry'*, 1st edition, McMillan India Ltd.,
2. Jayashree Gosh (2006), *'Fundamental concept of applied chemistry'* 1st edition, S. Chand Company Ltd.,
New Delhi.
3. B.K. Sharma (1995) *'Industrial Chemistry'* Goel Publishing House, Meerut.

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

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

General Objective:

To learn the error analysis and chromatography, instrumentation of different Spectroscopic techniques, diffraction techniques and Bio- inorganic Chemistry.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
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CO-1	Categorize the chromatographic techniques and error analysis
CO-2	demonstrate the instrumentation of spectroscopic techniques and analyze the Mossbauer and ESR spectra.
CO-3	Explain the principle and instrumentation of nephelometry, turbidimetry, fluorometry, XRD and execute their applications
CO-4	Understand and analyse the various nuclear reactions and application of different radioactive elements in medicine
CO-5	Analyze the interaction of metal ions with biological systems and illustrate the structure and functions of electron transfer proteins

UNIT: I

18Hrs

ERROR ANALYSIS AND CHROMATOGRAPHIC TECHNIQUES:

- 1.1 Significant figures and their importance in calculations - precision and accuracy - determinate and indeterminate errors - measures of precision, statistical concepts - standard or normal error curve and its features - reliability of mean values .
- 1.2 Confidence limits -distribution and confidence levels -Regression - distribution of data of a linear curve-method of propagation of errors. t values for various probability levels and varying, degrees of freedom, Rejection of result, F Tests, Regression and correlation.
- 1.3 Principle of chromatography, retardation factor, classification of chromatographic techniques. Partition chromatography and Thin layer chromatography: Principle, advantages, preparation of TLC plates, development of chromatogram. HPLC - instrumentation, procedure and applications, GC-MS – Instrumentation, technique and application.

Extra reading/keywords: Interpretation of chromatogram

UNIT: II

18Hrs

INSTRUMENTATION OF SPECTROSCOPIC TECHNIQUES AND MOSSBAUER SPECTROSCOPY:

- 2.1 Instrumentation of Atomic absorption spectroscopy, Photoelectron spectroscopy, Nuclear Magnetic spectroscopy, Electron spin resonance spectroscopy, Mossbauer spectroscopy, UV visible spectroscopy, Infrared spectroscopy.
- 2.2 Mossbauer spectroscopy: Mossbauer transition, Doppler effect, isomer shifts, Quadrupole interactions, Effect of magnetic field on spectra, Electronic structure and geometry of complexes, Magnetic interaction and its applications.
- 2.3 EPR spectroscopy – Zero field splitting, Kramer's degeneracy, Isotropic and anisotropic g value and the structure. Application of EPR to simple and polymeric inorganic complexes and few biological molecules containing Cu(II) and Fe(III) ions

Extra reading/keywords: Hands on training on instruments

UNIT: III

18Hrs

OPTICAL METHODS AND DIFFRACTION STUDIES:

- 3.1 Nephelometric and Turbidimetric methods - Introduction, Principle, Instrumentation, Analytical applications. Fluorometric and Phosphorimetric method of analysis –Introduction, Instrumentation, fluorometry, computation of results, Application Of fluorometry, Instrumentation of phosphorimetry, Application of Phosphorimetry.
- 3.2 X-ray diffraction – crystal structure, Bragg's equation – intensities of reflection, experimental methods, Laue photographic method, rotating crystal method, powder method, identification of powder diffraction pattern – Applications.
- 3.3 Neutron diffraction: Application and comparison with X-ray diffraction. Electron diffraction – Basic principles and application to simple molecules.

Extra reading/keywords: Interpretation of the structure of new crystalline compounds

UNIT: IV**18Hrs****NUCLEAR CHEMISTRY:**

- 4.1. Nuclear reaction - Q value, Coulomb barrier, nuclear cross section, threshold energy and excitation function. Proportional counters, Geiger-Muller counter. Accelerators - linear, cyclotron, synchrotron, betatron and bevatron.
- 4.2. Applications of isotopes, neutron activation analysis, isotopic dilution analysis, uses of tracers in structural and mechanistic studies, agriculture, medicine and - Dating of objects- hot atom chemistry.
- 4.3 Metals in medicine- therapeutic applications of cis-platin, radio-isotopes (E.g.: Tc & I₂) 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. O₂ 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 B₁₂ and cytochrome P₄₅₀ 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 excited molecules- Jablonski diagram, Wigner's spin conservation rule, Stern – Volmer equation and its applications , experimental techniques in photochemistry – chemical actinometers
- 1.2 Photochemical Kinetics – Reactions which do not involve chains – Dissociation of HI ,Reactions which involve chains – Distinguishing features,H₂- Cl₂ reaction, Photolysis of acetaldehyde, Photochemical equilibrium.
- 1.3 Laser and their applications, Elementary aspects of photosynthesis, photochemical conversion and storage of solar energy.

Extra reading/Keywords:Problems in quantum yields, Photochemical applications in biomedical and industrial fields

UNIT: II

18 Hrs

RADIATION CHEMISTRY

- 2.1 Difference between radiation chemistry and photochemistry, sources of high energy radiation, interaction of high energy radiation with matter.
- 2.2 Radiolysis of water, Hydrated electrons. Units of radiation energy – G value, Rad, Gray, RBE, Rontgen, Rem and Sievert. Linear energy transfer (LET)- Scavenging techniques , use of dosimetry in radiation chemistry.
- 2.3 Applications of nuclear radiations – radiation sterilization, radiation energy for chemical synthesis, radioisotopes as a source of electricity.

Extra reading/Keywords:Aqueous radiation chemistry

UNIT: III

18 Hrs

HOMOGENEOUS CATALYSIS

- 3.1 Mechanisms of catalysis, Equilibrium treatment, Steady – State treatment, Activation energies of catalysed reactions, Acid – base catalysis and its Mechanism, rate law derivation. Arrhenius vant'Hoff intermediate, 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 Electrophoresis, 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
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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 various organic reactions.
CO-3	apply and analyse the green techniques in various organic synthesis.
CO-4	understand the synthesis of nanoparticles and analyze the various characterization techniques involved in nanotechnology.
CO-5	understand and apply the concepts of carbon nanotubes and colloidal gold and analyze their applications in structural, electromagnetic, chemical and mechanical aspects.

UNIT: I**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 SYNTHESSES**

Microwave activation – advantage of microwave exposure, specific effects of microwave. Neat reactions – Solid supports reactions - deacetylation, deprotection, saponification of ester, reduction, functional group transformations, condensations reactions, oxidations-reduction reactions, Multi-component reactions.

Ultrasound Assisted Green Synthesis– Introduction, Applications of Ultra Sound- Esterification, Saponification, Substitution and Addition reactions.

Extra Reading/ Keywords: Comparison of Microwave synthesis Vs sonochemical synthesis

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

Synthesis of ionic liquids, physical properties, applications in alkylation, hydroformylations, epoxidations, synthesis of ethers, Friedel-Crafts reactions, Diels-Alder reactions, Knoevenagel condensations, Wittig reactions. Phase transfer catalyst - Synthesis and applications.

Extra Reading/ Keywords: Alternative green methods

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

Introduction, Nano particles – Classification of nano particles, Properties- Melting point, electrical, mechanical and optical properties. Production - Inert Gas Condensation (IGC), Physical Vapour Deposition (PVD), Chemical Vapour Deposition (CVD), Sol-Gel Process, Ball-milling. Characterization - XRD, SEM, TEM and AFM. Safety issues. Fullerenes – variations, properties of fullerenes.

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

UNIT: V**15 Hrs**

CARBON NANOTUBES AND COLLOIDAL GOLD

Carbon nanotube – Types and related structures, Properties, Synthesis of nanotubes - Arc discharge method, Laser ablation and CVD method. Defects of nanotubes, Applications of carbon nanotubes - Structural, Electromagnetic, Chemical and Mechanical applications. Colloidal gold– synthesis and applications

Extra Reading/ Keywords: Synthesis of Boron Nitride Nanotube

Course Outcomes (CO):

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Enumerate the Green Chemistry Principles.	PSO 1	U
CO-2	Distinguish microwave and ultrasound green synthesis.	PSO 1	U
CO-3	Elucidate the various mechanisms using ionic liquids and PTC.	PSO 2	Ana
CO-4	Discuss the properties and synthesis of nanoparticles.	PSO 5	U
CO-5	Summarizes the applications of carbon nanotubes and colloidal gold.	PSO 6	App
CO-6	Gain knowledge about Green chemistry and Nano technology	PSO 6	App

BOOKS FOR REFERENCE

1. Ahluwalia V. K. (2006) Green Chemistry - Environmentally benign reactions, Ane Books India.
2. T. Pradeep, (2007) Nano : The essentials-Understanding Nanoscience and Nanotechnology- Tata McGraw Hill Education Pvt. Ltd.
3. M. S. RamachandraRao and Shubra Singh (2013) Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley India Pvt. Ltd.
4. Paul T. Anastas & Tracy C. Williamson (1998). Green Chemistry – Designing Chemistry for the Environment (2nd ed.).
5. Rashmi Sanghi and Srivastava M.M. (2003). Green Chemistry – Environment friendly Alternatives. Narora Publishing House.
6. Rao C.N.R., Muller A and Cheetam A.K. (2004). The Chemistry of Nanomaterials, Vol.1, 2. Wiley – VCH, Weinheim.
7. Lakshman Desai, (2007). Nanotechnology. Paragon International Publishers.
8. Charles Jr. and Frank J. Owen, (2008). Introduction to nanotechnology. London: John Wiley & Sons.

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

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

General Objectives:

To know about the basics of Crystal Studies, Nuclear Chemistry, Polymer Chemistry, Soil Chemistry and Environmental Chemistry

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the fundamental concepts in solid state and to predict the structure of ionic crystals
CO-2	Apply the principles of nuclear chemistry in various nuclear reactions and understand the applications of radioactive isotopes.
CO-3	Discuss the different properties of inorganic polymers.
CO-4	Explain the components of soil, soil microorganism and soil reactions
CO-5	Determine the sources, causes and effects of air pollution, water pollution and solid waste management

Unit I: SOLID STATE CHEMISTRY

- 1.1 Introduction – Crystalline solids, amorphous solids, symmetry operations. Basic crystal system – space lattice, unit cell, Bravais lattice.
- 1.2 Lattice energy – Born Lande equation, Derivations of Born Haber cycle and applications. Radius ratio rules
- 1.3 Structure of ionic crystals – 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 – CO₂, CO, O₃ and photochemical smog.
- 5.2 Water pollution – Sewage and other oxygen demanding waste, Domestic water treatment, Industrial waste water and its treatment – Primary and secondary treatment.
- 5.3 Solid waste management – plastic and solid nuclear waste disposal , separation and recycling of plastics. Biodegradable plastics.

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the fundamental concepts in solid state and to predict the structure of ionic crystals	PSO 1	U
CO-2	Apply the principles of nuclear chemistry in various nuclear reactions and understand the applications of radioactive isotopes.	PSO 1	Ap
CO-3	Predict the different properties of inorganic polymers.	PSO 2	An
CO-4	Explain the components of soil, soil microorganism and soil reactions	PSO 3	U
CO-5	Identify the sources , causes and effects of air pollution, water pollution and solid waste management	PSO 5	Ap
CO-6	Develop the knowledge on soil and environmental chemistry	PSO 5	Ap

BOOKS FOR REFERENCE:

1. Lee J.D (1995) A new concise Inorganic Chemistry (4th edition) , London EIBS
2. Samuel Glasstone (1967) Sourcebook on Atomic Energy (3rd Edition) Devan and nostrand.
3. Cotton F.A and Wilkinson G (1985) Advanced Inorganic Chemistry (1985) New Delhi
4. Sashai V.N. (1993) Fundamental of soil 2nd Edition kalyani publishers.
5. Nyle C. Brady (1996), The nature and properties of soil 10th editon, Mcmillian Publishing company.
6. Sharma B.K (2005) Environmental Chemistry 8th Edition, Goel Publishing house.
7. V.P. Gowariker and N.V. Viswanathan- “ Polymer Science”, 1st Ed., Wiley Easter Pvt. Ltd., New Delhi.



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
SCHOOL OF PHYSICAL SCIENCES
PG AND RESEARCH DEPARTMENT OF CHEMISTRY
Programme: M.Phil

PO NO.	<i>Upon completion of the M.Phil.,Degree Programme, the graduate will have the ability to</i>
PO1	acquire scientific knowledge and understand the basic research principles and methods.
PO2	identify and tackle problems on critical social issues and to develop solutions through innovative scientific research.
PO3	develop skills to prepare materials, Characterization of materials, evaluate, analyze and interpret the data with theoretical background and spectral analytical techniques.
PO4	adopt various teaching methodologies to enhance the learning ability of students present in the classroom of HEI's.
PO5	apply the scientific knowledge to develop innovative prototype, ideas and products for the benefits of sustained society
PO6	create new project plans for the commercialization of chemical materials and to apply for copyright of the materials to make global competence.

PSO No.	Programme Specific Outcomes <i>Upon completion of these courses the student would</i>
PSO-1	provide Knowledge about all fundamental and advanced aspects of Chemistry
PSO-2	predict the structure and mechanism of Chemical compounds
PSO-3	examine specific phenomena theoretically and experimentally
PSO-4	carry out scientific experiments as well as record and analyze the results of such experiments
PSO-5	acquire knowledge, abilities and insight in well-defined area of research within Chemistry
PSO-6	contribute to the generation of new scientific insights or to the innovation of new applications of chemical research

(For Candidates admitted from June 2019 onwards)

HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

M.Phil Chemistry-COURSE PATTERN

Semester	Courses	Code	Hrs/wk	Credits	Marks
I	Course - I Research Methodology	MPH19CH1C01	6	4	100
	Course – II Physical Methods In Chemistry	MPH19CH1C02	6	4	100
	Course - III - Principles And Practice Of Teaching Chemistry	MPH17CH1C03	6	4	100

	Course – IV		6	4	100
	a) Corrosion in Metals	MPH19CH1E01			
	b) Electrochemistry	MPH19CH1E02			
	c) Environmental Chemistry	MPH17CH1E03			
	d) Kinetics And Mechanism	MPH19CH1E04			
	e) Phytochemistry	MPH17CH1E05			
	f) Material Chemistry	MPH19CH1E05			
	g) Nano Catalysts And Its Applications	MPH19CH1E06			
	h) Synthetic Organic Chemistry	MPH19CH1E08			
II	Dissertation & Viva-Voce (1)	MPH19CH1D01		8	200
Grand Total			24	24	600

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	MAJOR CORE 1- RESEARCH METHODOLOGY
Total Hours	90
Hours/Week	6
Code	MPH19CH1C01
Course Type	Theory
Credits	4
Marks	100

GENERAL OBJECTIVES:

To learn Principles of Research, Literature Survey and Error Analysis. To understand basic principles of green chemistry, Synthons, Synthetic equivalents, Organic Reagents and Chromatographic Techniques.

CO No.	Course Objectives
CO-1	To learn and understand the principles of research, literature survey and writing research paper and thesis writing.
CO-2	To gain some knowledge about the statistical analysis of data which will be highly helpful for research.
CO-3	To synthesize different organic compounds based on principles of green chemistry.
CO-4	To Design the target molecule based on retrosynthetic analysis and outline the applications of reducing and oxidizing reagents.
CO-5	To understand the basic principles of chromatographic techniques.

Unit I

- 1.1. Principles of Research- Observation, inference, hypothesis generation, testing of hypothesis, evolution of rules, theories and modification of theories and rules.
- 1.2. Literature Survey - Introduction to Chemical Abstracts – Uses of computer browsing for literature search and down loading – basics of Internet services – various sources of abstracts, articles and papers for browsing and downloading. Techniques of conversion from one format to another. Structure drawing programs and their uses – searches through structures- Scifinder.
- 1.3. Art of writing and publishing a research article and thesis - Preparation of a quality research paper – keywords – citations – references (software based) – bibliography. Preparation of abstract – delivering a paper. Publishing a research paper – Types of scientific publications- Publishers- Scientific journals, patents, books. Types of research articles –notes, short communications, full research paper, reviews, academic conferences (oral and poster presentation – contents– presentation – interaction) and blogs.
- 1.4. Knowledge of National and International Journals- Formats of National and International Journals, Impact Factor, Citation-Index, h-Index, i-10 Index, SCI Journals, Plagiarism, Fundamental knowledge of Patent and IPR. Art of writing Thesis- Types of report – title and abstract – the text – writing the thesis.

Unit II

- 2.1. Error Analysis- Various types of errors – precision and accuracy – significant figures, various statistical tests on the accuracy of results, positive and negative deviation from accurate results.
- 2.2. The Gaussian distribution – the normal distribution of random errors, mean value, variance and standard deviation, reliability interval, deviations from the Gaussian law of error distribution.
- 2.3. t-tests – comparison of the mean with the expected value, comparison of the results of two different methods, comparison of the precision of two methods by F-test, Gross errors and elimination of outlying results, graphical methods – Linear regression, standard deviation, correlation coefficient Multiple linear regression (one variable with two variables).

Unit III

- 3.1. Green Chemistry- Definition, Basic principles Green Reagents, Dimethyl carbamate, PolyN- Bromosuccinimide. Green catalysts, different types, phase-transfer catalysis and its application in organic synthesis – generation of dihalocarbenes, C-alkylation, N- Alkylation and Heterocyclic carbons – 3 alkyl coumerin and Flavones.
- 3.2. Microwave induced green synthesis – MW assisted reaction in water – Hofmann elimination, hydrolysisoxidation of alcohols, saponification. Reactions in organic solvents – Esterification, Fries rearrangement, synthesis of chalcone. Decarboxylation and deacetylation.
- 3.3. Ultra sound assisted Green synthesis and their application in Esterification, saponification, Substitution reaction, addition reaction, reduction Hydroboration coupling reactions, Diels

- Aldol cannizaro reaction. Solid phase organic synthesis – Halogenation, Hydrohalogenation. Michael Addition. Aldol condensation, Grignard Reagent, Nuclear bromination, Nitration, Pinacol-Pinacolone rearrangement and Beckmann rearrangement, Dimerisation of Fullerenes.
- 3.4. Synthesis involving Basic principles of green chemistry – Adipic acid, methyl ethacrylate, Aromatic amines, Free radical bromination, Ibuprofen, Paracetamol.

Unit IV

- 4.1. Synthons and Synthetic Equivalents- Synthons approach
- 4.2. Retrosynthetic Analysis of Simple Organic Compounds – Antithesis of mono and difunctional open chain target molecules. Retrosynthetic analysis of monocyclic and bicyclic target molecules.
- 4.3. Reagents for Reduction and Oxidation- Catalytic hydrogenation and dehydrogenation, reduction with NaH, LiAlH₄, NaBH₄, tritertiarybutoxy aluminium hydride, NaCNBH₃, trialkyl tinhydride, SiMe₃, reductions involving dissolved alkali metals; reductions with hydrazines – Osmium tetroxide, Chromyl chloride, Ozone, Periodic acid, Femy salt, Dioxane, Lead tetraacetate and Selenium dioxide.

Unit V

- 5.1. Chromatography -Solvent extraction – ion exchange, paper, thin layer and column Chromatography, Flash Chromatography
- 5.2. Gas Chromatography techniques – columns, methods, McReynold's constants and their uses. – GCMS, Moldi
- 5.3. HPLC techniques- Columns, detection methods, estimations, preparative column. GC-MS techniques. Methods – principles – applications – LCMS.

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO1	Discuss the art of writing thesis.	PSO 1	U
CO2	Compare t-test and F- test.	PSO 2	U
CO3	Explain microwave and ultrasound assisted green synthesis.	PSO 3	U
CO4	Give the mechanism of Wittig reactions.	PSO 4	Ana
CO5	Discuss the Applications of LC-MS technique.	PSO 5	App

TEXT BOOKS:

1. March J, 1996, "Advanced Organic Chemistry Reactions, Mechanisms and Structure". 5th ed. New York, Wiley. (New Edition)
2. Raman K.V., 1993, "Computers in chemistry", 1st ed., New Delhi, Tata Mc Graw Hill.

BOOK FOR REFERENCES:

1. Pine S.H., Hendrickson J.B., Cram D.J. and Hammond G.S., 1980, "Organic Chemistry," 4th ed. Mc Graw Hill.
2. Eckschlager K., 1969, "Errors, Measurement and results in chemical analysis", London, Van Nostrand Reinhold company, chapters-I, IV, V.
3. Mackie R.K. and Smith D.M., 1982 "Guide book to organic synthesis " London, ELBS.
4. VK. Ahluwalia and M. Kidwai, "New Trends in Green chemistry" Anamaya Publishers, New Delhi
5. Hilary Glasman, Scientific Research Writing for Non-native speakers of English, Imperial College press, UK.

6. Tips for writing better papers.
7. Umberto Eco, 'How to write a Thesis', MIT press , Cambridge , England , London.

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	MAJOR CORE 2- PHYSICAL METHODS IN CHEMISTRY
Total Hours	90
Hours/Week	6
Code	MPH19CH1C02
Course Type	Theory
Credits	4
Marks	100

CO No.	Course Objectives
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CO-1	To introduce the spectroscopic techniques to the students as invaluable tools in science for the detection, identification and analysis of a wide range of chemical compounds relevant to both Research and Industry.
CO-2	Understand the basic principle in NMR and infer structural information from it.
CO-3	Deepens the students' understanding of the principles of 2D-NMR and provide the required information about 2D-NMR techniques
CO-4	Illustrate Mass spectrometry, ORD and CD curves
CO-5	Understands the basic principle of diffraction techniques

Unit I:

- 1.1. UV Visible spectroscopy – Instrumentation - Microstates - Term symbols and energy levels for d^1 - d^9 systems. Electronic spectra of transition metal complexes (from d^1 to d^9 configurations) – Orgel and Tanabe sugano diagrams - intensity of ν values for octahedral complexes of cobalt and nickel - BB^1 bands – Evaluation of $10 Dq$ and charge transfer spectra.
- 1.2. IR and Raman spectroscopy - Combined applications of IR and Raman spectroscopy in structural elucidation of simple molecules and ions like N_2O , ClF_3 , NO_3^- and ClO_4^- . Uses of group vibrations in the structural elucidation of metal complexes of urea, thiourea, thiocyanate, nitrate, sulphate and dimethyl sulfoxide. IR spectra of metal carbonyls with reference to the nature of bonding, geometry and number of C-O stretching vibrations.
- 1.3. Mossbauer Spectroscopy -Principle – Instrumentation - isomer shift – electric and magnetic quadrupole splitting – applications to iron and its compounds.

Unit II:

- 2.1. NMR Spectroscopy: Principles and Methods- 1H NMR Spectroscopy – Coupling constant – first order and second order splitting spin-spin splitting – dependence of J on dihedral angle – vicinal and geminal coupling constants – Karplus equation – long range coupling, influence of stereochemical factors on chemical shift of protons-Simplification of complex spectra, Shift reagents, Chemical spin decoupling of rapidly exchangeable protons (OH, SH, COOH, NH, NH_2).
- 2.2. ^{13}C NMR spectroscopy- and chemical shift correlations (CH, CH_2 , $CH_3 = C$, aromatic). Examples for different spin systems – Chemical shifts and coupling constants - Spin-spin coupling involving different nuclei (1H , ^{19}F , ^{31}P , ^{13}C , ^{15}N and ^{17}O) interpretation. Systems with chemical exchange – Distortionless Enhancement by Polarisation Transfer (DEPT).
- 2.3. Evaluation of thermodynamic parameters in simple systems, study of fluxional behaviour of molecules, an elementary treatment of second order spectra, example, NMR of paramagnetic molecules.

Unit III:

- 3.1. Double resonance technique, relaxation mechanisms and Quadrupolar nuclei - Double resonance techniques, basic theory of FT-NMR –measurement of T_1 and T_2 . Relaxation mechanism, Broad band decoupling, off resonance decoupling – an elementary treatment of NOE phenomenon.
- 3.2. 2D technique (COSY, NOESY. HSQC HMBC AND ROSY). Effect of quadrupolar nuclei, evaluation of thermodynamic and kinetic data using NMR techniques –Characteristics of quadrupolar nucleus – effects of field gradient and magnetic field upon quadrupolar energy levels – NQR transitions – applications.
- 3.3. Applications to inorganic compounds - Effect of quadrupole nuclei (2H , ^{10}B , ^{11}B) on the H^1 NMR spectra.

UNIT- IV:

- 4.1. EPR Spectroscopy -Factors affecting the magnitudes of g and A tensors in metal species – Zero field splitting and Kramers degeneracy – spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II) and Cu(II) complexes – applications of EPR to few biological molecules containing Cu(II), Fe(II) and Fe(III) ions – spin densities and McConnell relationship.
- 4.2. Mass Spectrometry -Instrumentation – resolution. Ionization techniques, EI, CI and FAB methods– base peak, isotopic peaks, parent peak, metastable peak, importance of metastable peaks, determination and use of molecular formula, recognition of molecular ion peak. Fragmentation – general rules – pattern of fragmentation for various classes of compounds, McLafferty rearrangement.
- 4.3. Optical Rotary Dispersion and Circular Dichroism - ORD and CD – Cotton effect – Octant rule, alpha-haloketone rule – applications to determining absolute configuration of simple monocyclic ketones and metal complexes.

UNIT- V:

- 5.1. Diffraction Methods -Crystal symmetry – combination symmetry elements – crystal classes –screw axis and glide planes – space group – crystal axes – crystal systems, unit cell, Bravais lattices, asymmetric unit – space group – Equivalent positions – Relationship between molecular symmetry and crystallographic symmetry – basic concepts and examples. Single crystal and powder x-ray diffraction techniques.
- 5.2. Neutron diffraction – magnetic scattering – applications and comparison with X-ray diffraction. Electron diffraction – basic principles and applications to simple molecules – XeF₆, Be(BH₄)₂, Ferrocene, Cr(II) acetate.

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Interpret the FT-IR, NMR and Mossbauer spectra of the molecules	PSO 1	App
CO-2	Elucidate the structure of molecules involving NMR active nuclei.	PSO 2	App
CO-3	Analyze and interpret 2D NMR spectra of molecules and to differentiate between 1D and 2D spectra	PSO 3	An
CO-4	Interpret the structure of organic compounds using mass spectrometry	PSO 4	App
CO-5	Elucidate the structure of simple molecules using diffraction techniques	PSO 5	App

TEXT BOOKS:

1. Huheey JE, Keiter EA and Keiter RA, 2000, Inorganic Chemistry, Principles of Structure and Reactivity, 4th edition, New Delhi, Pearson Education (Asia).
2. Silverstein RM and Webster FX, 2003, Spectrometric Identification of Organic Compounds, 6th edition, New York, John-Wiley and Sons Inc.
3. Kalsi PS, 1990, Stereochemistry Conformation and Mechanism, 4th editions, New Delhi, New Age International Publishers.
4. Straughan BP and Walker S, 1976, Spectroscopy Vol. 1-3, London, Chapman and Hall.
5. Drago RS. 1980, Physical Methods in Chemistry, New Delhi, W.B. Saunders.

BOOK FOR REFERENCES:

1. Rifi MR and Covitz FH, 1974, Introduction to Organic Electrochemistry, New York, Marcel Dekker.
2. Kemp W, 1993, Organic Spectroscopy, 3rd edition, London, ELBS with Mecomillan.
3. Cotton FA, Wilkinson G, Murillo CA and Bochman M, 2003, Advance Inorganic Chemistry, 6th edition, New York, John-Wiley and Sons Inc.
4. Kalsi PS, 1999, Stereochemistry and Mechanism Through Solved Problems, 3rd edition, New Delhi, New Age International Publishers.
5. Sutton D, 2000, Electronic Spectra of Transition Metal Complexes, New Delhi, Narosa Publishing House.
6. Nasipuri D, 2000, Stereochemistry of Organic Compounds. New Delhi, Narosa Publishing House.
7. Bancroft M, 1973, Mossbauer Spectroscopy, New Delhi, Tata McGraw-Hill Publishing Company.
8. Wheatly PJ, 1959, The Determination of Molecular Structure, London, Oxford at the Clarendon Press.
9. Ebsworth EAV, 1987, Structural Methods in Inorganic Chemistry, 3rd ed. London, ELBS.

(For Candidates admitted from June 2017 onwards)
HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	PAPER III- PRINCIPLES AND PRACTICE OF TEACHING CHEMISTRY
Total Hours	90
Hours/Week	6
Code	MPH17CH1C03
Course Type	Theory
Credits	4
Marks	100

CO No.	Course Objectives
CO-1	acquaint different parts of computer system and their functions.
CO-2	understand the operations and use of computers and common accessories.
CO-3	develop skills of ict and apply them in teaching learning context and research.
CO-4	appreciate the role of ict in teaching, learning and research.
CO-5	acquire the knowledge of communication skill with special reference to its elements, types, development and styles.
CO-6	understand the terms communication technology and computer mediated teaching and develop multimedia /e- content in their respective subject.
CO-7	understand the communication process through the web.
CO-8	acquire the knowledge of instructional technology and its applications
CO-9	develop different teaching skills for putting the content across to targeted audience.

Unit I : COMPUTER APPLICATION SKILLS

Information and Communication Technology (ICT): Definition, Meaning, Features, Trends – Integration of ICT in teaching and learning – ICT applications: Using word processors, Spread sheets, Power point slides in the classroom – ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations-- **ICT for Professional Development**: Concept of professional development; institutional efforts for competency building; individual learning for professional development using professional networks, OERs, technology for action research, etc.

Unit II : COMMUNICATIONS SKILLS

Communication: Definitions – Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise – Types of Communication: Spoken and Written; Non-verbal communication – Intrapersonal, interpersonal, Group and Mass communication –

Barriers to communication: Mechanical, Physical, Linguistic & Cultural – Skills of communication: Listening, Speaking, Reading and Writing – Methods of developing fluency in oral and written communication – Style, Diction and Vocabulary – Classroom communication and dynamics.

Unit III : PEDAGOGY

Instructional Technology: Definition, Objectives and Types – Difference between Teaching and Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a Lecture – Narration in tune with the nature of different disciplines – Lecture with power point presentation - Versatility of Lecture technique – Demonstration: Characteristics, Principles, planning. Implementation and Evaluation – Teaching-learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion.

Unit IV : E- LEARNING, TECHNOLOGY INTEGRATION AND ACADEMIC RESOURCES IN INDIA

Concept and types of e-learning (synchronous and asynchronous instructional delivery and means), m-learning (mobile apps); blended learning; flipped learning; E-learning tools (like LMS; software’s for word processing, making presentations, online editing, etc.); subject specific tools for e-learning; awareness of e-learning standards- Concept of technology integration in teaching- learning processes; frameworks guiding technology integration (like TPACK; SAMR); Technology Integration Matrix- Academic Resources in India: MOOC, NMEICT; NPTEL; e-pathshala; SWAYAM, SWAYAM Prabha, National academic depository, National Digital Library; e-Sodh Sindhu; virtual labs; eYantra, Talk to a teacher, MOODLE, mobile apps, etc.

Unit V : SKILLS OF TEACHING AND TECHNOLOGY BASED ASSESSMENT

Teaching skills: Definition, Meaning and Nature- Types of Teaching Skills: Skill of Set Induction, Skill of Stimulus Variation, Skill of Explaining, Skill of Probing Questions, Skill of Black Board Writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills- **Technology for Assessment:** Concept of assessment and paradigm shift in assessment; role of technology in assessment ‘for’ learning; tools for self & peer assessment (recording devices; e- rubrics, etc.); online assessment (open source software’s; e-portfolio; quiz makers; e- rubrics; survey tools); technology for assessment of collaborative learning like blogs, discussion forums; learning analytics.

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Develop skills of ICT and apply them in Teaching Learning context and Research.	PSO 1	App
CO-2	Be able to use ICT for their professional development.	PSO 2	App
CO-3	Leverage OERs for their teaching and research.	PSO 3	An
CO-4	Appreciate the role of ICT in teaching, learning and Research.	PSO 4	App
CO-5	Develop communication skills with special reference to Listening, Speaking, Reading and Writing.	PSO 5	App
CO-6	Learn how to use instructional technology effectively in	PSO 2	App

	a classroom.		
CO-7	Master the preparation and implementation of teaching techniques.	PSO 3	An
CO-8	Develop adequate skills and competencies to organize seminar / conference / workshop / symposium / panel discussion	PSO 4	App
CO-9	Develop skills in e-learning and technology integration	PSO 5	App
CO-10	Have the ability to utilize Academic resources in India for their teaching.	PSO 2	App
CO-11	Have the mastery over communication process through the web.	PSO 3	An
CO-12	Develop different teaching skills for putting the content across to targeted audience.	PSO 4	App
CO-13	Develop different teaching skills for putting the content across to targeted audience.	PSO 5	App

BOOK FOR REFERENCES

1. Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi
2. Brandon Hall , E-learning, A research note by Namahn, found in: www.namahn.com/resources/.../note-e-learning.pdf, Retrieved on 05/08/2011
3. Don Skinner (2005), Teacher Training, Edinburgh University Press Ltd., Edinburgh
4. Information and Communication Technology in Education: A Curriculum for schools and programmed of Teacher Development, Jonathan Anderson and Tom Van Weart, UNESCO, 2002.
5. Jereb, E., & Šmitek, B. (2006). Applying multimedia instruction in e- learning. Innovations in Education & Teaching International, 43(1), 15-27.
6. Kumar, K.L. (2008) Educational Technology, New Age International Publishers, New Delhi.
7. Learning Management system https://en.wikipedia.org/wiki/Learning_management_system , Retrieved on 05/01/2016
8. Mangal, S.K (2002) Essential of Teaching – Learning and Information Technology, Tandon Publications, Ludhiana.
9. Michael,D and William (2000), Integrating Technology into Teaching and Learning: Concepts and Applications, Prentice Hall, New york.
10. Pandey,S.K (2005) Teaching communication, Commonwealth Publishers, New Delhi.
11. Ram Babu,A abd Dandapani,S (2006), Microteaching (Vol.1 & 2), Neelkamal Publications, Hyderabad.
12. Singh,V.K and Sudarshan K.N. (1996), Computer Education, Discovery Publishing Company, New York.
13. Sharma,R.A., (2006) Fundamentals of Educational Technology, Surya Publications,Meerut
14. Vanaja,M and Rajasekar,S (2006), Computer Education, Neelkamal Publications, Hyderabad.

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	PAPER IV: MAJOR ELECTIVE - CORROSION IN METALS
Total Hours	90
Hours/Week	6
Code	MPH19CH1E01
Course Type	Theory
Credits	4
Marks	100

UNIT-1: IONICS

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.

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 - determination of solubility and solubility product.

UNIT-II: ELECTRODE AND ELECTROLYTE INTERFACE

Electrode – electrolyte equilibrium, electrode potential – Applications of concentration cells liquid Junction potentials - Electrochemical energy storage systems – Primary and secondarybatteries – Fuel cells.

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.

UNIT –III:ELECTRO KINETIC PHENOMENA

Electro kinetic phenomena – Classification - Electro osmosis and 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 the equations – Butler - Volmer equation

Tafel equation – Application of Tafel equation in corrosion process and Pourbaix diagram, Evan diagram - Hydrogen over potential - Mechanism of hydrogen evolution reactions – pH and metal deposition - Application of hydrogen over potential.

UNIT –IV:CORROSION IN MATERIALS:

Introduction-definition. Forms of corrosion- dry corrosion, wet corrosion – mechanisms, Galvanic corrosion, Crevice corrosion, Atmospheric corrosion, Pitting corrosion, Intergranular

corrosion, Erosion corrosion, Stress corrosion, Soil corrosion, Waterline corrosion, Microbial corrosion.

Factors influencing corrosion: nature of metals-position in galvanic series, over voltage, relative areas of anodic and cathodic parts, purity of metals, physical state of metal, nature of surface film, solubility of corrosion products. Nature of corroding environment -temperature, humidity, presence of impurities in atmosphere, influence of pH, nature of ions present, conduction of the corroding medium, formation of oxygen concentration cell.

UNIT –V:CORROSION CONTROL:

Corrosion control- proper designing, use of pure metals, using metal alloys, cathodic protection sacrificial anodic protection method, impressed current. Use of inhibitors-Theories of inhibition of corrosion- adsorption theory and molecular structure, hydrogen over potential theory, film formation theory.

Corrosion Inhibitors: Inhibitors: definition, classifications-due to Putilova, anodic, cathodic and mixed type of inhibitors.Synergistic effect- examples. green inhibitors. Biofilms, Action of biocides. Corrosion inhibition in neutral gaseous, in acidic environments-examples.Silicates, polymers, carboxylates, Plant extracts, tannins, metal ions, cationic and anionic surfactants as corrosion inhibitors in electronic media.

TEXTBOOKS:

1. Corrosion Engineering, Mars.G.Fontana, Tata Mc Graw-Hill Publishing Company Ltd., Third Edition, 6th Reprint, 2008.
2. Modern Electrochemistry.B, John O'M.Bockris and Amulya.K.N.Reddy, Kluwer Academic Plenum Publishers,Second Edition, New York, 1998.

BOOK FOR REFERENCES:

1. Glasstone, S. (1968), *Introduction to Electrochemistry*, New Delhi: Affiliated East West Press.
2. Moore, W.J. (1982), *Physical Chemistry* (5th Ed.). Orient Longman.
3. Electroanalytical Methods,S.Rani, MJP Publishers,Chennai,(2008).

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	Paper- IV MAJOR ELECTIVE - ELECTROCHEMISTRY
Total Hours	90
Hours/Week	6
Code	MPH19CH1E02
Course Type	Theory
Credits	4
Marks	100

UNIT-1: IONICS

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.

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 - determination of solubility and solubility product.

UNIT-II:ELECTRODE AND ELECTROLYTE INTERFACE

Electrode – electrolyte equilibrium, electrode potential – Applications of concentration cells liquid Junction potentials - Electrochemical energy storage systems – Primary and secondary batteries – Fuel cells.

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.

UNIT –III:ELECTRO KINETIC PHENOMENA

Electro kinetic phenomena – Classification - Electro osmosis and 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 the equations – Butler - Volmer equation

Tafel equation – Application of Tafel equation in corrosion process and Pourbaix diagram, Evan diagram - Hydrogen over potential - Mechanism of hydrogen evolution reactions – pH and metal deposition - Application of hydrogen over potential.

UNIT- IV ELECTRODEPOSITION

Introduction-Ions- Simple and Complex -Electricity for Electroplating – Electrolytes and electrolysis- Electrode Potential, Deposition Potential- Hydrogen ion and Hydrogen Overvoltage- Anodes in Electroplating- Electrodeposited metal. Preparation of Work Surface- Preliminary Treatment – Removal of Heavy Grease and Oil- Descaling-Bright dipping- polishing and Buffing- Electropolishing- Preplating Operation.

Electrodeposition Practice for Metals and Alloys- Copper Plating- Nickel Electroplating- Zinc Electroplating- Zinc-Nickel Alloy Electroplating,

Unit –V Electrodeposition Process Control

Chemical Control, Physical- pH, Density, Surface tension, Conductivity, Current Efficiency in plating bath, Hull Cell, Throwing Power.

Specifications and Testing of Electroplate - Thickness- Destructive and Non-destructive testing methods- Adhesion- Bend test, Burnishing test, file test, grinding test, heat test, peel test - Corrosion Resistance- Neutral salt spray test, Acetic acid salt spray test- Potentiodynamic polarization study- AC impedance study. Porosity- Ferroxy test- Hardness.

TEXT BOOKS :

1. Glasstone, S. (1968), *Introduction to Electrochemistry*, New Delhi: Affiliated East West Press.
2. Moore, W.J. (1982), *Physical Chemistry* (5th Ed.). Orient Longman.
3. Parthasarathy, N.V., (1989), *Practical Electroplating Hand book*, Prentice-Hall, Inc., New Jersey

BOOK FOR REFERENCES :

1. H.Panda, (2010) *The Complete Technology book on Electroplating, Phosphating, Powder coating and metal Finishing*, Centre for information technology.
2. *Modern Electrochemistry*. B, John O'M. Bockris and Amulya.K.N.Reddy, Kluwer Academic Plenum Publishers, Second Edition, New York, 1998.

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	PAPER IV- ELECTIVE - ENVIRONMENTAL CHEMISTRY
Total Hours	90
Hours/Week	6
Code	MPH19CH1E03
Course Type	Theory
Credits	4
Marks	100

UNIT I: INTRODUCTION TO ENVIRONMENTAL CHEMISTRY

Introduction – components of environment – factors affecting environment – Man and environment – types of environment – segments of environment.

Atmosphere – structure of atmosphere – Hydrosphere – Hydrological cycle – Lithosphere – Biosphere - Water resources – complexation in natural water and waste water – Microorganism – The catalyst of aquatic chemical reaction, iron and manganese.

UNIT II: Water Pollution

Water Pollution: Aquatic environment, Water pollutants – organic pollutants, pesticides, organo chlorine insecticides, cyclodiene insecticides, Organophosphates, carbamates – detergents.

Toxic organic chemicals, Inorganic pollution, acid mine drainage, sediments, radioactive materials.

Eutrophication, waste water treatment, Domestic water treatment – primary, secondary and tertiary treatment of water, aerobic and anaerobic treatment processes, upflow anaerobic sludge bed (blanket) reactor (UASB) process, industrial waste water treatment, drinking water supplies.

Toxic elements in water, chemical species – Cu, Pb, Hg, As, Se, Cr, Cd – Water quality parameters and standards – Domestic water quality parameters, surface waters – Samplings – preservation.

UNIT III: WATER ANALYSIS

Monitoring techniques and methodology – pH, specific conductance, DO, ammonia, nitrate and nitrite, chloride, fluoride, cyanide, sulphide, sulphate, phosphate, total hardness (Ca& Mg), boron, silica, metals and metalloids, arsenic, selenium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, silver and zinc.

Chemical oxygen demand (COD), Biochemical oxygen demand (BOD), Total organic carbon (TOC), phenols, pesticides, surfactants, Tanin and Lignin, Escherichia coli (E-coli) and total bacteria. Some case studies of water pollution, summary of procedures for analysis of water quality parameters.

UNIT IV: INSTRUMENTAL TECHNIQUES ON ENVIRONMENTAL CHEMICAL ANALYSIS:

Neutron activation analysis, Anodic stripping voltammetry (ASV), Atomic absorption spectrophotometry (AAS), Inductively coupled plasma emission spectroscopy (ICPES), X-ray fluorescence, non-dispersive infra red spectrometry, Fourier transform infra red (FTIR) spectroscopy – chemiluminescence – Gas chromatography – High performance (pressure) liquid chromatography (HPLC) – Ion selective electrodes – Ion exchange chromatography.

UNIT V: SURFACE CHEMISTRY

Adsorption – Adsorption of gases by solids, Heat of adsorption, Freundlich adsorption isotherm – Langmuir theory of adsorption, BET theory of multilayer adsorption, Types of adsorption isotherm – Adsorption from solution – Gibb's adsorption isotherm, Adsorption chromatography – column chromatography, chemisorption, Application of adsorption.

TEXT BOOKS:

1. S.S. Dara (2002), A Text Book of Environmental Chemistry and Pollution control – 5th Revised Edition, S. Chand and company.
2. Gurdeep Raj, (1996), Advanced Physical Chemistry, 19th edition, Meerut Krishna Prakashan Publications.

BOOK FOR REFERENCES:

1. A.K. De., (2003), Environmental Chemistry, 5th Edition New Age International (p) Limited.
2. B.K. Sharma, (2005), Environmental Chemistry, 9th edition Krishna Prakashan Media (p) Limited.

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI-2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	MAJOR ELECTIVE - KINETICS AND MECHANISM
Total Hours	90
Hours/Week	6
Code	MPH19CH1E04
Course Type	Theory
Credits	4
Marks	100

GENERAL OBJECTIVES:

To learn the concepts and theories in Chemical Kinetics, role of catalysts in kinetics, substituent and temperature effects and reaction mechanisms in solution

CO No.	Course Objectives
CO-1	To learn and understand the fundamentals of chemical kinetics, reaction rates, order and instrumental techniques in kinetics
CO-2	To learn the derivation of ARRT, understand the application of thermodynamic parameters and factors affecting rates in solution
CO-3	To study the derivation of rate laws and application of catalysis in kinetics.
CO-4	To learn the influence the substituents and the effect of temperature in reaction rates
CO-5	To understand the mechanism of some reactions in solution and the derivation of rate law

UNIT I :INTRODUCTION TO CHEMICAL KINETICS

Empirical treatment of reaction rates: effect of concentration- rate expression-product study stoichiometry-Experimental methods of measuring reaction rates: Instrumental method of analysis, chemical methods-determination of order. Relation between rate and mechanism.

UNIT II: THEORIES AND CONCEPTS

Activated complex theory- current status-extension- applications. Entropy of activation, enthalpy of activation-Reactions in solutions: factors determining reaction rates in solution. Reaction between ions,dipoles-effect of ionic strength--primary and secondary salt effect-kinetic isotope effect, primary and secondary isotope effect.

UNIT III :CATALYSIS

Complex reactions: steady state treatment- microscopic reversibility- Homogeneous catalysis in solution: Mechanism of acid-base catalysis-catalytic constant-general and specific and base catalysis. Bronsted catalysis law, acidity function.

UNIT IV :SUBSTITUENT AND TEMPERATURE EFFECT

Hammett and Taft equation: Influence of substituents on reaction rates-electronic theory of organic reactivity-influence of substituents on the energy of activation-LFER substituent constant-reaction constant for aromatic and aliphatic systems. Applications of Hammett and Taft equations in reaction mechanism-Iso kinetic relationship: Effect of temperature on reaction rates-reaction series-enthalpy and entropy relationship. Exner plot-isokinetic temperature.

UNIT V: REACTION MECHANISM IN SOLUTION

Some reaction mechanism in solution: Oxidation of alcohols, aldehydes ,acetals and benzyl ethers by N- halogeno compounds like NCN, NBS, NCS, CBT etc.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discuss the fundamentals of chemical kinetics	PSO 1	U
CO-2	Explain the theories and concepts of chemical kinetics	PSO 2	U
CO-3	Correlates catalysis with chemical kinetics.	PSO 3	U
CO-4	Discuss the substituent effects based on LFER.	PSO 4	Ana
CO-5	Propose the reaction mechanism in solution and derive the rate law .	PSO 5	App

TEXT BOOKS

1. Laidler K.J, 1984, Chemical Kinetics, 3rd edition, New Delhi, Tata McGraw-Hill Publishing Company.
2. Rajaram and Kuriakose, 1993, Kinetics of Transformations, Shoban Lal Chand and Co.
3. Logan, S.R., 1996, Fundamentals of Chemical Kinetics, Longman

BOOK FOR REFERENCES

1. Amdur, I. and Hammes, B.B 1966, Chemical Kinetics – Principles and selected topics, McGraw Hill.
2. Frost A.A and Pearson R.G, 1970, Kinetics and Mechanism, John-Wiley Eastern.
3. Benson, S., 1960, Foundations of Chemical Kinetics, McGraw Hill.

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	Paper IV: MAJOR ELECTIVE - MATERIAL CHEMISTRY
Total Hours	90
Hours/Week	6
Code	MPH19CH1E05
Course Type	Theory
Credits	4
Marks	100

UNIT-1 - ORGANOMETALLIC COMPOUNDS

Functional Organic Materials

Introduction to material science- Classification and examples of application of functional (in)organic molecules.

Organic Electronics

Electron transport in organic materials- chiral and achiral organic (supra) conductors- n,p type semi conductors-OLED and OFT – solar cell materials.

UNIT –II METAL-ORGANIC FRAMEWORKS I & II

Metal-organic frameworks I Definition, nomenclature and classification of metal-organic frameworks (MOF's). Synthesis, physico-chemical properties and catalytic applications. Framework solids: silicates, zeolites, alumino phosphates. Metal-organic frameworks, covalent-organic frameworks – their structure and properties.

Metal-organic frameworks II Molecules encapsulation in MOF's and its applications – molecular gas cylinders (hydrogen, methane, acetylene), drug carriers (ibuprofen). Nanotechnologies based on MOF's.

UNIT- III ANALYTICAL TECHNIQUES

IR Spectroscopy: Modes of vibrations, instrument, sampling techniques, selection rules, Absorption frequencies of common functional groups, Application to structure determination, monitoring reactions. Electron beam instruments: Transmission electron and scanning electron microscopes, Auger electron spectroscope, x-ray spectrometers, electron microprobe, electron spectrometers. Interpretation of diffraction information: selected area and convergent beam Electron diffraction patterns. Analysis of micrographs in EDAX, TEM, SEM, and HRTEM: Theories of diffraction contrast in TEM, analysis of images in TEM and SEM.

UNIT- IV NANOTECHNOLOGY AND ITS APPLICATIONS:

Introduction to nanoscience and technology, terminology and history, optical and semiconducting properties of nanoparticles, metallic nanoparticles, top-down and top-up fabrication,

solution based and vapour phase synthesis, synthesis of frameworks, supports and substrates, physical and chemical vapour deposition, artificially layered materials, quantum wells, self-assembled nanostructures, supramolecular chemistry and morphosynthesis, dimensional control; carbon nanotubes, mesoporous materials and metal organic frameworks.

UNIT- V NANOTECHNOLOGY IN DRUG DELIVERY

Introduction, Manufacturing of Nanoparticles, Nanoparticles, Drug deliveries, Drug delivery system, Nanoparticle in Drug delivery Available applications, Nanotechnology future application understanding for treatment. Manufacture of Nanoparticles, Nanoparticles, Drug Delivery, Drug Delivery Systems, Nanopowder and Nanocrystals, Targeting Ligands Applications of Nanoparticle in Drug Delivery, Cancer Treatment.

TEXT BOOKS

1. "Inorganic Chemistry" by J E Huheey 6th Edition.
2. Douglas B. Murphy Fundamental of Light Microscopy and Electronic Imaging Kindle Edition 2001
3. Joachim Frank Three-Dimensional Electron Microscopy of Macromolecular Assemblies: Visualization of Biological Molecules in Their Native State , Kindle 2000.

BOOK FOR REFERENCES:

1. Nanotechnology in Biology and Medicine: Methods, Devices and Application by Tuan Vo-Dinh .CRC press, 2007.
2. P. Silva, S. M. F. Vilela, J. P. C. Tomé and F. A. A. Paz, Multifunctional metal–organic frameworks: from academia to industrial applications, *Chem. Soc. Rev.*, 2015, 44, 6774-6803.
3. S-Y. Ding and W. Wang, Covalent organic frameworks (COFs): from design to applications, *Chem. Soc. Rev.*, 2013, 42, 548-568

For Students admitted from June 2019 onwards
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	PAPER IV- ELECTIVE–NANO CATALYSTS AND ITS APPLICATIONS
Total Hours	90
Hours/Week	6
Code	MPH19CH1E06
Course Type	Theory
Credits	4
Marks	100

UNIT I: FUNDAMENTALS OF CATALYSIS

Acid-base catalysis – catalysis by transition metal ions and their complexes – supported transition metal complexes as catalysts – catalysis by enzymes – phase transfer catalysis - photocatalysis – adsorption – chemisorption on metals, metal oxides and semiconductors. Catalyst deactivation and regeneration.

UNIT II: NANOMATERIALS SYNTHESIS

Top-down approach (physical vapor deposition, chemical vapor deposition, lithographic method and high energy method) – bottom-up approach (sol-gel, co-precipitation, microemulsions, hydrothermal and solvothermal methods, template synthesis) – growth mechanism (vapor- liquid-solid, solid-liquid-solid).

UNIT III: NANOMATERIALS CHARACTERIZATIONS

Structural characterization (XRD, SAXS, SEM, TEM, SPM) – chemical characterization (optical spectroscopy, electron spectroscopy, ionic spectrometry) – surface characterization (XPS, AES, SIMS).

UNIT IV: WATER POLLUTION

Water quality parameters and standards – turbidity, color, pH, acidity, solids, hardness, chlorides, residual chlorine, sulphates, fluorides, phosphates, iron and manganese, nitrogen, DO, BOD, COD, grease, volatile acids – analytical techniques in water analysis – soil pollution.

UNIT IV: WASTEWATER TREATMENT

Primary treatment - equalization, neutralization, proportioning, sedimentation, oil separation, floatation, coagulation- aeration – air stripping of volatile organics; biological treatment process- lagoons, activated sludge process, trickling filtration, anaerobic decomposition – adsorption – theory

of adsorption - properties of activated carbon – ion-exchange, chemical oxidation - ozone, hydrogen peroxide, chlorine – wet oxidation; photochemical oxidation.

TEXT BOOKS

1. B.Viswanathan, Catalysis selected application, Narosa, 2009.
2. Gabor L. Hornyak, JoydeepDutta, Harry F. Tibbals and Anil K. Rao, Introduction to nanosciences, CRC press, Taylor and Francis (2008).
3. GuoZhongGao, Nanostructures and nanomaterials: synthesis, properties and applications, Imperial college press (2004).
4. S.S. Dara (2002), A Text Book of Environmental Chemistry and Pollution control – 5th Revised Edition, S. Chand and company.

BOOK FOR REFERENCES

1. J.M.Thomas and W.J.Thomas, Principles and Practice of Heterogeneous Catalysis, VCH Publishers Inc., New York, USA., 2008.
2. Zhen Gao, Li Tan, Fundamentals and application of nanomaterials, Artech house, Boston (2009).
3. Duncan W. Bruce, DermofO‘Hare, Richard I. Walton, Porous materials, John Wiley and sons, Ltd (2011).
4. Didier Astruc, Nanoparticles and catalysis, Wiley–VCH (2008).
5. A.K De, “Environmental Chemistry”, 5thEdn., New Age International Pub., New Delhi (2004).

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HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	PAPER IV – MAJOR ELECTIVE - PHYTOCHEMISTRY
Total Hours	90
Hours/Week	6
Code	MPH19CH1E07
Course Type	Theory
Credits	4
Marks	100

UNIT I: PLANTS AND PLANT PRODUCTS

Classification of Plants - Nomenclature - Cells - Tissues - Structures and Functions of Cells and tissues - Primary Metabolites - Secondary Metabolites - Microorganism- Types -Microbes and Man - Biological Activities - Microbial Studies - Techniques - Interpretation of Results.

UNIT II: METHODS OF PLANT ANALYSIS I

Methods of Extraction - Cold Percolation Method - Soxhlet Method - Methods of Isolation - Methods of Separation. Chromatography - Paper Chromatography - Column Chromatography - Thin layer Chromatography - Gas Chromatography - High performance Liquid Chromatography. Electro phoresis - Paper and Gel Electrophoresis - Distillations - Steam Distillation -Fractional Distillation - Vacuum Distillation - Crystallization Techniques

UNIT III: METHODS OF PLANT ANALYSIS II

UV-VIS spectroscopy - IR Spectroscopy - Proton and Carbon-13 NMR Spectroscopy - Mass Spectroscopy - X-ray and Neutron Diffraction studies - Optical studies - Qualitative and Quantitative Analyses - Interpretation of Results.

UNIT IV: PHENOLIC COMPOUNDS AND TERPENOIDS

Methods of separation, isolation and identification - Phenolics - Phenyl propanoids - Anthocyanins - Flavonoids - Xanthenes - Stilbenes - Chemical conversions of these compounds - Structure Elucidation of Quercetin, Vitexin and Naringin. Methods of separation, isolation and identification - Monoterpenes - Sesquiterpenes - Diterpenes - Triterpenoids - Steroids - Carotenoids - Chemical conversions of these compounds - Structure Elucidation of Menthol and Carotol.

UNIT V: NITROGEN COMPOUNDS, SUGARS, LIPIDS AND OTHER RELATED COMPOUNDS

Methods of separation, isolation and identification - Amino acids - Proteins - Peptides - Amines - Alkaloids - Cyanogenic glycosides - Purines - Pyrimidines - Cytokinins - Chlorophylls - Chemical conversions of these compounds - Structure Elucidation of Nicotine and Cytisin.

TEXT BOOKS:

1. Peach K and Tracey MV (eds.), 1956-1964, *Moderne der pflanzenanalyse*, Berlin, Spingerverlag.
2. Krishnasamy N.R, 1999, *Chemistry of Natural Products*, Hyderabad, University Press.
3. Boyer RF, 1993, *Modern Experimental Biochemistry*, II Ed., California, The Benjamin Cummings publishing company Inc.
4. Furniss BS, Hannaford AJ, Smith PWG and Tatchell AR, 1989, *Vogel's Text book of Practical Organic Chemistry*, V Ed., Essex, England, ELBS with Longman.
5. Harborne JB, 1988, *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*, II Ed., London and New York, Chapman and Hall.

BOOK FOR REFERENCES

1. Finar I.L. *Organic Chemistry*, Vol. 2. ELBS London
2. Raphael Ikan, 1969, *Natural Products: A Laboratory Guide*, Jerusalem, Israel University Press.
3. Jeffrey C, 1982, *An Introduction Plant Taxonomy*, II Ed., Cambridge, Cambridge University Press.
4. William J and Sham M, 1976, *Microorganisms*, London, Mills and Boon Limited

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HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 2
PG & RESEARCH DEPARTMENT OF CHEMISTRY
M.Phil CHEMISTRY – SEMESTER I

Course Title	Paper IV: MAJOR ELECTIVE – SYNTHETIC ORGANIC CHEMISTRY
Total Hours	90
Hours/Week	6
Code	MPH19CH1E08
Course Type	Theory
Credits	4
Marks	100

UNIT I: REAGENTS IN ORGANIC SYNTHESIS

Reactions for C–C bond formation – Organometallic reagents for C–C bond formation – Reagents for selective reductions – Reagents for selective oxidations – Functional group interconversions – Protection and deprotection strategies.

UNIT II: ORGANIC REACTION MECHANISMS

How to write an organic reaction mechanism – Influence of aromaticity – Aromatic nucleophilic and electrophilic substitution reactions – Aliphatic nucleophilic and electrophilic substitution reactions – Reactions involving reactive intermediates viz., carbocation, carbanion, carbene, radicals, benzyne, and nitrene. Popular named reactions viz., Reimer-Tiemann reaction, Beckmann rearrangement, Friedel-Crafts reaction, Aldol condensation, and Perkin reaction – Halogenation of alkane and alkene.

UNIT III: OXIDATION AND REDUCTION REACTIONS FOR FUNCTIONAL GROUP TRANSFORMATIONS

One electron transfer – Hydride transfer – Catalytic Hydrogenation – Named reduction reactions – Reducing agents – Oxidizing agents – Named oxidation reactions – Oxidation involving ozone and peroxides – Catalytic oxidation reactions – Examples of oxidation and reduction in total synthesis.

UNIT-IV: ADDITION AND ELIMINATION REACTIONS FOR FUNCTIONAL GROUP TRANSFORMATIONS

Addition to multiple bonds – Hydrogen addition – Alkyl halide addition – Halogen addition – Elimination reactions leading to multiple bond formation – Dehydration reactions – Hydrogen bromide elimination – Stereochemical consequences of addition and elimination reactions.

UNIT-V: SYNTHESIS OF HETEROCYCLIC MOLECULES

Retrosynthesis – disconnection approach – synthons, linear and convergent synthesis – Cyclization reactions – Reaction of carbon nucleophiles with carbonyl compounds – Regioselective reactions – Metathesis reactions.

TEXTBOOKS

1. March. J., (1999) Advanced Organic Chemistry, 4thEdn., Wiley Eastern Ltd.
2. Carey, F.A and Sundberg R.J, (1990), “ Advanced Organic Chemistry-Part B”, Springer.
3. Sanyal.S.N, (2013) “Reactions, Rearrangements & Reagents”, BharathiBhavan

BOOK FOR REFERENCES:

1. Clayden.J (2012) “Organic Chemistry”, 2ndEdn., Oxford University Press
2. Mukherji. S.M and Singh. S.P., (1978) Reaction mechanism in organic chemistry, 3rdEdn., McMillan.