PG & RESEARCH

DEPARTMENT OF CHEMISTRY

HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2

SCHOOL OF PHYSICAL SCIENCES

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

COURSE STRUCTURE (I & II SEMESTER) – CBCS

(For Candidates admitted from June 2020 onwards)

	Program Outcomes: ***Upon completion of the B.Sc. Degree Programme, the graduate will***
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: ***Upon completion of the B.Sc. Degree Programme, the graduate would***
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.

HOLY CROSS COLLEGE (Autonomous), TIRUCHIRAPPALLI – 2

SCHOOL OF PHYSICAL SCIENCES

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

COURSE STRUCTURE (I & II SEMESTER) – CBCS

(For Candidates admitted from June 2020 onwards)

Semester	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	Major Core1- Inorganic, Organic and Physical Chemistry	U20CH1MCT01	5	4	100
		Major Core – 2	Major Core 2- Volumetric Analysis (Lab cum theory)	U20CH1MCP02	4	3	100
		Major Core -3	Major Core 3- Analytical Chemistry	U20CH1MCT03	4	4	100
		Allied – 1	Differential Calculus and Trigonometry/ Biomolecular Chemistry	U20MA1ALT02/ U20BC1ALT01	4	2	100

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		Allied – 2	Algebra and Integral Calculus/ Practical	U20MA1ALT07/ U20BC1ALP02	4	2	100
	IV	Environmental Studies	Environmental Studies	U20RE1EST01	2	1	100
		Value Education	Ethics-I/ Bible Studies-I/ Catechism-I	U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01	1	-	-
		Service Oriented Course		-	-	-	
		Internship / Field Work / Field Project 30 Hours - Extra Credit		U20SP1ECC01	-	2(Extra Credit)	100
		Total			30	22 +2	800 +100
Semester	Part	Course	Title of the Course	Code	Hrs/ Wk	Credits	Marks
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	Major Core 4- Organic and Physical Chemistry	U20CH2MCT04	6	5	100
		Major Core –5	Major Paper 5- Semi-micro Qualitative Analysis (Lab cum Theory)	U20CH2MCP05	4	3	100
		Major Elective - 1	Major Elective paper-I Nanoscience and	U20BT2MET01	4	3	100

Candidates admitted from the academic year 2020-21 onwards)

			Nanotechnology for Chemical Sciences				
		Allied – 3	Analytical geometryof three dimentions, vector calculus and differential equations / Enzymes and Enzyme Technology	U20MA2ALT09/ U20BC2ALT03	4	2	100
	IV	Skill-based Course(SBC)– 1	Soft Skill Development	U20RE2SBT01	2	1	100
		Skill-based Course(SBC)– 2	Sustainable Rural Development and Student Social Responsibility	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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002
SCHOOL OF PHYSICAL SCIENCES
PG & RESEARCH DEPART MENT 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	apply the fundamental principles of atomic theory to explain the structure of the atom and understand the postulates of quantum mechanics
CO-2	describe the position of elements in the modern periodic table and assess the trend in periodic properties.
CO-3	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-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 1- FUNDAMENTALS OF QUANTUM CHEMISTRY 12Hrs

1.1. Atomic structure - Rutherford's nuclear model of atom. Planck's Quantum theory of radiation. Photoelectric effect and quantum theory.

1.2. Bohr's model of an atom. Bohr's theory and the origin of hydrogen spectrum. Somerfield's extension of Bohr's theory.

1.3. Particle and wave character. de Broglie's equation. Heisenberg's uncertainty principle.

1.4. Compton effect. Postulates of Quantum mechanics. Schrodinger wave

equation. Significance of ψ and ψ^2, Radial and angular functions. Quantum Numbers – wave picture of electron. Concept of atomic orbitals – shapes of s, p & d orbitals, nodal planes and nodal points in atomic orbitals.

Extra reading/Keywords*:* *Problems in Planck's quantum theory and particle in cubical box.*

UNIT -II PERIODICITY 12Hrs

2.1 Periodic variation of properties of elements – effective nuclear charge, screening effect, slater's rule. Periodicity of properties of s, p, d and f block elements with respect to atomic radii, ionic radii, ionisation energy, electronegativity, electron affinity, flame colouration, reducing properties, hydration of ions, oxidation of ions and oxidation potential.

2.2 Chemistry of s- block elements – Discussion of alkali metal group with group with respect to their oxides, halides and hydroxides.

2.3 Comparison of Li with other elements, diagonal relationship between Li and Mg

2.4 Alkaline earth metals – Discussion of alkaline earth metals with respect to their oxides, halides and hydroxides. Comparison of Be with other elements, diagonal relationship between Be and Al. Importance of Crystands and crown ethers, CaC_2, $CaCN_2$, plaster of paris,Epsom salt

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

UNIT -III CHEMICAL BONDING **12Hrs**

3.1 Ionic bond -Properties of ionic compounds – Factors favouring the formation of ionic compounds (ionization energy, Electron affinity, Electro negativity andLattice energy) – Lattice energy – definition, Born Lande equation (Derivation not required) factors affecting lattice energy – Born Haber cycle – Illustration and calculation for NaCl

3.2 Covalent bond – Covalent character in ionic bond, polarisation of ions and Fajan's rules with illustrations, percentage ionic character of a polar covalent bond.

3.3 Prediction of the molecular shapes – Valence Bond theory – Hybridization and geometry of molecules. VSEPR theory – Structures of CH_4, H_2O, NH_3, SF_4, XeF_2, XeF_6.

3.4 MO theory - LCAO method, criteria of orbital overlap, types of molecular orbitals (sigma and pi).Qualitative MO energy level diagram of homo and hetero diatomic molecules H_2, He_2, N_2, O_2, and CO, bond order and stability of molecules.

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

UNIT- IV

FIRST LAW OF THERMODYNAMICS AND THERMOCHEMISTRY **12Hrs**

4.1 Importance and Limitations of Thermodynamics. Terms and definitions – system, macroscopic properties, state variables, thermodynamic equilibrium, extensive and intensive properties, processes and their types, exact and inexact differentials, concept of heat and work.

4.2 First Law of Thermodynamics: Statement, the energy content, work, heat and energy changes, thermodynamic reversibility, work of expansion against constant external pressure, isothermal reversible work of expansion. Heat changes at constant volume and constant pressure, heat content, relationship between Cp and Cv, reversible adiabatic expansion and compression,

4.3 Thermochemistry - Joule-Thomson experiment, Joule-Thomson coefficient – derivation, derivation of inversion temperature in terms of Vanderwaal's constants.

4.4 .Heat of reaction, relationship between heat of reaction at constant pressure and at constant volume, types of heat of reactions – . Effect of temperature on heat of reaction – Kirchoff's equation, Thermochemical laws, Bond energies.

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

UNIT V - INTRODUCTION TO ORGANIC CHEMISTRY **12Hrs**

5.1 IUPAC Nomenclature of Organic Compounds. Isomerism-Types and examples Types of covalent bonds – σ,π bond, Polarity of covalent bonds. Hybridization – sp, sp^2 , sp^3.

5.2 Nature of Bond Fission – Homolytic and Heterolytic Cleavages.Types of Reagents – Electrophiles and Nucleophiles.Types of Organic Reaction: Substitution, Addition, Elimination and Rearrangement Reactions (Definition with an example)

5.3 Reactive Intermediates: Carbocations, Carb anions and Free Radicals - Formation, Stability and Structure, their Reactions with Examples.

5.4 Electron Displacement Effects - Inductive, Electromeric, Mesomeric, Resonance, Hyper- Conjugation and Steric Effect.

Extra reading/Keywords*:**Writing the IUPAC Name of organic compoundsand identifying the type of organic reactions*

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 dressed	Cognitive Level
CO-1	Describe the shapes of atomic orbitals	PSO2	R
CO-2	Compare and contrast the periodic properties of elements	PSO1	Ap
CO-3	Interpret the geometry of molecules using VSEPR	PSO4	An
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.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

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 - 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 $K_2Cr_2O_7$, internal indicator, external indicator, starch, iodimetry and iodometry. Precipitation titrations – conditions for precipitation titration and indicators.

1.4 Complexometric titration:-EDTA titrations, indicators of EDTA titrations, complexometric titration curves, EDTA – titration methods – masking of ions, precautions to avoid errors in titrimetric analysis, corrections for unavoidable errors.

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

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 wordsmust 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-5	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 DEPART MENT 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: *Hazardous waste management.*

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: *Problems.*

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: *Concept of ionic products, precipitation*

UNIT 5 – CHROMATOGRAPHY **12Hrs**

5.1 Column chromatography – Principle, types of adsorbents, preparation of column, elution, one application– separation of 2,4–dinitrophenyl hydrazones of butanone and acetophenone, Rf value and its significance, factors affecting Rf value.

5.2 Paper chromatography – principle, selection of solvents, development of chromatogram, applications – separation of amino acids only.

5.3 Thin layer chromatography–principle, choice of adsorbent, preparation of plates, development and application – separation of 2,4-dinitrophenylhydrazones of butanone and acetophenone only.

Extra reading/Key words: *Ion exchange and GC- MS chromatograph*y

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)

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT 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	**4**
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

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 effects operating in types of organic Reactions.	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

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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. Jain M.K, Sharma S.C, *Modern Organic Chemistry* , Vishal Publishing Co,. 2007

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT OF CHEMISTRY

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	**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,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, Equivalent weights of acid, base, salt, oxidizing and reducing agents.

1.2 Standard solution, requirements of a primary standard, preparation of standard solution, secondary standard, principle of volumetric analysis.

1.3 Acid-Base titrations – HCl with NaOH, CH_3COOH against NaOH, Na_2CO_3 with HCl. Acid-Base indicators – Ostwald's theory and quinonoid theory.

1.4 Redox titrations – Mohr salt against $KMnO_4$, Oxalic acid with $KMnO_4$, $FeSO_4$ against $K_2Cr_2O_7$. Redox indicator – Diphenyl amine, Iodometry - Estimation of copper sulphate

Extra reading/Keywords:*EDTA Titrations*

VOLUMETRIC ANALYSIS (DOUBLE TITRATION WITH WEIGHING):

(3 hrs. External)

I Acidimetry and Alkalimetry:

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

II Permanganometry:

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

III Iodometry:

5. Estimation of copper sulphate

IV Dichrometry:

6. Estimation of iron (internal indicator)

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 DEPART MENT 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 refinnig, 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 and reactions. Stability - Baeyer's strain theory, Sachse- Mohr theory, Coulson and Moffit's concept, orbital picture of angle strain.

1.4. Conformational analysis: conformers, configuration, dihedral angle, torsional strain (Definitions). Conformational analyses of ethane, n - butane and cyclohexane – axial and equatorial bonds, ring flipping showing axial and equatorial bonds and their inter- conversions.

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 KMnO4, allylic bromination by NBS.

2.3. Dienes: Types, Stability of dienes (conjugated, isolated and cumulative dienes). General methods of preparation and Reactions- Mechanism of 1,2- and 1,4-additions, Diels- Alder reactions. Addition polymerization reactions, mechanism of Ziegler Natta polymerization.

2.4. Alkynes: Preparation- Mechanism of dehydrohalogenation and dehalogenation. Reactions: acidity of alkynes, formation of acetylides, Electrophilc 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 IIlaw, 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 different conformers of butane and cyclohexane.	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 PhysicalChemistry*, (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.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

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

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 a given Salt Containing one Cation and one Anion (which will be aninterfering ion.)

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

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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HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002
SCHOOL OF PHYSICAL SCIENCES
PG & RESEARCH DEPART MENT 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	**4 Hrs /Wk**
Code	**U20CH2MET01**
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 **12Hrs**

2.1 Carbon nanotube: Types –SWNTs and MWNTs, Properties – mechanical, electrical, thermal and kinetic properties.

2.2 Synthesis of nanotubes – Carbon ARC method, laser evaporation, CVD and pyrolysis. Applications of carbon nanotubes.

2.3 Colloidal gold– 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 reactlon, 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	Recallsthe applications of carbon nanotubes and colloidal gold.	PSO-1	U
CO-3	Explains 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) Nano : 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.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

First Year - Semester – II

Course Title	**MAJOR ELECTIVE-1 – CHEMISTRY OF MATERIALS (FOR PHYSICS)**
Total Hours Code	**60 Hrs**
Hours/Week	**4 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 verities.
CO-4	learn the various metallurgical processes and extraction of metals from its ore.
CO-5	find the applications smart materials in technology.

Unit I- POLYMER, PLASTICS AND COMPOSITES **12 Hrs**

1.1 Definition of monomer, polymer. 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, engineering 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, verities of glass and thermoplastics.

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

Unit IV -METALLURGY **12 Hrs**

4.1 Metallurgical process – concentration of Ore, calcinations, 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 verities.	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

1. Jain M.K., Sharma S.C., (2012), Modern organic chemistry, Fourth edition, Vishal Publishing Co., Jalandhar.

2. Soni P.L., Mohan Katyal., (1996), Text book of 'Inorganic Chemistry', Sultan Chand and Sons, New Delhi.

3. R. Jayaprakash, Engineering Chemistry I, CBS Publishers& Distributors Pvt.Ltd, New Delhi.

4. Vijayamohanan K Pillai, Meera Parthasarathy, Functioal 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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HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620 002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT OF CHEMISTRY

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	**3**
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 compouds

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 Λo of a weak electrolyte, Conductometric titrations –HCl Vs NaOH, KCl Vs $AgNO_3$, CH_3COOH 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	Discuss 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*, 20^{th} 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.

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

HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI- 620002

SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPART MENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM

B.Sc. CHEMISTRY

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

21 Classification of dyes according to application and structure. Malachite green, Methyl orange, Bismarck brown. Phenolphthalein, Fluorescein, alizarin, Indigo – preparation and uses.

22 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 refining and recovery

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.