B.Sc. CHEMISTRY SYLLABUS

(Under Choice Based Credit System – CBCS)

For the students admitted in the academic year

2022 -2023

P.G. AND RESEARCH DEPARTMENT OF CHEMISTRY

Bishop Heber College(Autonomous)

(Nationally Reaccredited at the A+ Grade by NAAC
With a CGPA of 3.58 out of 4)
(Recognized by UGC as "College of Excellence")

Tiruchirappalli – 620 017

JUNE 2022

PG & Research Department of Chemistry

Bishop Heber College (Autonomous),

Tiruchirappalli – 620 017

VISION

The PG & Research Department of Chemistry envisions…

To transform students into globally-competent graduates by providing a vibrant, Innovative and all - inclusive learning environment that fosters Values, Professional ethics and Social Consciousness.

MISSION:

To reach its vision the Department would

- offer a Quality and Comprehensive Curriculum
- facilitate a Competent Learning Environment
- create an Integrated Research Culture
- foster Industry – Academia Network for education
- inspire to Innovate

Programme Outcomes – B.Sc. Chemistry

On successful completion of B.Sc. Chemistry Programme, the Grandaunt will beable to …

Knowledge

PO1 comprehend knowledge of basic concepts, fundamental principles and the scientific theories related to various scientific phenomena and their relevance to day-to-day life.

PO2 exhibit a scientific acumen and outlook in all walks of life in order to provide creative solutions for a sustainable future.

PO3 critically analyze and interpret scientific data in a logical and systematicmanner to arrive at objective conclusions.

Attitudes

PO4 show inclination to lifelong learning and adaptability to challenging situations.

Skills

PO5 acquire the ability to synthesize, separate and characterize compounds using laboratory and instrumentation techniques.

PO6 handle scientific instruments and tools with ease and to choose the appropriate scientific methods and experiments to test and produce reliable results.

PO7 communicate effectively in oral, written and electronic formats and display personal and interpersonal skills.

PO8 exhibit analytical skills and problem-solving skills using the principles of chemistry and its allied fields.

Ethical & Social Responsibility

PO9 practice professional, ethical, moral and social values in personal and social life and would contribute to nation building.

PROGRAMME SPECIFIC OUTCOMES – B.Sc. Chemistry

On successful completion of B.Sc. Chemistry Programme, the Graduand willbe able to ...

Intellectual Skills

PSO1 Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the different areas of chemistry.

Practical Skills

PSO2 Perform documented laboratory procedures involved in synthetic and analytical work, in relation to inorganic and organic systems by following standard laboratory safety protocols.

Transferable Skills

PSO3 Apply numeracy, mathematical and digital skills to error analysis, order- of-magnitude estimations, standard unit usage, modes ofdata presentation and scientific documentation.

PSO4 Use the evidence based comparative chemistry approach to explain the chemical the properties and reactions of various types of elements and compounds.

PROGRAM ARTICULATION MATRIX- B.Sc. Chemistry (2022-23)

S. No	Name of the Course	CourseCode	Correlation with PROGRAM OUTCOMES (PO) andPROGRAM SPECIFIC OUTCOMES (PSO)												
			P01	P02	P03	P04	P05	P06	P07	P08	P09	PS01	PS02	PS03	PS04
1.	General Chemistry-I	U22CH101	H	H	M	L	L	L	L	L	-	H	L	M	H
2.	Volumetric Analysis	U22CH1P1	H	H	H	L	H	H	L	H	-	H	H	M	H
3.	General Chemistry-II	U22CH202	H	H	L	-	-	-	M	H	-	H	-	M	H
4.	Applications of Computer in Chemistry	U22CH2:P	H	M	M	M	-	M	L	M	-	H	-	M	H
5.	Industrial Chemistry - I	U22CH2S1	H	H	-	M	-	-	L	-	-	H	-	-	H
6.	General Chemistry -III	U22CH303	H	H	H	-	-	-	-	M	-	H	-	-	H
7.	Inorganic Qualitative Analysis	U22CH3P2	H	M	M	L	H	H	L	H	L	H	M	L	H
8.	Inorganic Chemistry-I	U22CH404	H	L	L	L	M	M	L	L	-	H	L	L	H
9.	Organic Analysis	U22CH4P3	H	H	H	-	H	H	L	H	-	H	H	L	H
10.	Organic Chemistry-I	U22CH505	H	H	-	L	-	-	L	H	-	H	-	-	H
11.	Physical Chemistry-I	U22CH506	H	H	H	-	L	M	L	H	-	H	-	M	H
12.	Gravimetry, Organic & Inorganic Preparations & Determination of Physical Constants	U22CH5P4	H	H	M	L	H	H	L	H	-	H	H	L	H
13.	Analytical Chemistry/	U22CH5:2	H	H	L	L	-	-	-	L	-	H	-	-	H
	Forensic Chemistry/	U22CH5:A	H	-	H	M	H	H	-	H	-	H	H	M	H
	Polymer Chemistry	U22CH5:B	H	H	M	-	-	-	H	-	H	-	-	-	H
14.	Core - Project & Research Ethics	U22CH5PJ	H	H	H	H	H	H	H	H	H	H	H	H	H
15.	Industrial Chemistry - II	U22CH5S2	H	H	-	M	-	-	L	-	-	H	-	-	H
16.	Applied Chemistry Practical	U22CH5S3	H	H	-	L	-	-	L	-	-	H	L	L	H
17.	Inorganic Chemistry-II	U22CH607	H	H	H	M	-	-	-	H	-	H	-	-	H
18.	Organic Chemistry-II	U22CH608	H	H	-	-	M	-	L	H	-	H	-	-	H
19.	Physical Chemistry-II	U22CH609	H	H	H	-	M	M	L	H	-	H	M	M	H
20.	Physical Chemistry Practical	U22CH6P5	H	M	H	L	-	H	L	H	-	H	M	L	H
21.	Biochemistry/	U22CH6:3	H	H	M	M	H	H	L	-	-	H	H	M	H
	Agricultural Chemistry/	U22CH6:A	H	H	H	H	H	M	M	M	M	H	M	M	M
	Dairy Chemistry	U22CH6:B	H	H	M	L	H	H	M	M	L	-	-	M	-

B.Sc. Chemistry- Structure of the Programme

Sem.	Part	Course	Course Code	Course Title	Hrs./Week	Credits	Marks		
							CIA	ESA	Total
I	I	Tamil I /*	U18TM1L1	--	6	3	25	75	100
	II	English I	U16EGPL1	--	6	3	40	60	100
	III	Core I	U22CH101	General Chemistry-I	6	6	25	75	100
		Core Practical I	U22CH1P1	Volumetric Analysis	3	2	40	60	100
		Allied I	U16MAC11	Algebra and Calculus	5	4	25	75	100
			U19ZYY11	Biology of Invertebrates and Chordates	5*	5*	25*	75*	100*
	IV	Env. Studies	U16EST11	Environmental Studies	2	2	25	75	100
		VLO	U14VL1:1 / U14VL1:2	Value Education (RI/MI)	2	2	25	75	100
II	I	Tamil II / *	U18TM2L2	--	6	3	25	75	100
	II	English II	U16EGPL2	--	6	3	40	60	100
	III	Core II	U22CH202	General Chemistry-II	5	5	25	75	100
		Elective-I Practical	U22CH2:P	Applications of Computer in Chemistry	3	2	40	60	100
		Allied II	U16MAC22	Vector Calculus and Trignometry	4	4	25	75	100
			U19ZYY22	Human physiology and Economic zoology	4*	4*	25*	75*	100*
		Allied III	U16MAC23	Differential Equations and Laplace Transforms	4	4	25	75	100
		Allied Practical I	U19ZYYP1	Biology of Invertebrates, Chordates, Human physiology and Economic Zoology	4	3	40	60	100
	IV	SBEC - I	U22CH2S1	Industrial Chemistry-I	2	2	25	75	100

III	I	Tamil III/*	U18TM3L3	--	6	3	25	75	100
	II	English III	U16EGPL3	--	6	3	40	60	100
	III	Core III	U22CH303	General Chemistry -III	6	5	25	75	100
		Core Practical II	U22CH3P2	Inorganic Qualitative Analysis	3	2	40	60	100
		Allied IV / Allied III	U18PHY33	Mechanics, Sound, Thermal Physics and Optics	4	3	25	75	100
		Allied Practical II	U16PHYP1	Allied Physics Practical	3	-	-	-	-
	IV	NMEC I		***To be selected from the courses offered by other departments***	2	2	25	75	100
IV	I	Tamil IV/*V	U18TM4L4	--	5	3	25	75	100
	II	English IV	U16EGPL4	--	5	3	40	60	100
	III	Core IV	U22CH404	Inorganic Chemistry-I	6	5	25	75	100
		Core Practical III	U22CH4P3	Organic Analysis	3	2	40	60	100
		Allied V/ Allied IV	U16PHY44	Electricity, Atomic Physics and Digital Electronics	4	4	25	75	100
		Allied Practical II	U16PHYP1	Allied Physics Practical	3	3	40	60	100
	IV	NMEC II		***To be selected from the courses offered by other departments***	2	2	25	75	100
		Soft Skills	U16LFS41	Life Skills	2	1	-	-	100
	V	Extension Activities	U16ETA41	NSS, NCC, Rotaract, Leo Club, etc.,	-	1	-	-	-
V	III	Core V	U22CH505	Organic Chemistry-I	6	6	25	75	100
		Core VI	U22CH506	Physical Chemistry-I	6	6	25	75	100

		Core. IV	U22CH5P4	Gravimetry, Organic & Inorganic Preparations & Determination of Physical Constants	6	3	40	60	100
		Elective II	U22CH5:2/ U22CH5:A/ U22CH5:B	Analytical Chemistry/ Forensic Chemistry/ Polymer Chemistry	4	4	25	75	100
		Core Project	U22CH5PJ	Project & Research Ethics	4	3	40	60	100
	IV	SBEC II	U22CH5S2	Industrial Chemistry-II	2	2	25	75	100
		SBEC III	U22CH5S3	Applied Chemistry Practical	2	2	25	75	100
VI	III	Core VII	U22CH607	Inorganic Chemistry-II	6	6	25	75	100
		Core VIII	U22CH608	Organic Chemistry-II	6	6	25	75	100
		Core IX	U22CH609	Physical Chemistry-II	6	6	25	75	100
		Core Practical V	U22CH6P5	Physical Chemistry Practical	5	3	40	60	100
		Elective III	U22CH6:3/ U22CH6:A/ U22CH6:B	Biochemistry/ Agricultural Chemistry/ Dairy Chemistry	6	5	25	75	100
	V	Gender Studies	U16GST61	Gender Studies	1	1	-	-	100
				Extra Credits-Internship*		2*			
				TOTAL		**140**			**4100**

Other Languages

Other Languages	Hindi	Sanskrit	French
Semester I	U18HD1L1	U17SK1L1	U18FR1L1
Semester II	U18HD2L2	U17SK2L2	U18FR2L2
Semester III	U18HD3L3	U17SK3L3	U18FR3L3
Semester IV	U18HD4L4	U17SK4L4	U18FR4L4

UG-Skill Based Courses (SBC)

Sem.	Course	Code	Title	Hrs.	Credits	Marks		
						CIA	ESA	Total
IV	SBC	U16LFS41	Life Skills	2	1	100	---	100

SBEC	Skill Based Elective Course
VLOC	Value added Life Oriented Course
NMEC	Non Major Elective Course
SBE	Skill Based Course
CIA	Continuous Internal Assessment
ESE	End Semester Assessment

Overall Consolidated Structure for B.Sc. Chemistry (2022 - 23)

Parts of the Curriculum			No. of Courses	No. of Hours	Credits	Total Credits
Part – I : Language			4	23	12	**12**
Part – II : English			4	23	12	**12**
Part-III (Majo						**66**
Core(Theory)			9	53	51	
Core (Practical)			5	20	12	
Core (Project)			1	4	3	
Elective (Theory)			2	10	9	**11**
Elective (Practical)			1	3	2	
Allied (Mathematics/ **Zoology)**	Maths		3	13	12	**22**
	Zoo	**T**	**2**	**10**	**10**	
		P	**1**	**3**	**2**	
Allied (Physics)		T	2	8	7	
		P	1	6	3	
Part – IV SBEC			3	6	6	**14**
NMEC			2	4	4	
VLO			1	2	2	
Env. Studies			1	2	2	
Part – V Extension			1	-	1	**3**
Gender Studies			1	1	1	
Life Skills			1	2	1	
Total			**42**	**180**	**140**	**140**

Structure of B.Sc. Chemistry Curriculum 2022-23

Semester- I

Course	Hours	Credit
Tamil	6	3
English	6	3
Core-I	6	6
Core-Practical.-I	3	2
Allied-I Maths /	5	4
Allied-I Zoo *	5	5
ES	2	2
VLO	2	2
7	30	22 / 23

Semester- II

Course	Hours	Credit
Tamil	6	3
English	6	3
Core-II	5	5
Elective – I (Practical)	3	2
Allied-II Maths /	4	4
Allied – II Zoo*	4	4
Allied-III Maths /	4	4
Allied Prac. –II Zoo*	4	3
SBEC – I	2	2
7	30	23 / 22

Semester- III

Course	Hours	Credit
Tamil	6	3
English	6	3
Core-III	6	5
Core-Practical.-II	3	2
Allied-IV Physics.	4	3
Allied Practical. Physics.	3	-
NMEC – I	2	2
6	30	18

Semester- IV

Course	Hours	Credit
Tamil	5	3
English	5	3
Core-IV	6	5
Core-Practical.-III	3	2
Allied-V Physics.	4	4
Allied Practical. Physics.	3	3
NMEC-II	2	2
Life Skills	2	1
Extension	-	1
9	30	24

Semester- V

Course	Hours	Credit
Core V	6	6
Core VI	6	6
Core Practical – IV	6	3
Elective – II	4	4
Core Project	4	3
SBEC – II	2	2
SBEC – III	2	2
7	30	26

Semester- VI

Course	Hours	Credit
Core VII	6	6
Core VIII	6	6
Core IX	6	6
Core Practical – V	5	3
Elective – III	6	5
Gender	1	1
6	30	27

Total Courses : 42
Total Credits : 140
Total Hours : 180

Core Course I : GENERAL CHEMISTRY – I

Semester : I **Code : U22CH101**
Credits : 6 **Total Hours : 90**
Hours/week : 6

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Recollect the atomic structure & Concept of Quantization.	K2	I
2	Reason out the periodicity of elements with their properties.	K4	II
3	Predict the shape of molecules based on VBT and VSEPR theories.	K4	III
4	Predict the stability of reactive intermediates	K4	IV
5	Balance chemical equations.	K3	V
6	Adhere first aid procedure, safety measures in chemistry laboratory	K3	V

2A. Syllabus

Unit I - Atomic Structure and Periodic Properties 18 Hours

1.1. Atomic structure: Atomic Model of Bohr - Spectrum of hydrogen - drawbacks of Bohr's theory. Dual nature of electron-Concept of Quantization – Principles of quantum Theory – Black body Radiation - Planck's Quantum theory- *de* Broglie equation, Heisenberg uncertainty principle, Derivation of Schrodinger equation - significance of ψ and ψ^2 – **Problems**.

1.2 Periodic Properties: Modern periodic Table – Full form with atomic Number - grouping of elements into different blocks, Variation of atomic volume, atomic and ionic radii, Effective nuclear charge - Slater's rule - ionization potential, comparison of IE of N and O; Mg and Al; Be and B, electron affinity and electronegativity along the periods and groups – Pauling's and Mullikan's scales of electronegativity **-** Factors affecting periodic properties – Aufbau's principle – Hund's rule.

Unit II - Main Block Elements 18 Hours

2.1 s - block elements: Comparative study of alkali and alkaline earth metal compounds – size of ions and atoms – Electronegativity - Ionization potential- **Problems**. Solubility of oxides, halides, hydroxides, carbonates and sulphates. Diagonal relationship between Li and Mg- Anomalous behavior of Be, H_2 and Li.

2.2 Zero group elements: General trends in Ionization Energy and Electron Affinity - Isolation of Noble gases from atmosphere and uses. Special properties of Helium - Compounds of Xenon – XeF_2, XeF_4, XeF_6, $XeOF_2$, XeO_2F_2, XeO_3, $XeOF_4$ - preparation, structure and uses. Clathrates - types and uses.

2.3 p – block elements: General trends in periodic properties – Electron affinity - Electronegativity –Ions and their properties – polarizability - polarizing power - Inert pair effect – Transition from non - metallic to metallic character – oxidation states – Fajan's rule in p - block- catenation – **Problems**.

Unit III - Theories of Chemical Bonding 18 Hours

3.1 Types of chemical bonds: Nature and properties **–** characteristics of ionic bonds **-**Lattice energy and Born-Haber Cycle - NaCl. Polarizing power and Polarizability of ions: Partial ionic character - Transition from ionic to covalent character and vice versa - Fajan's rule.

3.2 Hydrogen bonding: Nature, types and consequences. Intermolecular forces– London forces, van der Waals forces.

3.3 Theories of Bonding: VSEPR Theory - Shapes of simple inorganic molecules ($BeCl_2$, BF_3, $SiCl_4$, PCl_5, SF_6, IF_7, H_2O, ICl, ICl_3, BrF_3, IF_5, ICl_2^-, NH_3, XeF_6) containing lone pair and bond pairs of electrons – **Problems**.

3.4 M.O. Theory: Qualitative MO energy level diagram and bond order calculation of homo nuclear diatomic (N_2 and O_2) and hetero nuclear diatomic (CO and NO) molecules.

Unit IV - Bonding in Organic Compounds 18 Hours

4.1 Bond Formation: The Octet rule–Lewis Structures–Multiple bonds and their characteristics -bond length, bond angle, bond energy, bond polarity of some important bonds (C-C, C-O, C-N, C=C, C-Cl, C=O, H-H, O-H, N-H and S-H) - Hybridization and geometry of molecules (sp, sp^2, sp^3 - methane, ethane, ethylene and acetylene) - sigma and pi bonds. Rigidity of pi bonds – Rotation of single bonds -Electronegativity and Bond Polarity – Dipole moments of simple organic compounds.

4.2 Electron displacement effects: Inductive, Electromeric, Resonance effects & Hyperconjugation (5 examples each).

4.3 Cleavage of bonds: Homolytic and Heterolytic fission of carbon–carbon bonds - Reaction intermediates – Stabilities of free radicals, carbocations and carbanions (primary, secondary, tertiary) – Factors affecting stability of Reaction Intermediates – **Problems**.

Unit V Theories of Acids and Bases, Redox Reactions & Good Laboratory Practices (GLP) 18 Hours

5.1 Acids and bases: Arrhenius theory, Bronsted–Lowry concept and Lewis's concept, Factors that influence the strength of acids and bases. pH and pKa (**Problems**). Buffers – Types - buffer action -Henderson–Hasselbalch equations (**Problems**) - Hydrolysis of salts – neutralization. Hydrolysis of salts of strong acid and weak base & salt of weak acid and strong base-derivation of K_a, K_b and K_w **(Problems)**.

5.2 **Redox Reactions:** Oxidation and reduction reactions – Oxidation number concept of some important reagents-$KMnO_4$, $K_2Cr_2O_7$, CrO_3, H_2SO_5, $H_2S_2O_8$, Ferrous salts, CrO_5, $H_2C_2O_4$, I_2, $S_2O_3^{2-}$-Balancing redox equations by oxidation number method and ion electron method (**Problems)**

5.3 **Good Laboratory Practices - Maintenance** and Calibration of Glasswares - Measurements using standard Measuring flask, Pipette and Burette. General instructions about Storage and handling of different types of Chemicals (corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals). Simple Essential first aid procedure for accidents - acid in eye, alkali in eye, acid burns, alkali burns, bromine burns, poisoning, inhalation of gasses and heat burns.

Outfits for laboratory and Personal protective measures - Space management of Working table and Placement of reagents - Usage of Bunsen Burner- Lab Tour.

2B. Topics for Self-Study

S. No.	Topics	Web Links
1	Application of Schrodinger wave equation to Particle in one dimensional Box Model.	http://home.iitk.ac.in/~madhavr/ CHM102/P hysical/Lec3.pdf
2	Chemistry of Borazine, phosphazine	https://www.youtube.com/watch?v= YRlZ8HDttDc
3	MOT of delocalized Pi bonding (CO_3^{2-})	https://www.youtube.com/watch?v= 1felJvwr 5PU https://www.youtube.com/ watch?v=UjS_eT7t UYQ
4	Intermediate – Carbenes	https://www.youtube.com/watch?v =YJrzXHJ9I1M
5	Good Laboratory Practices	https://www.oecd.org/chemicalsafety/testing/oecdseriesonprinciplesofgoodlaboratorypracticeglpandcompliancemonitoring.htm

2C. Text Books

1. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers, New Delhi, 2017 **(Unit I, II, III)**

2. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand & Co. Ltd., New Delhi, 2012 **(Unit IV)**

3. B.R. Puri, L.R. Sharma and Madan S. Pathania, Principles of Physical Chemistry Vishal Publishing Co., Jalandhar, 2017 **(Unit V)**
4. P.L. Soni, H.M. Chawla, Text Book of Organic Chemistry , Sultan Chand & Sons, New Delhi,2004
5. R.L. Madan and G.D. Tuli, Inorganic Chemistry, S. Chand Co. Ltd., New Delhi,**2010 (UNIT 1-3)**
6. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House, Meerut**, 2016**
7. R.Gopalan, P.S Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 2003. **(Unit V)**

2D. Reference Books

1. J.D. Lee, "Concise Inorganic Chemistry", Oxford University Press, New Delhi, 2008.
2. Morrison and Boyd "Organic Chemistry" Pearson Education, 2016.
3. Peter Atkins and Julio de Paula, "Physical Chemistry" Oxford University Press, 2018.

3. Specific Learning Outcomes (SLOs)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
I	**Atomic Structure and Periodic Properties**		
1.1	Bohr's Am Model & Spectrum ofHydrogen and Draw backs	Define the details of theBohr's am model and itsH2 spectra	K1
	Wave Particle Duality-Concept of quantization- Principles of quantumtheory.	Apply the concept of Duality both microscopic & Macroscopic Particles	K3
	Black body radiation-deBroglie Equation-Heisenberg's Uncertainityprinciple	Identify the momentumand frequency of microscopic particles.	K2
	Schrodinger's Equation-Significance of ψ and ψ^2	Define the Physical Significance of the wavefunction	K2
	Orbital Concept	Relate stability of elements based on electronic arrangement.	K2
1.2	Periodic properties - ModernPeriodic table	Justify the position of elements in the periodictable	K4
	Variation of periodic properties along period and group-	Apply periodicity with various chemical & physical properties of elements.	K3
	Principles of Orbital Occupancy- Hund's rule and Aufbau's Principle	Apply the Orbital fill-up rules complete electronic configurations of elements.	K3
II	**Main Block Elements**		
2.1	s- Block elements Comparative study - Size of ions & Electronegativity & IP	Arrange the atoms according the gradation in the atomic properties of the elements in the S- block	K3

Unit/ Section	Course Content	Learning Outcomes	HBTLT
	Solubility of its compounds	Apply the role of atomic properties in solubilityof compounds of the s-block compounds	K3
	Diagonal relationship & anomalous behaviour	Relate the properties of diagonal elements	K2
2.2	Zero group element	Relate the Uniquenesses of the Zero group elements	K2
	General trends in ionization energy and electron affinity	Analyze across the groups & Periods the impact & gradation of Ionization Energy & Electron affinity	K4
	Isolation from atmosphere and uses	Explain the methods of Isolation of noble gases from atmosphere	K2
	Special properties of Helium	Compare the properties of Helium spectra	K2
	Compounds of Xenon-Preparation, structure and uses	Explain the details of the preparation of xenon compounds	K2
	Clathrates-Types and Uses	Explain the types & uses of Clathrates	K2
2.3	p-Block elements - General Trends in periodic properties	Describe the gradation in the atomic properties of the elements in the p-block	K2
	Electron affinity and Electronegativity - Ions and Properties-Polarizability, polarizing power,	Compare the reactivity and chemical behavior of compounds based on Polarizability principles	K4
	Inert pair effect	Identify the violation of group principle in selected elements due Inert pair effect	K2
	Transition from non-metallic metallic character	Apply the atomic properties identify the metallic nature	K3
	Fajan's Rule & p-block catenation	Analyze size selectivity of different cations and anions	K3
III	**Theories of Chemical Bonding**		
3.1	Types of chemical bonds-Nature and Properties	Recall the characteristics of Chemicals bonds	K2
	Ionic Bonds-Characteristics- Lattice energy and Born-Heber Cycle -NaCl	Identify Ionic bonds	K2
	Polarizability of Ions-Partial Ionic character-Fajans' Rule	Apply Fajan's rule in prediction of Ionicity.	K3
3.2	Hydrogen Bonding	Explain the features of hydrogen bonds	K2
	Nature-Type and Consequences	Classify stabilities of compounds based on hydrogen bonding	K2
	London Forces, Van der Waals forces	Explain the role of week interactions in chemical systems	K2

Unit/ Section	Course Content	Learning Outcomes	HBTLT
3.3	Theories of Bonding	Compare the theories of bonding	K4
	VSEPR Theory - Shapes of simple inorganic molecules containing lone pair and bond pair of electrons	Predict the geometry of simple inorganic molecules	K4
3.4	Molecular Orbital Theory	Explain the principles of Molecular orbitals	K2
	Qualitative Energy level diagram and bond order calculation For homonuclear and heteronuclear diatomic molecules	Construct the MO energy diagrams of some important diatomic molecules	K3
IV	**Bonding in Organic Compounds**		
4.1	Bond Formation -Octet rule and Lewis Structure	Draw the Lewis structure of compounds	K4
	Multiple bonds and their characteristics	Outline the Features of multiple bonds	K2
	Hybridization and geometry of molecules (sp, sp^2,sp^3)	Explain the Hybridisation scheme of alkenes, alkynes and substituted alkanes	K2
	Sigma and Pi bonds	Explain the orbital overlapment in sigma & pi bonds of simple organic compounds	K2
	Electronegativity and bond polarity	Explain the role of bond polarity in the given compound	K2
4.2	Electron displacement effects Inductive, Electromeric, Resonance and hyperconjugation (Examples)	Analyze the impact of different electronic effects in a given organic compound	K4
4.3	Cleavage of bonds	Compare the characteristics of types of fission reactions	K3
	Homolytic and Heterolytic fission of C-C bonds		
	Reaction intermediates and their stability (Free Radicals, Carbocations & Carbanions)	Classify the stabilities of reactive intermediate based on the electronic factors	K2
V	**Theories of Acids and Bases, Redox reactions & Good Laboratory Practices**		
5.1	Theories of Acids and Bases: Arrhenius, BL, And Lewis theories	Apply the features and importance of the theories of Acids& Bases	K3
	Factors influencing the strengths of acids and bases	Examine the strengths of acids & bases based on electronic Factors	K2
	pH and pKa	Compare the pKa& PH values of the given acids	K4
	Buffers-Types and Henderson- Hasselbalch Equation	Explain the Henderson- Hasselbalch Equation	K2
	Hydrolysis of Salts	Illustrate the mechanism of Hydrolysis of salts	K2

Unit/ Section	Course Content	Learning Outcomes	HBTLT
	Derivations of Ka, Kb, and Kw	Explain the mathematical expressions of Ka, Kb,and Kw	K2
5.2	Redox Reactions:	Recall the features ofRedox reactions	K2
	Oxidation and Reduction Reactions-Oxidation number concept of some important reagents($KMnO_4$, $K2Cr_2O_7$, CrO_3, H_2SO_5, $H_2S_2O_8$, ferrous salts, CrO_5, $H_2C_2O_4$, I_2, $S_2O_3^{2-}$)	Apply the - Oxidationnumber of compounds	K3
	Balancing redox equations by oxidation number and Ion-ElectronMethod.	Solve a Redox reaction	K3
5.3	**Good Laboratory Practices:**		
	Storage and handling of corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals	Describe the Safety measures to be taken store and handle Chemicals.	K3
	Simple first aid procedure for accidents - acid in eye, alkali in eye, acid burns, alkali burns, bromine burns, poisoning, inhalation of gases and heat burns	Choose appropriate first aid procedure for accidents.	K3
	Calibration of Glassware - Requisites for making standard Measuring flask, Pipette and Burette	Apply glassware calibration procedures.	K3
	Outfits for laboratory and Personal protective measures-Space management of Working table and Placement of reagents.	Choose appropriate outfits for laboratory	
	Usage of Bunsen Burner		
	Lab Tour		

4. Mapping (CO, PO, PSO)

GENERAL CHEMISTRY –I													
Code : U22CH101													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**H**	**M**	**M**	**L**	**-**	**-**	**L**	**L**	-	**H**	**-**	**-**	**H**
CO2	**H**	**H**	**H**	**L**	**-**	**-**	**L**	**L**	-	**H**	**-**	**-**	**H**
CO3	**H**	**H**	**M**	**L**	**_**		**L**	**M**	-	**H**	**_**	**-**	**H**
CO4	**H**	**H**	**M**	**L**	**H**	**L**	**L**	**H**	H	**H**	**M**	**H**	**H**
CO5	**H**	**H**	**L**	**L**	**M**	**L**	**L**	**L**	-	**H**	**M**	**H**	**H**
CO6	**H**	**H**	**H**	**-**	**-**	**-**	**L**	**L**	-	**H**	**H**	**M**	**H**

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : Dr. C. Raja

Head, Department of Chemistry : Dr J. Princy Merlin

Core Practical - I : VOLUMETRIC ANALYSIS

Semester : I **Code : U22CH1P1**
Credits : 2 **Total Hours : 45**
Hours/week : 3

1. **Course Outcomes**

After the completion of this course the students will be able

S.No.	Course Outcomes	Level
1	Apply knowledge of principles of volumetric Analysis estimate a given analyte.	K3
2	Perform a systematic and skillful volumetric analysis	K4
3	Prepare standard solutions with different concentration units	K4
4	Choose appropriate titrimetric method for a given sample.	K5
5	Produce accurate and precise results in a prescribed format	K5
6	Determine the quality of water used for different purposes	K3

2A - Syllabus

Principles of Volumetric Analysis: Mole concept**,** Atomic Mass, Molecular Mass, Equivalent Mass of some common oxidizing and reducing agents, concentration terms - ppm, mole fraction, normality, molarity, molality. Principle of titrimetry - neutralization point & end point – standard solution – primary and secondary standards. Types – neutralization, redox, complexometric and precipitation titrations. Indicators - fluorescent indicators, redox indicator, internal indicator, universal indicators.

Experiments:

I. Acidimetry – Alkalimetry

1. Preparation of standard solutions and dilutions
2. Estimation of Hydrochloric acid
3. Estimation of Sodium hydroxide

II. Permanganometry

4. Estimation of ferrous ion in Mohr's salt
5. Estimation of oxalic acid

III. Iodometry and Iodimetry

6. Estimation of copper
7. Estimation of potassium permanganate
8. Estimation of Iodine (Demonstration)

IV. Complexometry

9. Estimation of total hardness of water
10. Estimation of zinc in Talcum Powder

2B. Reference Books

1. Handbook Of Inorganic Qualitative Analysis by Maharudra Chakraborty, Scifinity Publication; 1st Edition (2019).
2. Vogel, Text Book of Quantitative Chemical Analysis, 6th edition, Pearson Education,2009.
3. Day R A., Underwood A l., (1991). Quantitative Analysis, (6th ed.,) New York: Pearson Emory University. Print.

3. Specific Learning Outcomes (SLOs)

Unit/ Section	Course Content	Learning Outcomes	HBTLT
1	**Acidimetry – Alkalimetry** Estimation of Hydrochloric acid Estimation of Sodium hydroxide	Evaluate the strength of acidsand bases.	K5
2	**Permanganometry** Estimation of ferrous ion in Mohr's salt Estimation of oxalic acid	Determine the concentrations of iron and oxalic acids by Permanganometry	K5
3	**Iodometry and Iodimetry** Estimation of copper Estimation of potassium permanganate	Determine the quantity ofcopper and $KMnO_4$ usingIodine.	K5
4	**Applied Experiments(Complexometry)** Estimation of total hardness ofwater Determination of Calcium in commercial Milk Powder using EDTA	Estimate the extent of hardness in given water sample. Estimate the quantity of calcium present in commercial milk powder	K5
5	**Demonstrative Experiment** Preparation of Distilled and Deionized water	Describe the set up of a water distillation and a deionizer unit	K2

4. Mapping (CO, PO, PSO)

GENERAL CHEMISTRY –I Code : U22CH1P1													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	L		H	H		L		H	H		H
CO2	H	H	H		H	H		H		H	H		H
CO3	H	H	H		H	H		H		H	H	H	H
CO4	H	H	H		H	H		H		H	H		H
CO5	H	H	H		H	H	H	H		H	H	H	H
CO6	H	H	H	L	H	H		H		H	H		H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II
2. Model Exams I and II
3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Dr. I. Sharmila Lydia**

Head, Department of Chemistry : Dr J. Princy Merlin

Core Course II : GENERAL CHEMISTRY – II

Semester : II **Code : U22CH202**
Credits : 5 **Total Hours : 75**
Hours/week : 5

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No	Course Outcomes	Level	Unit
1	Apply the IUPAC nomenclature name hydrocarbons	K3	I
2	Describe the chemistry of alkanes, cycloalkanes, alkenes, dienes and alkynes	K2	II
3	Describe the chemistry of Compounds of Boron, and carbon family	K2	III
4	Describe the chemistry of Compounds of Nitrogen and Oxygen family and the discuss the properties of binary compounds	K3	IV
5	Apply Gas laws to explain the behaviour of gaseous and liquid states in specific systems and the principles concerning solid state structures	K3	V
6	Classify different colloids used in day to day life	K4	V

2A. Syllabus

Unit I - Chemistry of Hydrocarbons **15 Hours**

1.1. IUPAC nomenclature of cyclic & acyclic alkanes: General structure of IUPAC names - Parent name – Root name- locants- branched and unbranched alkanes, alkyl groups, alkenes, dienes and alkynes (up to 20 carbon system).

1.2. Alkanes - Physical properties of Alkanes – Structure and reactions of C-C bonds – Oxidation, Aromatization, Pyrolysis and free radical substitution. Petroleum and petrochemicals - cracking, synthetic petrol, refining of gasoline, reforming, knocking, diesel engine fuel, Octane number and Cetane number.

1.3 Cycloalkanes - Preparation using Wurtz reaction, Kolbe's Electrolytic Synthesis, Dieckmann's ring closure and reduction of aromatic hydrocarbons – Substitution and ring opening reactions – Baeyer's strain theory (Mechanism for all reactions).

Unit II - Chemistry of Unsaturated Hydrocarbons **15 Hours**

2.1 Alkenes: Physical Properties of alkenes – electrophilic and free radical addition reactions (with mechanism) addition reactions of hydrogen,

hydrogen halides, (Markownikoff's rule), hydrogen bromide (peroxide effect) and Water. Hydroboration, formation of diols using Bayer's reagent, peroxybenzoic acid and OsO_4, oxidation of alkenes (ozonolysis and acidic $KMnO_4$), allylic substitution by NBS.

2.2 **Dienes:** Classification – isolated, conjugated and cumulated dienes. 1,3-Butadiene – preparation, chemical reactions – 1,2- and 1,4 -additions - Introduction to Pericyclic Reactions - Diels-Alder Reaction – Effect of substituents in dienes and dienophiles.

2.3 **Alkynes:** Preparation using-CaC_2**,** dehydrohalogenation of vicinal halides – Kolbe's electrolysis method, Properties – Addition of H_2O, HCN, Halogens and HX, reduction using Lindlar's catalyst, Na and liq. NH_3, Cyclisation of acetylene, Ozonolysis and oxidation with hot alkaline $KMnO_4$ and chromic acid – Acidity of alkynes.

III Chemistry of Group III & IV Elements 15 Hours

3.1 **Boron family:** Comparative study of boron family, inert pair effect, preparation, properties, structure and uses of boric acid, borax, diborane and borazole. **(**Self study: compounds of Al, precious gems, alums)

3.2 **Carbon family:** General characteristics of carbon group elements with reference to ionisation energy, catenation, inert pair effect and allotropy. Anomalous behaviour of carbon – comparison of carbon and silicon – allotropy of carbon – diamond – graphite – fullerene – graphene –intercalation compounds of graphite – structure of oxides – oxyacids and their salts – carbides and their classification – properties and uses of silica – preparation and properties of stannous chloride – white and red lead.

Unit IV Chemistry of Group – V, VI elements & Binary Compounds 15 Hours

4.1. **Nitrogen family**: Comparative study of halides and oxides of nitrogen group elements, preparation, properties of Oxyacids of nitrogen (HNO_2 and HNO_3) & Oxyacids of phosphorus (H_3PO_3, H_3PO_4, $H_3P_2O_7$) - preparation, properties and structure of hydrazine.

4.2 **Oxygen family**: Anomalous behavior of oxygen- preparation, properties, structure, Oxidation states and uses of sulphuric acid, Caro's acid, Marshall's acid and oleic acid. Classification of oxides based on chemical behavior (acidic, basic, amphoteric and neutral oxides) and based on oxygen content (normal, peroxide, superoxide, suboxide and mixed oxide). Preparation, oxidizing and reducing character of H_2O_2.

4.3 **Hydrides**: Types- salt like, covalent, diamond like, interstitial hydrides and uses.

Nitrides : Types-salt like, covalent, diamond like, interstitial, nitride complexes and uses.

Borides : Borides having isolated B atoms, Borides having chain of B atoms, Borides having extended 2-dimensional network, Borides having 3-dimensional network and uses.

UNIT V States of Matter **15 Hours**

5.1. **Gaseous & Liquid state**: Laws of gases– Avagadro's law –Ideal gas equation– R in different units. Kinetic theory of gases. *van der* Waals equation of state – modification of the equation at high, low and moderate pressures and temperature -law of corresponding states - critical states (with derivation) - determination of critical constants - Vapour pressure– Trouton's rule- Liquid Crystals - types and Uses.

5.2. **Solid state:** Elements of symmetry, space lattice and Unit cell, Bravais lattice– seven crystal systems – Differences between Crystallographic symmetry and Molecular Symmetry – Symmetry operations – Identification ofPoint Groups - lattice energy – law of rational indices – Miller indices – X-ray diffraction – Bragg's equation with derivation. Packing in Crystals, Determination of crystallite size using Sherrer Equation by powder XRD.

5.3 **Colloidal state**: Classifications of colloids – Methods of preparation of colloids - peptization, coagulation- Gold Number Rule – Bredict's Arc Method – Chemical Methods – Applications: Reverse osmosis – Desalination of sea water – Dialysis – Delta formation – Artificial rain – Purification of water (addition of polyvalent electrolytes), Sewage disposal- Cottrell's precipitator. Amphoteric nature of colloids, micelle formation of soaps & detergents. Cleansing action of soap- Liquid crystals – types, applications of liquid crystals.

2B. **Topics for Self-Study**

S. No.	Topics	Web Links
1.	Petrochemical Paradox	https://www.youtube.com/watch?v=VQlbiQj_49o
2.	Preparation of Liquid crystal	https://www.youtube.com/watch?v=ul2_mYkrkiE
3.	Colloids around us	https://www.youtube.com/watch?v=5ckvg2aeNbc&t=429s
4.	Packing efficiency in HCP structures	https://www.youtube.com/watch?v=TvRkqL2xid0&t=3 82s
5.	Main Block Elements	http://www.digimat.in/nptel/courses/video/104101090/L43.html
6.	Introduction to Solid State Chemistry	https://nptel.ac.in/courses/104104101
7.	Basic Organic Chemistry	https://nptel.ac.in/courses/104103071

2C. Text Books

1. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand Co Ltd., New Delhi, 2012. **(Unit I, II, III)**

2. B.R. Puri and L.R. Sharma and Madan S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., Jalandhar, 2017 **(Unit IV, V)**

3. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi, 2017 **(Unit V)**
4. P.L. Soni, H.M. Chawla, Text Book of Organic Chemistry, Sultan Chand & Sons, New Delhi,2004.
5. R.L. Madan and G.D. Tuli, Inorganic Chemistry, S. Chand Co . Ltd., New Delhi, 2010.
6. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House, Meerut, 2016.
7. Vogel, Text Book of Qualitative Chemical Analysis, 6th edition., Pearson Education, 2009.

2D. Reference Books

1. J.D. Lee, "Concise Inorganic Chemistry", Oxford University Press, New Delhi, 2008.
2. Morrison and Boyd "Organic Chemistry" Pearson Education, 2016.
3. Peter Atkins and Julio de Paula, "Physical Chemistry" Oxford University Press, 2018.

3. Specific Learning Outcomes (SLOs)

Unit/ Sec.	Course Content	Learning Outcomes	BTLT
I	**Chemistry of Hydrocarbons**		
1.1	**IUPAC Nomenclature cyclic & acyclic alkanes** :General structure of IUPAC names- Parent name - Root name- locants-branched and unbranched alkanes, alkyl groups, alkenes, dienes and alkynes.(up 20carbon system)	Apply the IUPAC nomenclature name hydrocarbons	K3
1.2	**Alkanes**: Physical properties of Alkanes	Interpret the general trends in the physical properties of alkanes	K3
	Structure and reactions of C-C bonds	Describe the structure and reactions of C-C bonds	K3
	Oxidation, Aromatization, Pyrolysis and free radical substitution.	Describe the reactions of alkanes	K2
	Petroleum and petrochemicals- cracking, synthetic petrol, refining of gasoline, reforming, knocking, diesel engine fuel and cetane number	Outline the importance of alkanes as petrochemicals	K2
1.3	**Cycloalkanes** : Preparation using Wurtz reaction, Dieckmann's ring closure and reduction of aromatic hydrocarbons - Substitution and ring opening reactions	Describe the methods of preparation of cycloalkanes Write the methods of preparation of a given cycloalkanes	K2 K3
	Baeyer's strain theory	Predict the stability of the different cycloalkanes	K5

Unit/ Sec.	Course Content	Learning Outcomes	BTLT
II	**Chemistry of unsaturated hydrocarbons**		
2.1	**Alkenes**: Physical Properties of alkenes.	Compare the physical properties of alkenes.	K3
	Electrophilic and free radical addition reactions (with mechanism)	Describe the mechanistic details of addition reactions in alkenes	K2
	Addition reactions of hydrogen, hydrogen halides, (Markownikoff's rule),	Predict the product of addition reactions using Markowanikoff's rule	K5
	Hydrogen bromide (peroxide effect) and Water. Hydroboration, formation of diols using Bayer's reagent, peroxybenzoic acid and OsO_4, oxidation of alkenes (ozonolysis, and acidic $KMnO_4$),	Utilize the different oxidation reagents for interconversion offunctional groups.	K3
	Allylic substitution by NBS	Write the conditions and mechanism of the given allylic substitution	K3
2.2	**Dienes** : Classification - isolated,conjugated and cumulated dienes - butadiene	Classify the diene based on the conjugation.	K2
	Preparation of dienes	Apply the general methods of preparation of dienes given cases.	K3
	Chemical reactions - 1, 2 and 1,4 additions, Thiels theory - Diels- Alder reaction.	Predict addition products based on Thiels, Markovikoff and Diels- Alder reactions	K5
2.3	**Alkynes**: Preparation - using CaC_2, dehydrohalogenation of vicinal dihalides - Kolbe's electrolysis method -	Describe the steps involved in the preparation of alkynes of different sizes	K2
	Properties - Addition of H_2O, HCN,Halogens and HX, reduction using Lindlar's catalyst, Na and liq NH- Cyclisation of acetylene, ozonolysis and oxidation with hot alk. $KMnO_4$ and chromic acid - acidity of alkynes.	Predict products of the reactions of alkynes	K3
III	**Chemistry of Group III & IV elements**		
3.1	**Boron family** : Comparative study of boron family	Illustrate the characteristic of the boron family	K3
	Inert pair effect	Apply inert pair effect explain the electronic arrangement of the atoms	K3
	Preparation, properties, structure and uses of boric acid, borax, diborane and borazole.	Describe the properties and uses of boron and its derivatives	K2
	Self study: compounds of Al, precious gems, alums	Identify compounds of Aluminium, precious gems and alums	K3
3.2	**Carbon family:** General characteristics of carbon group elements with reference to ionisation energy, catenation, inert pair effect and allotropy.	Illustrate the characteristic of the cabron family	**K3**
	Anomalous behaviour of carbon - comparison of carbon and silicon	Explain anamolous behavior of carbon and the similarities between C and Si.	**K3**

Unit/ Sec.	Course Content	Learning Outcomes	BTLT
	Allotropy of carbon – diamond – graphite - fullerene - graphene - intercalation compounds of graphite -	Classify the different allotropes of carbon	**K2**
	Structure of oxides - oxyacids and their salts	Correlate structure with reactivity	**K3**
	Carbides - Types-salt like, covalent,interstitial and applications	Classify the different types of Carbides and itsapplications	K2
IV	**Chemistry of Group V & VI elements and Binary compounds**		
4.1	**Nitrogen family** : Comparative study of halides and oxides ofnitrogen group elements,	Compare the chemistry of halides and oxides of nitrogen group elements	**K2**
	Preparation, properties of Oxy acids of nitrogen (HNO2 and HNO3) & Oxy acids of phosphorous(H_3PO_3,H_3PO_4, $H_3P_2O_7$) -	Describe the preparation and properties of the oxy acids of nitrogen and phosphorous	K2
	Preparation, properties and structure of hydrazine.	Describe the preparation, properties and structure of hydrazine	K2
4.2	**Oxygen family:** Anomalous behaviour of oxygen	Explain the Anomalous behaviour of oxygen	K2
	Preparation, properties, structure, Oxidation states and uses of sulphuric acid, Caro's acid, Marshall's acid and oleic acid.	Describe the preparation methodology, properties, structure and uses of mineral acids	K2
	Classification of oxides based on chemical behaviour (acidic, basic, amphoteric and neutral oxides) and based on oxygen content (normal, peroxide, superoxide, suboxide and mixed oxide).	Categorize the oxides based on their chemical behaviour and oxygen content	K3
	Preparation, oxidizing and reducing character of H_2O_2.	Utilize H_2O_2 as reducing and oxidizing agent in specific reactions	K3
4.3	**Binary Compounds**		
	Hydrides - Types-salt like, covalent, diamond like, interstitial hydrides and uses	Classify the different typesof Hydrides and its uses	K2
	Borides - Borides having isolated B atoms Borides having chain of B atoms, Borides having extended 2- dimensional network, Borides having 3- dimensional network and uses	Compare the 2-dimensional network Borides and 3- dimensional network Borides	K2
	Nitrides - Types-salt like, covalent, diamond like, interstitial, nitride complexes and uses.	Classify the different typesof Nitrides and its uses	K2
V	**States of Matter**		
5.1	**Gaseous state** - laws of gases - Avagadro's law - Ideal gas equation R in different units.	Justify by applying ideal gas equation how a gas responds changes in P, V, n, or T.	K5

Unit/ Sec.	Course Content	Learning Outcomes	BTLT
	Kinetic theory of gases. *van der* Waals' equation of state -modification of the equation at high, low and moderate pressures and temperature, -law of corresponding states -	Discuss the modifications of *van der* Waals' equation with respect pressure and temperature	K2
	Critical states (with derivation) -determination of critical constants	Calculate the critical constant values	K3
	Liquid state - vapour pressure -Trouton's rule.	Calculate the molar heat of vaporization of a liquid using Trouton's rule	K3
	Liquid crystals - types, applications of liquid crystals.	Summarize the properties of liquid crystals and their applications	K2
5.2	Solid state - Elements of symmetry, space lattice and Unit cell, Bravais lattice - seven crystal systems - lattice energy -	Analyze specific crysta structures by applying Elements of symmetry Compute the parameters of a crystal lattice.	K4 K4
	Law of rational indices - Miller indices - X-ray diffraction - Bragg's equation with derivation Packing in Crystals, Determination of crystallite size using Sherrer Equation by powder XRD	Relate diffraction intensities mathematically structural parameters and derive extinction conditions based on Bragg's equation Evaluate the packing of crystals and calculate crystal size.	K4 K5
5.3	Colloidal state -Classifications of colloids Methods of preparation of colloids -peptisation coagulation.	Classify different colloids usedi n day day life.	K4
	Applications - reverse osmosis - desalination of sea water - dialysis - delta formation - artificial rain purification of water (addition of polyvalen electrolytes), Amphoteric nature and micelle formation of soap -detergent action of soap sewage disposal- Cottrell's precipitator.	Explain the applications of colloids	K2

4. Mapping (CO, PO, PSO)

GENERAL CHEMISTRY – II Code : U22CH202													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	--	--	--	--	M	H	--	H	--	--	H
CO2	H	H	--	--	--	--	M	H	--	H	--	--	H
CO3	H	H	--	--	--	--	M	H	--	H	--	--	H
CO4	H	H	H	--	--	--	M	H	--	H	--	M	H
CO5	H	H	--	--	--	--	M	H	--	H	--	--	H
CO6	H	H	--	--	--	--	M	H	--	H	--	M	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

2. Course-end survey

Course Co-ordinator : **Dr. N. Mohan**

Head, Department of Chemistry : Dr J. Princy Merlin

SBEC - I : INDUSTRIAL CHEMISTRY - I

Semester : II **Code : U22CH2S1**
Credits : 2 **Total Hours : 30**
Hours/week : 2

1. Course Outcomes

After the completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Describe the types and properties of Fibers	K2	I
2	Elaborate the classification of Dyes based on their nature, bonding interactions of dyes with Fibers and the principles of the dyeing process	K2	II
3	Classify the polymers and calculate the molecular mass, average molecular mass and weight average molecular mass of polymers	K2	III
4	Explain the types, composition, manufacture and uses of glass, cement and ceramics	K2	IV
5	Illustrate the constituents and applications of different protective coatings	K2	V
6	Correlate the basics of industrial processes learnt with the Industry environment and Prepare a Report with suitable data and graphics summarize the industrial processes	K4	V

2A. Syllabus

Unit I Textile Chemistry - I **6 Hours**

1.1. Introduction and Importance of Dyeing Industries in India- Classification of Textile fibres: natural, synthetic and semi synthetic fibres.

1.2 Structure of textile fibres: Cotton, wool, silk, nylon, polyester, polyacrylamide. Physical, chemical and biological properties of Textile Fibres and uses of cellulose fibre (cotton), Protein fibre (silk and wool) and synthetic fibres (nylon and polyester)-Rayon - manufacture of viscose rayon, cuprammonium rayon and Acetate rayon.

1.3 Mercerization process and its applications.

Unit II - Textile Chemistry – II **6 Hours**

2.1 Dyes – Requisites of a dye –Theories of colour - Witt Theory and Modern theory.

2.2 Dye-Fibre interactions: Ionic, Covalent, van der Waals, H-bonding interactions.

2.3 Dyeing – Conditions for dyeing, selection of dye stuff. Dyeing methods-Direct dyeing, Stock dyeing, Yarn dyeing, piece dyeing and garment dyeing.

2.4 Dyeing Processes -Stripping of dyes, Bleaching - Reductive and oxidative bleaching agents, Brightening: Optical brightening agents-Types and uses-Challenges faced by Dye Industries

Unit III - Polymer Chemistry **6 hours**

3.1. Classification of polymers based on microstructures, macrostructures and applications (thermo-setting and thermoplastics). Determination of molecular mass of polymer: number average molecular mass (Mn) and weight average molecular mass (Mw method).

3.2. Zeigler - Natta polymerization. Degree of polymerization - General preparation, properties and uses of Teflon, PAN, PVC.

Unit IV - Glass, Cement and Ceramics **6 hours**

4.1. Glass- Types of glass, composition, manufacture and uses.

4.2. Cement- Manufacture wet and dry processes, composition of Portland cement, setting of cement, Concrete and RCC.

4.3 Ceramics- Types - raw materials – white wares, manufacture and uses.

Unit V - Protective Coatings and Industrial Products **6 hours**

5.1. Organic coating - Paints - requisites - constituents - Formulation of paint- uses. Varnishes- types- constituents of varnish and uses. Enamels - constituents and uses. Lacquers- constituents and uses, Emulsion paints - constituents and uses. Special paints- (luminous paint, heat resistant paint, fire resistant paint, cellulose paint, coal-tar paint, cement paint, anti-fouling paint, aluminium paint, water repellent paints and distemper.

5.2. **Industrial Products** - **Gaseous fuels -** Non-petroleum fuels: Natural gas and CNG- composition and uses - manufacture, composition and uses of Coal gas, Water gas, Producer gas and Power alcohol. Liquefied petroleum gases (LPG), Gobar gas, Benzol and semi-water gas – composition and uses-

Fertilizers–Manufacture of N, P, K and mixed fertilizers, Micro-nutrientsand their role in plant life -General Characteristics of Safety matches, fireworks and manufacture of important explosives (TNT, Amatol, nitroglycerine NG or GTN and RDX).

5.3 Internal component: In-plant training: One day visit to an industry involving chemical technology in and around Tiruchirappalli, (Sugar, Cement, Textile, Paper Industries, etc.) and submission of a mini report.

2B. Topics for Self –Study

S.No	Topic	Web links
1.	**Textile Chemistry - I**	https://nptel.ac.in/courses/116102026 https://www.youtube.com/watch?v=0-VZs5qWV8Y https://ncert.nic.in/textbook/pdf/hesc103.pdf https://www.youtube.com/watch?v=gaD1IjpxrZE https://textilefashionstudy.com/physical-and-chemical-properties-of-cotton/ https://www.youtube.com/watch?v=ZUroZZFx-B4 https://www.youtube.com/watch?v=YeqJMKD0MZM https://www.youtube.com/watch?v=wrl4KIr4QZA
2.	**Textile Chemistry - II**	http://nitttrc.edu.in/nptel/courses/video/116102052/lec3.pdf https://www.youtube.com/watch?v=9sC5cmq0sJ0 https://www.youtube.com/watch?v=j3mMrDChzHw https://www.fibre2fashion.com/industry-article/3871/dyeinhttps://www.youtube.com/watch?v=qcWV-yhFLq8 https://textilelearner.net/optical-brightening-agents/ https://www.slideshare.net/VenkateshBairabathina/dye-fiber-interactions
3.	**Polymer Chemistry**	https://www.embibe.com/exams/classification-of-polymers/ https://www.polychemistry.com/ https://www.youtube.com/watch?v=5_MKZ2nI-z4 https://pslc.ws/macrog/ziegler.htm https://www.embibe.com/exams/synthetic-fibres/ https://www.britannica.com/technology/mercerization
4.	**Glass, Cement and Ceramics**	https://theconstructor.org/building/types-glass-properties-applications-construction/14755/ https://www.youtube.com/watch?v=2xzf3Cgz99I https://www.youtube.com/watch?v=BRePixlqXiY https://www.explainthatstuff.com/glass.html https://www.cement.org/cement-concrete-applications/how-cement-is-made https://www.youtube.com/watch?v=E43jyaW2nCQ
5.	**Protective Coating**	https://www.resene.co.nz/paint-testing.htm https://www.sigmatest.org/Paint-Coating-Testing.html http://www.iitk.ac.in/ce/test/Materials/62.html https://www.youtube.com/watch?v=3I9DbE6c9tY https://gharpedia.com/blog/different-types-of-paints-used-for-interior-and-exterior/

2C. Text Books

1. Sharma B.K., "Polymer Chemistry", Goel Publishing House, Meerut, 1989. **(Unit- II)**
2. B.K. Sharma, "Industrial Chemistry", Goel Publishing Co., 1997 **(Unit- I, III, IV, V)**

2D. Recommended Reference Books

1. Jain and Jain, Engineering Chemistry, 15th Edition, Dhanapat Rai Publishing Company, NewDelhi, 2010.
2. Arora M.G M. and Yadav M.S., "Polymer Chemistry", 2nd revised edition, Anmol Publications Private Ltd., New Delhi, 1989.

3. Specific Learning Outcomes (SLOs)

Unit	Course Content	Learning Outcomes	BTLT
I	**Textile Chemistry -I**		
	1.1 Introduction - Classification of fibres: natural, synthetic and semisynthetic fibres.	Classify the fibers with examples	K2
	1.2 Structure of textile fibres: Cotton, wool, silk, nylon, polyester, polyacrylamide.	Categorize the textile fibers based on the nature of fibers.	K2
	Physical, chemical and biological properties and uses of cellulose fibre(cotton), protein fibre(silk and wool) and synthetic fibres (nylon and polyester).	Write the properties and uses of fibres	K2
	Synthetic fibres: Preparation, properties and Uses of Nylon 6, Nylon 66, Polyester and polyacrylamide.	Explain the chemistry of synthetic fibers	K2
	Semi - synthetic fibres: Rayon - manufacture of viscose rayon, cuprammonium rayon and Acetate rayon.	Explain the manufacturing of rayon	K2
	1.3.Mercerization-Manufacture of mercerized cotton and its applications.	Describe the manufacturing process of mercerized cotton	K2
II	**Dyes**		
	2.1 Dyes - Requisites of a dye -Theories of colour - Witt Theory and Modern theory.	Comprehend the theories of color	K2
	2.2 Dye-Fibre interactions Ionic,	Explain the different types of Dye	
	Covalent, van der Waals, H-bonding interactions.	fiber interaction.	K2
	2.3 Dyeing conditions; Dye Assisting agents: NaOH, Na_2CO_3, aluminium sulphate, chromic sulphate	Comprehend the role of dyeing assisting agents	K2

Unit	Course Content	Learning Outcomes	BTLT
		Describe the role of dyeing assisting agents	K2
	2.4 General concept of dyeing process: affinity of a dye, conditions for dyeing, selection of dye stuff.	Explain the concept of dying process	K2
	Dyeing methods - Direct dyeing, p dyeing, Stock dyeing, Yarn dyeing, piece dyeing and garment dyeing.	Describe the dyeing methods with examples	K2
	Unit III Polymer Chemistry		
	3.1 Classification of polymers based on microstructures, macrostructures and applications (thermosetting and thermoplastics	Classify polymers based on their structures and their applications	K2
	Determination of molecular mass of polymer number-average molecular mass (Mn) and weight average molecular mass(Mw) of polymers.	Explain the methods of determination of molecular mass of polymers. Compute the molecular mass of polymers by using the methods.	K2
	3.2 Zeigler-Natta polymers. Degree of polymerization General preparation, properties and uses of Teflon, PAN, PVC	Illustrate preparation, properties and uses of Teflon, PAN, PVC	K2
	UNIT-IV Glass, Cement and Ceramics		
4	Glass- Types of glass, composition- Manufacture and uses.	Classify the types of glass and composition of glass. To explain the manufacture and uses of glass.	K2
	Cement- Manufacture wet and dry processes, composition of Portland cement, setting of cement, Concrete and RCC	Outline the manufacture, composition and setting of cement.	K2
	Ceramics- Types- raw materials – white wares, manufacture and uses.	Classify the types of ceramics. Illustrate the manufacture and uses of ceramics.	K2 K2
	Unit–V Protective coatings and Industrial Products		
	5.1 Organic coating- Paints- requisites- constituents-Formulation of paint-uses	Explain the requisites, constituents and formulation of paints.	K2
	Organic coating-Paints-requisites- constituents-Formulation of paint-uses	Explain the requisites, constituents and formulation of paints.	K2
	Varnishes-types- constituents of varnish and uses.	Classify the types of varnishes. Illustrate the constituents and uses of varnishes.	K2 K2
	Enamels - constituents and uses.	Outline the constituents and uses of enamels.	K2
	Lacquers- constituents and uses	Explain about the constituents and uses of lacquers.	K2

Unit	Course Content	Learning Outcomes	BTLT
	Gaseous fuels - Non - petroleum fuels: Natural gas and CNG-composition and uses;	Classify the non- petroleum and based fuels and their composition and uses.	K2
	Manufacture, composition and uses of Coal gas, Water gas, Producer gas and Power alcohol. Liquefied petroleum gases (LPG), Gobar gas, Benzol and semi-water gas-composition and uses	Describe the manufacturing process of various fuel gases	K2
	Fertilizers- Manufacture of N, P,K and mixed fertilizers, Micronutrients and their role in plant life.	Outline the classification manufacture of fertilizers.	K2
	General Characteristics of Safety matches, fireworks and manufacture of important explosives (TNT, Amatol, nitroglycerine NG or GTN and RDX).	Describe the preparation composition and characteristics of the safety matches, fireworks and important explosives.	K2

4. Mapping (CO, PO, PSO)

ELECTIVE I – PRACTICAL Code : U22CH2:P													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	M		M	-	M	-			H			H
CO2	H	M	H	M	-	H	-	H		H		H	H
CO3	H	M	H	M	-	H	-	H		H		H	H
CO4	H	M		M	-	H	-			H			H
CO5		L		M	-		H			H			H
CO6	H	M	M	M	-	L	-	M		H		M	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)
3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Dr. N. Radhika**

Head, Department of Chemistry : Dr J. Princy Merlin

Elective I PRACTICAL : APPLICATIONS OF COMPUTER IN CHEMISTRY

Semester : II **Code : U22CH2:P**
Credits : 2 **Total Hours : 45**
Hours/week : 3

1. Course Outcomes

On completion of the course the student will be able to

S.No.	Course Outcomes	Level
1	Draw Chemical structure, reaction pathways and apparatus set up using Chemistry drawing Tools	K3
2	Perform basic quantum chemical calculations using ARGUS LAB	K3
3	Relate the structure with the properties of chemical compounds using Online and offline software	K3
4	Retrieve Physical and Chemical properties using relevant software	K3
5	Convert output & input files required digital formats	K2
6	Visualize the different Molecular orbitals of chemical compounds	K2

2A. Syllabus

Experiments

1. Calculation of Heat of formation of conformers using ARGUS Lab Software.
2. Calculation of Strain energies of alicyclic rings using ARGUS Lab Software – Baeyer's Strain Theory.
3. Visualization of Molecular orbitals and lone pairs in simple molecules using ARGUS Lab Software.
4. Calculation of bond energies, bond orders and bond lengths of delocalized and resonance stabilized bonds.
5. Introduction chemistry drawing Tools - *ISIS draw*, *Chemsketch*, *Chemdraw*, *Chemdoodle* -Drawing chemical structure, writing chemical equation.
6. Drawing the structure of alkanes from methane n-dodecane. Calculation of their Properties and Comparing their Melting and Boiling Points.
7. Construction of Linear and Branched chain alkanes containing 5,6,7 & 8 carbons and tabulating their properties like Melting and Boiling Points.
8. Drawing the cis- and trans- isomers of 1,2-dichloroethene, 1,2-dicarboxyethene and1,2- diphenylethene. Calculation and Comparison of their dipole moments.
9. Sketch the apparatus setup for a distillation process using Chemdraw.
10. Drawing Sawhorse and Wedge representations of molecules.
11. Draw the molecular structure of the given Natural Product and get its physical properties: (a) Caffeine (b) Nicotine.

12. Depict the mechanism of a simple S_N1 reaction using Chemdraw. Indicate the mobility of electrons by arrows.

13. Using the template tool draw any 5 fused aromatic ring systems and find their IUPAC Names using 'structure name' option.

2C. Text Books

1. Course Handout on "Basics of Computation ols for Chemists" developed and published by PG & Research Dept. of Chemistry, Bishop Heber College, Trichy 2020 (for private Circulation Only)
2. User Manual of Chemdoodle- https://www.ichemlabs.com/ downloads/ ChemDoodle3DUserGuide.pdf
3. User Manual of Chemdraw - https://www.perkinelmer.com/lab- products-and-services/resources/software-downloads.html
4. User Manual of Argus Lab Software - http://www.arguslab.com/arguslab.com /ArgusL ab.html

2D. Reference Books

1. Guy H. Grant & W. Graham Richards, Computational Chemistry, Oxford UniversityPress, 2005.
2. Andrew R. Leach, "Molecular modeling Principles & Applications", Prentice Hall, 2nd edition, 2008.

3. Short Learning Outcomes (SLOs)

S.No	Course Content	Learning Outcomes	BTLT
1	Calculation of Heat of formation of conformers using ARGUS Lab Software	Compute Heat of formation of given conformers using Argus software	K3
2	Calculation of Strain energies of alicyclic rings using ARGUS Lab Software	Use Argus Lab find out the strain energies of alicylic rings	K3
3	Visualization of Molecular orbitals and lone pairs in simple molecules using ARGUS Lab Software	Obtain the molecular orbitals and lone pair of electrons in molecules using Argus software	K2
4	Calculation of bond energies, bond orders and bond lengths of delocalized and resonance stabilized bonds.	Compute the bond energies, bond orders and bond lengths of different types of bonds	K3
5	Introduction chemistry drawing tools - *ISIS draw*, *Chemsketch*, *chemdraw*, *Chemdoodle* - Drawing chemical structure, Writing chemical equation.	Draw any chemical structure using drawing tools like ISIS draw, Chemsketch, Chemdraw, Chemdoodle	K2
6	Drawing the structure of alkanes from methane n-dodecane. calculation of their Properties and Comparing their Melting and Boiling points.	Construct the structure and compare the properties (melting and boiling points) of alkanes Relate the structure with the properties of chemical compounds	K3

4. Mapping (CO, PO, PSO)

ELECTIVE I – PRACTICAL Code : U22CH2:P													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	H	H	H	-	H	M	L	H	L	L	L
CO2	H	H	M	L	L	-	L	L	L	H	M	M	M
CO3	H	H	H	H	H	-	H	M	M	H	H	H	H
CO4	H	H	M	H	H	-	M	M	M	H	H	H	H
CO5	H	H	M	H	M	-	M	M	M	H	H	H	H
CO6	H	H	M	H	M	-	H	M	H	H	H	H	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Dr. L. Sharmila Lydia**

Head, Department of Chemistry : Dr J. Princy Merlin

CORE – III : GENERAL CHEMISTRY – III

Semester : III **Code : U22CH303**
Credits : 5 **Total Hours : 90**
Hours/week : 6

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Explain the chemistry of halogens and d-block elements	K4	I
2	Outline the chemistry of lanthanides and actinides	K4	II
3	Summarize the reactions of alcohols, ethers and organohalogens	K5	III
4	Comprehend the reactivity of benzene and the effect of substituents in benzene ring.	K4	IV
5	Deduce the kinetics of chemical reactions	K5	V
6	Demonstrate the importance of catalysts in chemical and biological reactions	K5	V

2A. Syllabus

Unit I - Chemistry of Halogens and d-block Elements **18 Hours**

1.1 **Halogens & Interhalogens -** Diatomic nature –oxidizing property – Electron affinity - Electronegativity - size effect. Comparison of halogens with O, N & C groups - Anomalous behavior of fluorine – Chemical properties of halo acids and oxyhalides. Interhalogens – Preparation, structure and bonding of AX, AX_3, AX_5 and AX_7 type interhalogens - uses. Pseudo-halogens - Comparison with halogens - Preparation, properties and uses of cyanogen and thio-cyanogen, Chemistry of Astatine, Oxyacids of halogens – $HClO_4$, $HClO_3$, $HClO_2$, HClO.

1.2 **d-block elements –** Introduction **-** General characteristics (metallic character, atomic and ionic radii, oxidation states, colour, complex formation and magnetic properties). Preparation, properties and uses of some Important compounds (Zeigler- Natta catalyst, Prussian blue, sodium nitroprusside, Turnbull's blue, Wilkinson's catalyst, $KMnO_4$, $K_2Cr_2O_7$).

Unit II - Chemistry of f-Block Elements **18 Hours**

2.1 **Lanthanides**–General discussion of periodic properties of lanthanides – electronic configuration–oxidation states - Ionization Energy - occurrence – isolation –separation by Ion-exchange Chromatography and solventextraction methods – complexation behaviour, colour – magnetic and spectral properties of lanthanides – lanthanide contraction and its consequences.

2.2 **Actinides** – occurrence - General discussion of periodic properties of electronic configuration–oxidation states - Ionization Energy - complexation behaviour - extraction of thorium and uranium – and uses, Actinide contraction and its consequences.

Unit III - Chemistry of Alcohols, Ethers and Organohalogens **18 Hours**

3.1 **Alcohols -** Classification and nomenclature of monohydric alcohols - Preparation by reduction of aldehydes, ketones, carboxylic acids and hydrolysis of esters. Hydrogen bonding, Acidic nature. Reactions of alcohols - Etherification, Alkylation reaction of halogen acids, dehydrogenation, oxidation. Dihydric & Trihydric alcohols, Glycerol-preparation, chemical reactions, cleavage reactions of polyhydric alcohols with $Pb(OAc)_4$, HIO_4, OsO_4, uses of glycerol. Glyceryl trinitrate - Preparation, properties and uses.

3.2 **Ethers -** Nomenclature, preparation, chemical reactions –cleavage reactions and auto oxidation, Zeisel's method. Epoxides – preparation and properties.

3.3 **Organohalogens -** Nomenclature – Aliphatic halogen compounds – preparation, properties and uses of CH_2Cl_2, $CHCl_3$, CCl_4 and vinyl chloride – Commercially important halogen compounds – Westorn, Freon, DDT and BHC **-** Synthesis and uses.

Unit–IV Aromatic Compounds **18 Hours**

4.1 **Aromaticity -** Nomenclature of benzene derivatives, structure of benzene – molecular formula and Kekule structure – Stability and C-C bond length of benzene, MO picture, MOT of aromaticity, Application of Huckel's rule to benzene, naphthalene and anthracene.

4.2 **Substituent Effect**:-Effects of substituent in benzene ring–Reactivity and orientation–Theory of reactivity- Electrophilic substitution reactions – Mechanism of nitration, halogenation, sulphonation, Mercuration, Friedel- Crafts alkylation and acylation.

4.3 **Phenols:** Preparation, properties, and reactions of Phenol - Couplingreaction - Acidity of Phenols-Preparation, properties and reactions of Resorcinol, Catechol and Quinol.

Unit – V Kinetics & Catalysis **18 Hours**

5.1 **Chemical Kinetics**: Definition– Determination of rate using Concentration versus Time curves – Rate laws and Rate constants for zero, I, II and III order reactions– unit of rate constants – Order and Molecularity – Derivation of expressions for rate constants for zero, I, II and III order reactions–half–life period (**Problems**) - Pseudo first order reaction, methods of determination of order of reactions - integration, graphical, half-life and Ostwald's isolation methods. Factors affecting rate of reaction.

5.2 Temperature dependence of reaction rate–Arrhenius parameters and calculations– Theories of reaction rate - Simple Collision Theory and its limitations -ARRT and thermodynamic derivation of rate constant (Erying's Equation) – **Problems** - Steady State Approximation - Lindemann's Hypothesis of unimolecular reactions.

5.3 **Adsorption-** Introduction - Types of adsorption and Mechanisms – Factors affecting Adsorption -adsorption isotherms - Freundlich, Gibb's and Langmuir isotherms (Derivation not required)- Interpretation of Isotherm Plots.

5.4 **Catalysis -** Introduction - Types of catalysis – Intermediate compound formation Theory and Adsorption theory- Factors affecting the catalysis – Positive and Negative Catalysts – Catalytic promoters and poisons – Auto catalysis - Enzyme catalysis – Derivation of Michaelis–Menten equation.

2B. Topics for Self-Study

S.No.	Topics	Web Links
1	Charge Transfer Spectra	https://careerendeavour.in/wp-content/uploads/2018/09/coordination-chemistry.pdf
2	Magnetic properties of inner transition elements	https://player.uacdn.net/lesson-raw/9Y60GCT18A3RHN0GCJ5C/pdf/2618155165.pdf
3	Macromolecules (Crown ethers) and its applications	https://web.wpi.edu/Pubs/E-project/Available/E-project-090211-121333/unrestricted/MQP_-_Josh_Wimble.pdf
4	Industrial applications of enzymes	http://biochem.du.ac.in/web/uploads/45%20Enzymes%20-%20Applications.pdf
5	Craig's rule for Aromaticity	https://youtu.be/sUtqD9qv5S8
6	Inorganic polymers	https://www.slideshare.net/salmaamir2/classification-of-inorganic-polymers-248126595

2C. Text Books:

1. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milesne Publishers, New Delhi, 2017 **(Unit- I, II).**

2. B.K. Sharma, Industrial Chemistry, Goel Publishing Co., 1997 **(Unit-II)**

3. Arun Bahl and B.S. Bahl, *Advanced Organic Chemistry*, S. Chand Co. Ltd., New Delhi, 2012, (Unit-III, IV).

4. B.R. Puri, L.R. Sharma and Madan S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., Jalandhar, 2017 **(Unit-V).**

2D. Recommended Reference Books:

1. J.D. Lee, "*Concise Inorganic Chemistry*", Oxford University Press, New Delhi, 2008.
2. Morrison and Boyd "*Organic Chemistry*" Pearson Education, 2016.
3. Peter Atkins and Julio de Paula, "*Physical Chemistry*" Oxford University Press, 2018.

4. R.L. Madan and G.D. Tuli, *Inorganic Chemistry*, S.Chand Co. Ltd., New Delhi, 2010.
5. Gurdeep Raj, *Advanced Physical Chemistry*, Goel Publishing House, Merrut, 2016.
6. V.B. Patania, *Chemical Kinetics*, Campus Publications, New Delhi, 2004.
7. M.K.Jain and S.C.Sharma, Modern Organic Chemistry, Vishal Publishing Co, Jalandhar-Delhi, 2010.

3. Specific Learning Outcomes (SLOs)

Unit/ Section	Course Content	Learning Outcomes	BTLT
Unit - I Chemistry of Halogens and d-block Elements			
1.1	Properties of Halogens and interhalogens: Diatomic nature, oxidizing property, electron affinity, electronegativity, size	Relate the periodic trends and reactivity of halogens and interhalogens	K4
	Comparison of halogens with O, N & C groups	Compare and contrast the properties of halogens with the O, N and C groups	K4
	Anamolous behavior of fluorine	List out the anomalous behavior of fluorine	K2
	Chemical properties of haloacids and oxyhalides	Consolidate the chemistry of haloacids and oxyhalides	K3
	Preparation, uses, structure and bonding of AX, AX_3, AX_5 and AX_7 type interhalogens	Summarize the chemistry of different types of Interhalogens	K3
	Comparing pseudo-halogens with halogens	Compare the properties of pseudo-halogens and halogens	K2
	Preparation, properties and uses of cyanogen and thio-cyanogen	Summerize the chemistry of cyanogens and thiocyanogen	K2
	Chemistry of Astatine	Outline the chemistry of astatine	K2
	Chemistry of oxyacids of halogens - $HClO_4$, $HClO_3$, $HClO_2$, HClO	Compare the chemistry of different oxyacids of halogens	K5
1.2	Introduction to d-block elements and their general characteristics (metallic character, atomic and ionic radii, oxidation states, colour, complex formation and magnetic properties)	Compare the general characteristics of the different d-block elements	K4
	Preparation, properties and uses of Zeigler-Natta catalyst, Prussian blue, sodium nitroprusside, Turnbull's blue, Wilkinson's catalyst, $KMnO_4$, $K_2Cr_2O_7$	Interpret the chemistry of Zeigler-Natta catalyst, Prussian blue, sodium nitroprusside, Turnbull's blue, Wilkinson's catalyst, $KMnO_4$ and $K_2Cr_2O_7$	K4

Unit/ Section	Course Content	Learning Outcomes	BTLT
Unit-II	**Chemistry of f- Block elements**		
2.1	General study of lanthanides involving electronic configuration, oxidation states, lanthanide contraction and complexation behavior	Comprehend the general properties of lanthanides	K4
	Separation of lanthanides by ion-exchange and solvent extraction methods	Outline the various processes involved in the separation of lanthanide ions	K2
	Complexation behaviour, colour - magnetic and spectral properties of lanthanides	Interpret the chemistry of lanthanides	K3
	lanthanide contraction and its consequences	Explain the consequences of lanthanide contraction	K2
2.2	General study of Characteristics of actinides ,	Appreciate the general characteristics of actinides. Compare lanthanides and actinides based on their properties	K4 K3
	Occurrence, electronic configuration, oxidation states, actinide contraction and complexation behaviour of actinides	Analyze properties of lanthanides	K2
	Extraction of thorium and uranium and their uses	Explain the extraction processes of thorium and uranium and their uses	K2
	Actinide contraction and its consequences	Relate Actinide contraction and its consequences with reactivity of actinides	K3
	Unit-III Chemistry of Alcohols, Ethers and Organo Halogens		
3.1	Classification and nomenclature of monohydric alcohols	Organize the various monohydric alcohols	K3
	Preparation of alcohols by reduction of aldehydes, ketones, carboxylic acids and hydrolysis of esters	Distinguish the preparation of alcohols	K4
	Hydrogen bonding and acidic nature of alcohols. Reactions of alcohols, Etherification, Alkylation reaction of halogen acids, dehydrogenation, oxidation	Summarize the properties of alcohols	K5
	Chemistry of dihydric and trihydric alcohols	Apply the chemistry of dihydric and trihydric alcohols	K3
	Preparation, uses and properties of glycerol (cleavage reactions of polyhydric alcohols with $Pb(OAc)_4$, HIO_4, OsO_4) - Preparation, uses and properties of Explain the chemistry of glycerol	Utilize the chemistry of glycerol and glyceryl trinitrate	K3

Unit/ Section	Course Content	Learning Outcomes	BTLT
3.2	Nomenclature, preparation and chemical reactions of ethers (cleavage reactions and autooxidation by Zeisel's method) - Preparation and properties of epoxides	Describe the chemistry of ethers and epoxides	K3
	Nomenclature, preparation, properties and uses of aliphatic halogen compounds (CH_2Cl_2,$CHCl_3$, CCl_4 and vinyl chloride)	Explain the chemistry of aliphatic halogen compounds	K4
Unit IV Aromatic Compounds			
4.1	Nomenclature of benzene derivatives	Name the benzene derivatives using IUPAC rules.	K3
	Structure of benzene - molecular formula and Kekule's structure - stability and C-C bond length of benzene, MO picture	Explain the structure of benzene	K4
	MOT of aromaticity, application of Huckel's rule benzene, naphthalene and anthracene	Explain the MOT of aromaticity and Huckle's rule	K5
	Effects of substituent in benzene ring	Distinguish the effects of various substituents in Benzene Rings	K4
	Electrophilic substitution reactions	Apply electrophilic substitution mechanism in formation of benzene derivatives	K4
4.2	Effects of substituent in benzene ring- Reactivity and orientation-Theory of reactivity	Predict products based on reactivity and orientation principles	K3
	Electrophilic substitution reactions - Mechanism of nitration, halogenation, sulphonation, Mercuration, Friedel-Crafts alkylation and acylation	Elucidate the mechanism of given electrophilic substitution reactions	K4
4.3	Preparation, properties, and reactions of Phenol - Coupling reaction - Acidity of Phenols	Apply the chemistry of phenols for interconversion of functional groups	K4
	Preparation, properties and reactions of Resorcinol, Catechol and Quinol	Understand the chemistry of resorcinol, catechol and quinol	K2
V	**Kinetics and Catalysis**		
5.1	Definitions	Define terms commonly used in chemical kinetics	K1
	Determination of rate using Concentration versus Time curves - Rate laws and Rate constants for zero, I, II and III order reactions- unit of rate constants	Summarize the rate Laws.	K2
	Order and Molecularity	Find out the order and molecularity of a given reactions	K2
	Derivation of expressions for rate constants for zero, I, II and III order reactions-half-life period (Problems)	Derive the expressions for rate constants of zero, I, II and III order reactions	K5

Unit/ Section	Course Content	Learning Outcomes	BTLT
	Pseudo first order reaction, methods of determination of order of reactions - integration, graphical, half-life and Ostwald's isolation methods	Elaborate the methods of determining the rate of reactions of different order and half-life of a reaction	K2
	Factors affecting rate of reaction	Outline the factors affecting the rate of a reaction	K2
5.2	Temperature dependence of reaction rate- Arrhenius parameters and calculations	Relate the temperature dependence of reaction rates	K3
	Theories of reaction rate - Simple Collision Theory -limitations -ARRT	Illustrate ARRT	K2
	Thermodynamic derivation of rate constant	Derive the thermodynamic basis of rate constant	K2
	Steady State Approximation - Lindemann's Hypothesis of unimolecular reactions	Apply steady state approximation in derivation of rate laws.	K3
5.3	Introduction to adsorption and types of adsorption	Classify the types of adsorption	K2
	Factors affecting Adsorption and the Mechanisms of adsorption	Relate the factors affecting adsorption and the mechanism involved	K2
	Adsorption isotherms - Freundlich, Gibb's and Langmuir isotherms (Derivation not required)	Interpret the different adsorption isotherms	K2
5.4	Introduction to catalysis and types of catalysis	Summarize the characteristics of the types of catalysis	K2
	Intermediate compound formation Theory and Adsorption theory	Describe the theories of adsorption	K2
	Factors affecting the catalysis -Positive and Negative analysts -Catalytic promoters and poisons	List out the factors affecting positive and negative catalysts	K3
	Enzyme catalysis - Derivation of Michaelis-Menten equation	Derive the Michaelis Menten equation.	K2

4. Mapping (CO, PO, PSO)

General Chemistry-III											Code : U22CH303		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	-	-	-	-	M	-	H	-	-	H
CO2	H	H	H	-	-	-	-	M	-	H	-	-	H
CO3	H	H	H	-	-	-	-	M	-	H	-	-	H
CO4	H	H	H	-	-	-	-	M	-	H	-	-	H
CO5	H	H	H	-	-	-	-	M	-	H	-	-	H
CO6	H	H	H	-	-	-	-	M	-	H	-	M	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Dr. R. Swinton Darious**

Head, Department of Chemistry : Dr J. Princy Merlin

CORE PRACTICAL - II : INORGANIC QUALITATIVE ANALYSIS

Semester : III **Code : U22CH3P2**
Credits : 2 **Total Hours : 45**
Hours/week : 3

1. Course outcomes

After the completion of this course the students will be able to

S.No.	Course Outcomes	Level
1	Recall the basic Principles of Inorganic Qualitative Analysis.	K2
2	Apply the various principles to identify the cations and anions systematically.	K3
3	Exhibit analytical skill in identifying a given inorganic mixture using Systematic semi micro method with green approach.	K4
4	Separate the cations in different groups	K3
5	Confirm the cations and anions by Confirmatory tests	K5
6	Present a Scientific report without violating protocols and procedures.	K4

2A. Syllabus

Principles of Qualitative analysis - Reactions involved in the detection of anions and cations: F^-, Cl^-, Br^-, NO_3^-, CO^{2-}, $S_2O_4^{2-}$, PO^{3-}, CO^{2-}, BO^{3-}, Pb^{2+}, Cd^{2+}, Bi^{3+}, Cu^{2+}, Fe^{2+}, Al^{3+}, Ni^{2+}, Co^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+} and NH_4^+ ions. Solubility product, Common ion effect, Interfering and Non-Interfering radicals, principle involved in group separation and in the preparation of Na_2CO_3 extract.

Experiments :

I. Cations to be analysed

Lead, Copper, Bismuth, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Barium, Calcium, Strontium, Magnesium and Ammonium.

II. Anions to be analysed

Carbonate, Sulphide, Sulphate, Nitrate, Chloride, Bromide, Fluoride, Borate, Oxalate and Phosphate.

2 B. Weblink(s)

1. Shilpa Shrivastava (2016) Qualitative analysis of Anions. Retrieved from https://www.chemistrynotmystery.com/2016/02/qualitative-analysis-of-anions.html CC BY-NC-SA4.0 license.

2C. Text Books

1. V. Venkateswaran , R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi,1997.
2. Mala Nath, (2016). Inorganic Chemistry: A Laboratory Manual, New Delhi: Narosa Publishing House Pvt. Ltd. Print.
3. Ramanujam, V. V. (2012). Inorganic Semi Micro Qualitative Analysis, (3rd ed.), Chennai: The National Publishing Company. Print.

2D. Reference Books

1. Vogel, Text Book of Quantitative Chemical Analysis, 6th Edition, Pearson Education,2009.
2. Svehla, G. (1996). Vogel's Qualitative Inorganic Analysis, (7th ed.) India: Pearson. Print.

3. Specific Learning Outcomes (SLOs)

Unit	Course content	Learning Outcomes	BTLT
	Reactions involved in the detection of anions and cations: F^-, Cl^-, Br^-, NO_3^-, CO_3^{2-}, S^{2-}, PO_4^{3-}, CO^{2-}, BO_3^-, Pb^{2+}, Cd^{2+}, Bi^{3+}, Cu^{2+}, Fe^{2+}, Al^{3+}, Ni^{2+}, Co^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+} and NH_4^+ ions.	Categorize the reactions involved in the detection of some cations and anions.	K4
	Interfering and Non-Interfering radicals	Identify the interfering and non-interfering radicals	K3
	The concept of solubility product and common-ion effect	Understand and apply the concepts of solubility product and common-ion effect	K4
	Principle involved in group separation and in the preparation of Na_2CO_3 extract	Describe the principle involved in group separation	K4
	Cations to be analysed: Lead, Copper, Bismuth, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Barium, Calcium, Strontium, Magnesium and Ammonium	To identify the cations and anions in a mixture	K4
	Anions to be analysed: Carbonate, Sulphide, Sulphate, Nitrate, Chloride, Bromide, Fluoride, Borate, Oxalate and Phosphate	To analyse systematically the given unknown samples.	K5
		To practice laboratory ethics and to adopt the ethical values in the semi-micro analysis	K5

4. Mapping (CO, PO, PSO)

INORGANIC QUALITATIVE ANALYSISS Code: U22CH3P2													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	L		H	H		L		H	H		H
CO2	H	H	H		H	H		H		H	H		H
CO3	H	H	H		H	H		H		H	H	H	H
CO4	H	H	H		H	H		H		H	H		H
CO5	H	H	H		H	H	H	H		H	H	H	H
CO6	H	H	H	L	H	H		H		H	H		H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II
2. Model Exams I and II
3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Dr. I. Sharmila Lydia**

Head, Department of Chemistry : Dr J. Princy Merlin

CORE COURSE – IV : INORGANIC CHEMISTRY- I

Semester : IV **Code : U22CH404**
Total Hours : 90 **Hours/ Week: 6**
Credits 5

1. Course Outcomes

After the successful completion of this course, students will be able to

S.No.	Course Outcomes	Level	Unit
1	Predict the hybridization of Coordination compounds and the stable and unstable metal complexes using EAN rule	K5	I
2	Discuss the different types of nucleophilic substitution reactions in Octahedral and Square planar complexes	K4	II
3	Apply different methods calculate dipole moment of molecules	K3	III
4	Explain the magnetic and electrical properties of molecules and complexes	K2	III
5	Summarize the importance of metal carbonyls, metal nitrosyls and metal olefins	K2	IV
6	Determine the size and percentage of crystallinity in Inorganic nanoparticles by powder XRD using Scherrer equation	K4	V

2A. Syllabus

Unit I - Coordination Chemistry – I **18 Hours**

1.1 Types of ligands, IUPAC nomenclature. Differences between Double and Single Salts.

1.2 Werner theory – Sidgwick theory – EAN rule - Valence bond theory – Postulates. sp^3, dsp^2, and sp^3d^2 hybridization with examples and limitations.

1.3 Crystal Field Theory – Postulates - shapes of d-orbitals- splitting of '*t2g'* and '*eg'* levels, CFSE, Octahedral and Tetrahedral splitting with examples and limitations- Spectrochemical series.

1.4 Molecular orbital theory – Postulates, M.O. Diagram of octahedral complexes with both strong and weak field ligands (σ – bonding only).

Unit II - Coordination Chemistry – II **18 Hours**

2.1 Isomerism – Stability of complexes – factors affecting the stability of complexes.

2.2 Unimolecular and bimolecular nucleophilic substitution reactions in Octahedral and Square planar complexes – Trans effect and its applications.

Biologically important co-ordination compounds– Chlorophyll, Haemoglobin and Vitamin-B_{12} **-** structure and application (Elucidation is not required)

2.3 Application of coordination compounds–detection of potassium ions, separation of copper and cadmium ions.

Unit III - Electrical and Magnetic Properties **18 Hours**

3.1 **Electrical Properties:** Induced dipole moment–polarizability, polarization ofa molecule in an electric field– Clausius–Mosotti equation and Debye equation (derivation not required) – measurement of dipole moment for molecules – Vapour-temperature method, dilute solution method. Bond moments-bond angle relationship, dipole moment and molecular structure (CO_2, NH_3, CCl_4 and *o, m* and *p*-dichlorobenzene)

3.2 **Magnetic Properties:** Magnetic permeability, magnetic flux, density (B), magnetic field intensity (H), B and H relationships, magnetic susceptibility, magnetic moment(M), Diamagnetism, Paramagnetism, Ferromagnetism, anti-ferromagnetism, measurements of magnetic susceptibility – Gouy Method - number of unpaired electrons-spin only value for magnetic moment – application to structural Problems of $K_3[Fe(CN)_6]$, $K_4[Fe(CN)_6]$ and $[Ni(CO)_4]$.

Unit IV - Organometallic Compounds **18 Hours**

4.1 **Metal carbonyls -** Introduction **-** Metal carbonyls–Mononuclear carbonyls - 18 electron rule and polynuclear carbonyls of Ni, Fe, Cr, Co and Mn – synthesis, reactions, structure and uses. -Organometallic reagents (Organo Zinc, Organolithium and Organocopper compounds.)

4.2 **Metal Nitrosyls** – classification, preparation, properties and structure of nitrosyl chloride and sodium nitroprusside.

4.3 **Metal olefins** - Zeise's salt- Cyclopentadiene -Ferrocene - preparation, aromatic character, reactions of the aromatic rings, structure and bonding.

Unit V - Inorganic polymers and Nanomaterials 18 Hours

5.1 Inorganic polymers - General properties - classification - phosphorous based polymers, chain polymer and network polymer - Sulphur based polymers - polymeric sulphur nitrides, Boron based polymers - polymeric Boron nitrides, Organosilicon polymers - preparation, structure and applications.

5.2. Inorganic Nanomaterials – Types, Classification, Synthesis of nanomaterials – top-down and bottom-up approaches - Electrical & Optical Properties and applications of nanomaterials in medicine, defense and solar cells – Identification of nanomaterials using Scherrer equation by Powder XRD (size and Percentage of Crystallinity only).

2B. Topics for Self-Study

S.No.	Topics	Web Links
1	Crystal Field theory of square planar complexes	https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch12/crystal.php
2	Molecular orbital theory of tetrahedral complexes	http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/inorganic_chemistry-ii/08.molecular_orbital_theory(tetrahedral_complexes)/et/4806_et_et.pdf
3	Porphyrins and Hemoglobin	https://basicmedicalkey.com/porphyrins-and-hemoglobin/
4	Application to structural Problems of copper II sulphate	https://www.ebi.ac.uk/chebi/searchId.do?printer Friendly View=true & locale=null & =31440& view Term Lineage=null & structure View=&
5	Inorganic Polymers	http://www.vpscience.org/materials/Unit-IV%20Inorganic%20Polymers%20(Sem-V).pdf
6	Binary compounds boranes	science.marshall.edu/castella/chm448/boranes.pdf

2C. Text Books

1. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone publishers, NewDelhi, 2017 (Unit- I-V)
2. R.D. Madan, *Modern Inorganic Chemistry*, S.Chand & Co., New Delhi, 2003. (UnitI-IV)
3. J.D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, New Delhi, 2008.

2D. Recommended Reference Books:

1. Gurdeep Raj, *Advanced Inorganic Chemistry*, Goel publishing, Meerut, 2014.
2. Kamalesh Bansal, *Coordination Chemistry*, Campus Publications, New Delhi, 2003.
3. G.S. Sodhi, *Inorganic Chemistry*, Viva Books, New Delhi, 2006.
4. D. Banerjee, *Coordination Chemistry*, Asian Books, 2007.

3. Specific Learning Outcomes (SLOs)

Unit	Course Content	Learning outcomes	BTLT
	Unit – I : Coordination Chemistry – I		
1.1	Types of ligands	Explain different types of ligands	K2
	IUPAC - nomenclature	Make use of the various rules for nomenclature of co-ordination compounds	K3
	Differences between Double and Single Salts	Distinguish between Double and Single Salts	K4
1.2	Werner theory - Sidgwick theory - EAN rule	Discuss the postulates of Werner's theory	K3
		Apply EAN rule.	K3
	Valence bond theory - Postulates.sp3, dsp2, and sp3d2 hybridizations with examples and limitations	Discuss the merits and limitations of VBT	K2
		Explain valence bond theory with suitable examples for high spin and low spin complexes	K2
		Identify the high spin andlow spin complexes	K3
		Predict the hybridization of Coordination compounds	K5
1.3	Crystal Field Theory - Postulates - shapes ofd-orbitals - splitting of t_2g and eg levels, CFSE, Octahedral and Tetrahedral splitting with examples and limitations	List out the postulates of CFT	K2
		Discuss the splitting of d- orbitals in Octahedral and Tetrahedral field	K2
1.4	Molecular orbital theory – Postulates, application octahedral complexes only.	Explain the postulates of MOT	K2
		Discuss the MOT of octahedral complexes	K2
	Unit–II Coordination Chemistry – II		
2.1	Isomerism - Stability of complexes- factors affecting the stability of complexes.	Define the types of Isomerism	K2
		Explain the factors affecting the stability of complexes	K2
		Determine the stability of complexes	K2
2.2	Unimolecular and bimolecular nucleophilic substitution reactions in Octahedral and Square planar complexes - Trans effect and its applications.	Discuss the different types of nucleophilic substitution reactions in Octahedral and Square planar complexes	K4
		Explain the Trans effect and its applications.	K2
		Discuss the Trans effect in square planer complexes	K2

Unit	Course Content	Learning outcomes	BTLT
2.3	Biologically important co- ordination compounds-Chlorophyll, Haemoglobin and Vitamin-B12 structure and application (Elucidation is not required)	Compare the structure and application of different Biologically important co- ordination compounds	K4
2.4	Application of coordination compounds-detection of potassium ions, separation of copper and cadmium ions.	Separate copper and cadmium ions	K4
	Unit – III Electrical and Magnetic Properties		
3.1	Induced dipole moment- polarisability, polarization of a molecule in an electric field-Clausius-Mosotti equation and Debye equation (derivation not required) - measurement of dipole moment for molecules - vapour temperature method, dilute solution method. Bond moments- bond angle relationship, dipole moment and molecular structure (CO_2, NH_3, CCl_4 and o, m and p-dichlorobenzene)	Apply different methods calculate the dipole moment of different molecules	K3
3.2	Magnetic permeability, magnetic flux, density (B), magnetic field intensity (H), B and H relationships, magnetic susceptibility, magnetic moment(M), Diamagnetism, Paramagnetism, Ferromagnetism, anti-ferromagnetism,	Explain the different terms in magnetic properties of matter.	K2
		Compare the characteristics of diamagnetism and paramagnetism	K2
3.3	Measurements of magnetic susceptibility - Gouy Method - number of unpaired electrons-spin only value for magnetic moment - application structural Problems of $K_3[Fe(CN)_6]$, $K_4[Fe(CN)_6]$ and $[Ni(CO)_4]$	Explain the magnetic susceptibility measurements solve structure of complexions	K2
		Explain the gouy balance method for the measurement of magnetic susceptibility	K2
	Unit–IV Organometallic Compounds		
4.1	Pi acceptor ligands - Introduction - Metal carbonyls-Mononuclear carbonyls - 18-electron rule and polynuclear carbonyls of Ni, Fe, Cr, Co and Mn - synthesis, reactions, structure and uses.	Summarize the synthesis, structure and uses of different metal carbonyl and poly nuclear carbonyls	K2
4.2	Nitrosyl compounds - classification, preparation, properties and structure of nitrosyl chloride and sodium nitroprusside.	Summarize the preparation, properties and structure of nitrosyl compounds	K2
4.3	Metal olefins (Zeise's salt)-Cyclopentadienes (Ferrocene)- preparation, aromatic character, reactions of the aromatic rings, structure and bonding.	Explain the salient features of the structure of the Zeise's salt and Ferrocene	K2

Unit	Course Content	Learning outcomes	BTLT
	Unit 5 Inorganic Polymers and Inorganic Nanomaterials		
5.1	**Inorganic polymers -** General properties - classification - phosphorous based polymers, chain polymer and network polymer	Explain the classification of inorganic polymers	K3
	Sulphur based polymers - polymeric sulphur nitrides,	Appreciate the importance of inorganic polymers	K3
	Boron based polymers - polymeric Boron nitrides,	Correlate the structure and bonding	K3
	Organosilicon polymers - preparation, structure and applications.	Summarize the p reparation structure and applications of organosilicon polymers	K3
5.2	**Inorganic Nano materials –** Types, Classification, Synthesis of nanomaterials - top-down and bottom-up approaches	Explain the classification and the synthetic methods of nanomaterials	K2
	Electrical & Optical Properties	Summarize the electrical and optical properties of nanomaterials	K2
	Applications of nanomaterials in medicine, defense and solar cells	Appreciate the applications of nanomaterials in various fields	K2
	Identification of nanomaterials using scherrer equation by Powder XRD (size and Percentage of Crystallinity only).	Calculate the particle size and crystallinity of nanomaterials	K2

4. Mapping (CO, PO, PSO)

INORGANIC CHEMISTRY- I Code: U22CH404													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	M	-	L	-	L	-	-	H	M	-	H
CO2	H	M	L	L	L	-	L	L	-	H	-	-	H
CO3	H	-	L	-	M	M	-	L	-	H	L	M	H
CO4	H	-	L	-	M	M	-	L	-	H	L	M	H
CO5	H	L	-	-	L	-	-	-	-	H	-	-	H
CO6	H	-	H	-	H	M	-	M	-	H	M	L	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator	:	**Dr. S. Priscilla Prabhavathi**
Head, Department of Chemistry	:	**Dr J. Princy Merlin**

CORE PRACTICAL III : ORGANIC ANALYSIS

Semester : IV **Code : U22CH4P3**
Credits : 2 **Total Hours : 45**
Hours/Week : 3

1. Course Outcomes

After the completion of this course the students will be able:

S.No.	Course Outcomes	Level
1	Apply the knowledge of chemistry behind the qualitative organic analysis	K3
2	Compare different chemical tests to identify organic functional groups	K3
3	Report the results Scientifically	K2
4	Deduce the functional group of different organic compounds based on the inference	K4
5	Confirm the different functional groups by derivatization	K2
6	Justify the results by providing suitable confirmatory tests	K3

2A. Syllabus

I. Theory Of Organic Analysis

Principles of qualitative analysis- handling of apparatus and hazardous chemicals like bromine, sodium, $NaNO_2$, concentrated acids and bases, etc.– theory of the various chemical reactions / tests- techniques of derivatization- scientific reporting.

II. Introduction to Green & Sustainable Chemistry -Anastas' Twelve principles with examples

2B. Organic Analysis

Analysis of simple organic compounds

Characterization of organic compounds by their functional groups and confirmation of functional groups and preparation of derivatives.

Functional Groups

- Carboxylic acid (both Aliphatic & Aromatic)
- Esters
- Phenols

- Carbonyl compounds
- Carbohydrates
- Amides (both Aliphatic & Aromatic)
- Anilides
- Amines
- Nitro compounds.

2C. Text Books

1. V. Venkateswaran, R.Veerasamy , A.R. Kulandaivelu, "*Basic Principles of Practical Chemistry*", Second Edition, Sultan Chand & Sons, New Delhi, 2006.

2D. Recommended Reference Books:

1. A.I. Vogel‟s, Text Book of Practical Organic Chemistry, 5th Ed., Prentice Hall, 1989.

3. Specific Learning Outcomes (SLOs)

Unit	Course content	Learning Outcomes	BTLT
	Principles of qualitative analysis-.	Understand the reactions involved qualitative analysis of organic compounds	K4
	Handling of apparatus and hazardous chemicals like bromine, sodium, $NaNO_2$, concentrated acids and bases	Apply precautionary measures while handling hazardous chemicals	K3
	Theory of the various chemical reactions /	Understand and apply the concepts of	K4
	Tests and techniques of derivatization-scientific reporting	Describethe techniques involved in derivatization	K4
	Green Chemistry: Introduction and basic principles of green chemistry - green solvents - green reactions - microwave induced green synthesis.	Describe the importance of green synthetic route	K2
	Characterization of organic compounds by their functional groups and and preparation of derivatives.	Analyse systematically the given unknown compound. Identify the functional groups present in unknown organic compound. Prepare the derivatives.	K3 K5 K3
	Confirmation of functional groups	To practice laboratory ethics and to adopt the ethical values in the semi-micro analysis	K5

4. Mapping (CO, PO, PSO)

ORGANIC ANALYSIS Code : U22CH4P3													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	L		L	L		L		H	L		H
CO2	H	H	H		H	H		H		H	H		H
CO3		H	H		H	H	H	H			H	H	
CO4		H	H		H	H		H			H		
CO5	H	H	H		H	H		H		H	H		H
CO6	H	H	H		H	H		H		H	H		H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II
2. Model Exams I and II
3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Mr. P. Sathiaseelan**

Head, Department of Chemistry : Dr J. Princy Merlin

CORE COURSE V : ORGANIC CHEMISTRY – I

Semester : V **Code : U22CH505**
Credits : 6 **Total Hours : 90**
Hours/Week: 6

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Enumerate the dimensionality of molecules and their importance in determining the reactivity.	K4	I
2	Apply the basic concepts of stereochemistry solve the problems related stereochemistry of organic compound.	K3	II
3	Classify the organic compounds in different stereoisomers.	K4	II
4	Categorize different types of reactions of carbonyl compounds based on the reactive species and products.	K4	III
5	Convert mono and di carboxylic acids in other functional groups using relevant reagents.	K4	IV
6	Distinguish the chemistry of different types of nitrogen containing organic compounds	K4	V

2A. Syllabus

Unit I Stereochemistry – I **18 Hours**

1.1 **Isomerism in organic compounds** – Definition – Classification into Structural and Stereoisomerism.

1.2 **Projection Formula**–Fischer, Flying Wedge, Sawhorse and Newmann - Notations for optical isomers – Cahn–Ingold–Prelog rules – R, S notationsfor optical isomers with one asymmetric carbon–Erythro and Threorepresentations.

1.3 **Optical isomerism** – Optical activity – Optical and specific rotations – conditions for optical activity– Asymmetric centre – Chirality – Achiral molecule – (+) and (-) and D and L notations – Elements of symmetry – Racemization – Resolution methods (Mechanical separation, seeding, biochemical and conversion into diastereomers).

Unit II - Stereochemistry – II **18 Hours**

2.1 **Geometrical isomerism** – cis-trans, syn-anti and E-Z notations, Geometrical isomerism in Maleic, Fumaric acids and in unsymmetrical Ketoximes – Methods of distinguishing geometrical isomers (Dipolemoment, dehydration, heat of hydrogenation, cyclization, melting points) – Methods of determining the configuration of geometrical isomers.

2.2 **Conformers** – Open Chain compounds (n-butane) - cyclic compounds (cyclohexane and di-substituted cyclohexane)

2.3 Asymmetric synthesis (partial and absolute asymmetric synthesis) – Walden inversion van't Hoff's rule - Freudenberg's rule of shift.

Unit III Carbonyl Compounds - Aldehydes and Ketones 18 Hours

3.1 **Structure**–Nomenclature- Methods of preparation, Physical and Chemical properties -Nucleophilic addition- Sodium bisulphite, Hydrogen cyanide, Acid & base catalyzed reactions and acidity of α-hydrogens.

3.2 **Reduction reaction**–reduction to alcohol and alkane using Grignard reagent- $LiAlH_4$ -$NaBH_4$ and MPV reduction

3.3 **Oxidation reaction** – Oxidation of aldehydes and ketones.

3.4 **Naming reactions** involving carbonyl compounds with mechanism- Haloform,Reformatsky and Wittig Reaction.

3.5 **Condensation** reactions with mechanistic details –Aldol condensation, Cross-Aldol- Cannizaro - Stobbe- Dakin -Perkin condensation

Unit IV Carboxylic Acids and Derivatives 18 Hours

4.1 **Monocarboxylic a**cid–Nomenclature - methods of preparation by oxidation of primary alcohol, aldehydes, hydrolysis of nitriles, Hydrolysis of esters, Carboxylation of alkenes - Acidity of carboxylic acid- Ortho effect- – Acidity constant – chemical properties of mono carboxylic acids -salt formation – formation of acid halides- formation of amides- formation of esters

4.2 **Dicarboxylic acids**–preparation and properties of oxalic, malonic, succinic, glutaric and adipic acids.

4.3 **Malonic and acetoacetic esters**–characteristics of reactive methylene group–synthetic uses of malonic and acetoacetic esters.

Unit V - Chemistry of Nitrogen Compounds 18 Hours

5.1 **Nitrogen compounds** - nomenclature - nitro alkanes - synthetic uses and reactions of nitroalkanes, alkyl nitrites – differences between nitroalkanes and alkyl nitrites.

5.2 **Aromatic nitro compounds -** Physical and chemical properties of aromatic nitro, di and trinitro compounds - preparation and reduction of nitro benzene under different conditions. Chemistry of Picric acid.

5.3 **Amino compounds** - Classification of Aliphatic and aromatic amines – Reactions of Aromatic and Aliphatic amines- effect of substituents on basicity and comparison of aliphatic and aromatic amines, mechanism of carbylamine reaction and diazotization– preparation and synthetic importance of Amines and benzene diazonium chloride - Hinsberg Test.

2B. Topics for Self-Study

S.No.	Topics	Web Links
1	Conformations of open-chain compounds	https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Organic_Chemistry_with_a_Biological_Emphasis_v2.0_(Soderberg)/03%3A_Conformations_and_Stereochemistry/3.02%3A_Conformations_of_open-chain_organic_molecules
2	Conformations of cyclic organic compounds	https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Organic_Chemistry_with_a_Biological_Emphasis_v2.0_(Soderberg)/03%3A_Conformations_and_Stereochemistry/3.03%3A_Conformations_of_cyclic_organic_molecules
3	R and S sequence rules	https://chem.libretexts.org/Bookshelves/Organic_ Chemistry/Supplemental_Modules_(Organic_Ch emistry)/Chirality/Absolute_Configuration_R-S_Sequence_Rules
4	E and Z notation	https://chem.libretexts.org/Bookshelves/Organic_ Chemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_(Roberts_and_Caserio)/19%3A_ Mo re_on_Stereochemistry/19.07%3A_E%2CZ_ Notation
5.	Naming reactions involving carbonyl Compounds	https://nptel.ac.in/content/storage2/courses/10 4101005/downloads/LectureNotes/ chapter% 2010.pdf
6.	Organomagnesium compounds	https://chem.libretexts.org/Bookshelves/OrganicChemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_(Roberts_and_Caserio)/14%3A_Organohalogen Organometallic_Compounds/14.12%3A_Organomagnesium_Compounds
7.	Acetoacetic ester synthesis	https://www.organic-chemistry.org/ namedreactions/acetoacetic-ester-synthesis.shtm
8.	Malonic ester synthesis	https://www.organic-chemistry.org/named reactions/ malonic-ester-synthesis.shtm

2C. Text Books

1. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S.Chand & Co., Ltd., New Delhi,2012. **(Unit- III, IV, V).**
2. M.K. Jain and S.C. Sharma, Modern Organic Chemistry, Vishal Publishing &Co,2015 **(Unit-III, IV, V)**
3. D. Nasipuri, Stereochemistry of Organic Compounds, New Age International, New Delhi,2018. **(Unit- I, II).**
4. R.T. Morrison and R.N. Boyd, Organic Chemistry, Pearson Education, New Delhi, 2016.

2D. References Books

1. Bhupinder Mehta& Manju Mehta, Organic Chemistry, PHI Learning Pvt. Ltd., 2015
2. P.S. Kalsi, Stereochemistry, Conformation and Mechanism, Wiley Eastern Limited, New Delhi, 2017
3. Ernest L. Eliel, Stereochemistry of Carbon Compounds, Tata McGraw Hill, New Delhi, 2008
4. L.C. Wade, Organic Chemistry, Pearson Education, New Delhi, 2016.
5. Paula Yurkanis Bruice, Organic Chemistry, Pearson Education, New Delhi, 2013.
6. Raj K. Bansal, Text Book of Organic Chemistry, New Age International Ltd., NewDelhi, 2016.

3. Specific Learning Outcomes (SLOs)

Unit	Course Contents	Learning Outcomes	BTLT
I	**Unit –I Stereochemistry – I**		
1.1	Stereoisomerism - Definition - Classification in Structural and Stereoisomerisms.	Classify the compounds in constitutional and stereoisomers	K2
1.2	Optical isomerism - Optical activity -Optical and specific rotations - conditions for optical activity	Relate chiral and achiral center in organic compounds	K2
		Summarize the conditions for optical activity	
	Asymmetric Centre - chirality - Achiral molecule	Identify chiral /achiral compounds	K3
	Meaning of (+) and (-) and D and L notations, Elements of symmetry	Classify elements of symmetry in compounds, differentiate dl & + and - notations	K2
1.3	Racemization - methods of resolution (Mechanical separation, seeding, biochemical and conversion diastereoisomers)	Explain Racemization and Resolution methods. Explain advantages and disadvantages of these Methods	K2
	Asymmetric synthesis (partial and absolute asymmetric synthesis	Utilize the knowledge of asymmetric synthesis solve theoretical problems of organic reaction.	K3
1.4	Walden inversion – van't Hoff's rule – Freudenberg's rule of shift.	Identify Stereochemistry of products obtained in SN1 and SN2 substitution reactions.	K3
		Verify the Freudenberg's rule of shift with examples know Two or more asymmetric carbons make independent contribution the total molecular rotation	K4
	Unit II Stereochemistry – II		
2.1	Projection Formula-Fischer, Flying Wedge, Sawhorse and Newmann- Notations for optical isomers	Illustrate various stereochemical projectionsfor organic compounds	K2

Unit	Course Contents	Learning Outcomes	BTLT
	Cahn - Ingold - Prelog rules - R,S notations for optical isomers with one asymmetric carbon Erythro and Threo representations.	Apply CIP rules to assign R S and EZ configurations molecules.	K3
		Identify Erythro and Threo representations.	K2
	Geometrical isomerism in Maleic, Fumaric acids and in unsymmetrical Keximes	Classify maleic acid and fumaric acid & ketoximes using EZ notation.	K4
	Methods of distinguishing geo - metrical isomers (Dipolemoment, dehydration, heat of hydrogenation, cyclization, melting points)	Choose various Methods of distinguishing geometrical isomers	K3
	Methods of determining the configuration of geometrical isomers.	Outline the methods of determining the configuration of geometrical isomers.	K2
Unit III Carbonyl Compounds - Aldehydes and Ketones			
3.1	Structure-Nomenclature-	Assign names for aldehydes and ketones using IUPAC rule	K3
	Methods of preparation, Physical properties, chemical properties - nucleophilic addition- acid- base catalysed reaction - acidity of α-hydrogens, Addition reactions - sodium bisulphate, hydrogen cyanide.	Demonstrate the properties of carbonyl compounds.	K2
		Explain the mechanism of nucleophilic addition reactions of aldehyde and ketones at different condition.	K2
3.3	Reduction reaction-reduction alcohol& alkane using Grignard reagent andLiAlH4- NaBH4	Compare the reducing abilities of Grignard reagents, LiAlH4& NaBH4	K4
	Introduction organometallic reagents like Organo Zn- Organo lithium and Organo Copper compounds	Explain the chemistry of different organometallic reagents like OrganoZinc, Organo lithium and Organo Copper compounds	K2
	orbital structure of C- metal bonds, ionic character, preparation, structure and synthetic uses.	Summarize the synthetic applications of the listed organometallic reagents.	K2
3.4	Oxidation reaction - Oxidation of aldehydes and ketones.	Select suitable oxidizing agents oxidize aldehyde and keto group.	K4
3.5	Naming reactions involving carbonyl compounds - Haloform, Reformatsky and Wittig Reaction.	Illustrate the mechanism of listed named reactions.	K2
3.6	Condensation reactions with mechanistic details -Aldol condensation, Cross-Aldol- Cannizaro - Stobbe- Dakin -Perkin condensation	Illustrate the mechanism of listed named reactions.	K2
Unit IV Carboxylic Acids and Derivatives			
4.1	Monocarboxylic acid-Nomenclature	Assign names for all carboxylic acids	K3
	Methods of preparation by oxidation of primary alcohol, aldehydes, hydrolysis of nitriles, Hydrolysis of esters, Carboxylation of alkenes	Examine different functional groups for the preparation of carboxylic acid.	K4
	Acidity of carboxylic acid- Ortho effect- - Acidity constant	Relate Acidity and pKa of carboxylic acids with resonance stabilization	K3

Unit	Course Contents	Learning Outcomes	BTLT
	Chemical properties of mono carboxylic acids - salt formation -formation of acid halides- formation of amides- formation of esters.	Distinguish different products obtained from carboxylic acid using different reagents.	K4
4.2	Dicarboxylic acids-preparation and properties of oxalic, malonic, succinic, glutaric and adipic acids	Compare the physical and chemical properties of different dicarboxylic acids	K4
4.3	Malonic & acetoacetic esters- characteristics of reactive methylene group-synthetic uses of malonic and acetoacetic esters.	Apply reactivity of active methylene group in malonic and acetoacetic for synthesis.	K3
	Unit V Chemistry of Nitrogen Compounds		
5.1	**Nitrogen compounds** - Nomenclature -nitro alkanes - synthetic uses and reactions of nitroalkanes - alkyl nitrites- differences between nitroalkanes and alkyl nitrites	Assign names for aliphatic and aromatic nitro & amino compounds	K2
		Compare the formation and reactions of alkyl nitrite and nitro alkanes	K4
5.2	**Aromatic nitro compounds -** Physical and chemical properties of aromatic nitro, di and trinitro compounds	Demonstrate the physical and chemical properties of aromatic nitro compounds	K2
	preparation and reduction of nitro benzene under different conditions. Chemistry of Picric acid	Explain the method of preparation and reduction of aromatic nitro compounds.	K2
5.3	**Amino compounds** - Classification of Aliphatic and aromatic amines	Describe the Characteristics of the aliphatic and aromatic amines	K2
	Effect of substituents on basicity and comparison of aliphatic and aromatic amines -	Compare the basicity of different substituted aliphatic and aromatic amines.	K4
	Mechanism of carbylamine reaction and diazotization-	Apply diazotization route convert nitro - other functional groups	K3
	Preparation and synthetic importance of Amines and benzene diazoniumchloride. Hinsberg Test.	Explain the preparation and synthetic uses of Amines and benzene diazonium chloride.	K2

4. Mapping (CO, PO, PSO)

ORGANIC CHEMISTRY – I Code: U22CH505													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**H**	**H**	**-**	**L**	**-**	**-**	**L**	**H**		**H**	**-**	**-**	**H**
CO2	**H**	**H**		M	**-**	**-**	**L**	H		**H**	**-**		**H**
CO3	**H**	**H**		L	**-**	**-**	**L**	H		**H**	**-**	**-**	**H**
CO4	**H**	**H**	**-**	L	**-**	**-**	**L**	H		**H**	**-**	**-**	**H**
CO5	**H**	**H**	**-**	L	**-**	**-**	**L**	H		**H**	**-**	**-**	**H**
CO6	**H**	**H**	**-**	L	**-**	**-**	**L**	H		**H**	**-**	**-**	**H**

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Mr. J. Thangarathinam**

Head, Department of Chemistry : Dr J. Princy Merlin

CORE COURSE – VI : PHYSICAL CHEMISTRY – I

Semester : V **Course Code: U22CH506**
Hours/Week : 6 **Total Hours : 90**
Credits : 6

1. Course Outcomes

After the completion of this course, the student will be able to:

S.No.	Course Outcomes	Level	Unit
1.	Predict the feasibility and nature of reactions from the thermodynamic properties like ΔH, ΔG & ΔS values	K5	I
2.	Utilize Joule-Thomson effect to liquefy gases	K3	I
3.	Apply the principle of Carnot cycle, types of heat engines and working efficiency	K3	II
4.	Compute the absolute entropies of pure substancesat temperatures other than 0 K from their heat capacities and heats of transition.	K3	III
5.	Predict qualitatively the effect of changing temperature, pressure or concentration on heterogeneous system in equilibrium by means ofphase diagram	K5	IV
6.	Apply the colligative properties for determining the molecular weight of solute.	K3	V

2A. Syllabus

Unit I - Zero & First Law of Thermodynamics **18 Hours**

1.1 Definition of thermodynamic terms - system and surrounding–isolated, closed and open systems - Intensive and Extensive properties. Thermodynamic processes Reversible and Irreversible, Isothermal and Adiabatic processes– State and Path functions.

1.2 Laws of thermodynamics: Zeroth law and First law of thermodynamics - Internal energy (E), Enthalpy(H) and Heat capacities, Relation between Cp and Cv - Calculation of q, W, ΔE and ΔH for expansion of ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes (Problems). Joule – Thomson effect as an iso-enthalpic process. Relationship between $\mu_{J.T}$ for ideal and real gases – inversion temperature- **Problems.**

1.3 Thermochemistry – Enthalpy change in chemical reactions – relationship between ΔE and ΔH - Hess's law and its applications, Standard states – standard enthalpy of formation, enthalpy of combustion, enthalpy of neutralization, Bond energy and its calculation from thermochemical data. Temperature dependence of ΔH - Kirchoff's equation – **Problems.**

Unit II - Second Law of Thermodynamics **18 Hours**

2.1 Need for the II law – Second law of thermodynamics (different statements) – Cyclic process – heat engine – Carnot's cycle and its efficiency - Problems.

2.2. Concept of entropy - Claussius Inequality - Entropy as a criterion of spontaneous and equilibrium process in isolated systems - Entropy as a function of P, V and T – Entropy change in phase changes, Entropy of mixing – Problems.

2.3. Gibbs and Helmholtz functions -ΔA and ΔG as a function of P, V and T. Maxwell's Relations - Gibbs – Helmholtz equation and its applications – Thermodynamic criteria for spontaneity and equilibrium – Problems.

Unit III - Third Law, Thermodynamic Applications and Partial Molar Properties **18 hours**

3.1. Third law of thermodynamics–statement–evaluation of absolute entropy from heat capacity data, Exception to third law (CO, N_2O) – Nernst Heat theorem and its expression.

3.2. Equilibrium constant and standard free energy change, van't Hoff isotherm (van't Hoff equation) –Thermodynamic derivation of law of mass action-van't Hoff's Isochore –thermodynamic interpretation of Le Chatelier's principle.

3.3. Partial molar properties–chemical potential and its significance, Gibbs- Duhem equation- variation of chemical potential with T, P and X (mole fraction)

Unit IV - Phase Rule and its Applications **18 Hours**

4.1 Meaning of the terms – phase, component and degree of freedom -derivation of Gibb's phase rule. Phase equilibria of one component systems – CO2, water and sulphur systems. Phase equilibria of two component systems – simple eutectic systems – (Pb – Ag), Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (Na-K), Freezing mixtures (NaCl -water) – Effflorescence and Deliquescence.

4.2 Partially miscible liquid pairs - Phenol-Water, Trimethylamine–Water and Nicotine-Water systems - Effect of impurities on miscibility temperature, Immiscible liquids – Principle and Application of Steam Distillation, Nernst distribution law (thermodynamic derivation) and its applications.

Unit V - Solutions **18 Hours**

5.1. Dilute solutions - Colligative properties of solutions, Experimental determination of molecular weight by Relative lowering of vapour pressure, Berkely- Hartley and Cottrell's Method. Laws of osmotic pressure and its applications. thermodynamic derivation of Lowering of Vapour Pressure, Elevation of boiling point, Depression of freezing point and Osmoticpressure.

5.2 Binary liquid mixtures - Henry's law, Raoult's law - Deviation from Raoult's law - Ideal liquid mixtures (benzene and toluene), Fractional distillation, Non-ideal systems, Azeotropes (HCl- water and ethanol-water systems).

2B. Topics for Self-Study:

S.No.	Topics	Web links
1	First Law of Thermodynamics	https://www.grc.nasa.gov/www/k-12/airplane/thermo1.html
2	Second Law of Thermodynamics	https://www.youtube.com/watch?v=WTtxlaeC9PY
3	Third Law, Thermodynamic Applications and Partial Molar Properties	https://www.youtube.com/watch?v=kswiDQ2aAKA
4	Phase Rule and its applications	https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/DeVoes_Thermodynamics_and_Chemistry/13%3A_The_Phase_Rule_and_Phase_Diagrams/132_Phase_Diagrams%3A_Binary_Systems
5	Solutions	https://www.youtube.com/watch?v=_XunLuNS https://www.youtube.com/watch?v=hGt5-SOan2M

2C. Text Books

1. B.R. Puri, L.R. Sharma and Madan S. Pathania, Elements of Physical Chemistry, Vishal Publishing Co., Jalandhar, 2017 **(Unit I- V)**
2. K.K. Sharma and L.K. Sharma, A Text Book of Physical Chemistry, 4th Edn., Vikas Publishing House (P) Ltd., New Delhi, 2016 **(Unit I - V)**
3. K.L. Kapoor, A Text Book of Physical Chemistry, Macmillan, New Delhi, 2017
4. G.W. Castellan, Physical Chemistry, Narosa Publishing House, New Delhi, 2004.

2D. Reference Books

1. K. Kundu and S.K. Jain, Physical Chemistry, S. Chand Co. Ltd., New Delhi,2003
2. B.S. Bhal, G.D. Tuli and Arun Bhal, Essentials of Physical Chemistry, S.Chand and Co. Ltd., New Delhi, 2010.
3. P. Atkins and J. Paula, Physical Chemistry, Oxford University Press, NewDelhi, 2018.

3. Specific Learning Outcomes (SLOs)

Unit	Course Content	Learning Outcomes	BTLT
I	**First Law of Thermodynamics**		
1.1	Definition of thermodynamic terms	Define various thermodynamic terms	K2
	System and surrounding – isolated, closed and open systems - intensive and extensive variables.	Illustrate open closed and isolated systems. Distinguish Intensive and Extensive properties.	K2
	Thermodynamic processes - reversible and irreversible, isothermal and adiabatic State and path functions	Illustrate the state and path functions. Distinguish reversible and irreversible processes. Explain isothermal and adiabatic processes.	K3
1.2	Laws of thermodynamics Thermodynamics statements (E, H, Cp, Cv, q, W, ΔE and ΔH) isothermal and adiabatic conditions for reversible and irreversible processes Joule - Thomson effect - isoenthalpic process Relationship between μ J.T for ideal and real gases Inversion temperature	State the I law of thermodynamics	K2
		Derive thermodynamic expressions for I law,work done, heat capacity and ΔH.	K3
		Explain Joule-Thomson effect.	K2
		Derive expression for Joule-Thomson co-efficient.	K3
1.3	Thermochemistry Enthalpy change in chemical reactions Relation between ΔE and ΔH of reactions	Evaluate enthalpy change during various chemical processes.	K5
	Hess's law and its applications Standard enthalpy of formation, enthalpy of combustion, enthalpy of neutralization Bond energy calculation from thermochemical data	Apply Hess's Law for calculating ΔH values.	K3
	Kirchoff's equation	Relate the temperature dependence of internal energy and enthalpy of a thermodynamic process.	K4
II	**Second Law of Thermodynamics**		
2.1	Second law of thermodynamics Different statements of the second law	Explain the total entropy of an isolated system	K2
	Cyclic process and heat engine, Carnot's cycle and its efficiency	Build the Carnot theoretical device and relate the reversible heat engine process	K3
2.2	Concept of entropy-entropy Definition	Outline the concept of entropy	K2
	Claussius inequality Entropy criterion of spontaneous and equilibrium process in isolated systems	Derive the mathematical expression of Claussius in equality.	K4
	Entropy function of P,V and T Entropy change in phase changes, entropy of mixing	Derive the mathematical expression for entropy of mixing.	K4

Unit	Course Content	Learning Outcomes	BTLT
2.3	Gibbs and Helmholtz functions	Calculate the changes in the Gibbs energy of a system as a function of temperature.	K2
		Derive Gibbs-Helmholtz equation.	K2
	ΔA and ΔGas function of P, V and T Maxwell's relations Gibbs - Helmholtz equation and its applications	Apply Gibbs-Helmholtz equation for reversible galvanic cells	K3
	Thermodynamic criteria for spontaneity and equilibrium	Predict the spontaneity of reactions from entropy data.	K3
III	**Third Law, Thermodynamic Applications and Partial Molar Properties**		
3.1	Third law of Thermodynamics and statement	State the third law of thermodynamics.	K2
	Evaluation of absolute entropy from heat capacity data	Evaluate the absolute entropy from Heat capacity data.	K5
	Exception to third law	State the Exception of third law of thermodynamics	K2
	Nernst Heat theorem and its expression	Derive Nernst Heat theorem.	K3
3.2	Equilibrium constant and standard free energy change Thermodynamic derivation of law of mass action	Derive the mathematical expression for law of mass action.	K4
	Van't Hoff isotherm, van't Hoff's isochore and Le Chatelier's principle	Derive the van't-Hoff isotherm.	K3
		Derive the van't Hoff isochore.	K3
		Explain the Le chaterlier's principle.	K2
3.3	Partial molar properties	Explain parital molar properties.	K2
	Chemical potential and its Significance	Derive the thermodynamic expression for chemical potential.	K2
	Gibbs-Duhem equation variation of chemical potential with T,P and mole Fraction	Derive Gibbs-Duhem equation.	K2
IV	**Phase Rule and its Applications**		
4.1	Terms of phase, component and degree of freedom	Define components, phases and degrees of freedom present in a system	K2
	Derivation of Gibb's phase rule	Calculate degree of freedom of a system	K4
	Phase equilibria of one component systems (CO_2, H_2O and S)	Identify triple point and metastable equilibrium. Explain the phase diagram of one component systems (CO_2, H_2O and S).	K4

Unit	Course Content	Learning Outcomes	BTLT
	Phase equilibria of two component systems Simple eutectic systems – (Pb – Ag)	Explain the phase diagram of simple systems with Eutectic Congruent melting point and Incongruent melting point.	K4
	Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (Na-K)		
	Freezing mixtures	Identify the methods to prepare freezing mixtures with desired temperature from phase diagrams.	K3
4.2	Efflorescence deliquescence and Partially miscible liquid pairs	Relate solid-liquid-gas equilibria with water of hydration using phase rule.	K3
		Identify partially miscible solvent pairs.	K3
	Phenol-water, Trimethylamine and -water nicotine-water systems	Predict the temperature effect on two partially miscible liquids using phase diagram.	K3
	Effect of impurities on miscibility temperature and immiscible liquids	Find out the effect of temperature on miscibility of liquids	K3
	Principle and application to steam distillation	Elaborate the method of purification of organic compounds and solvents	K4
	Nernst distribution law and its applications	Derive Nernst Distribution Law.	K4
V	**Solutions**		
5.1	Dilute solutions -colligative properties solutions	Explain colligative properties of solutions.	K4
	Experimental determination of molecular weight by relative lowering of vapour pressure	Determine molecular weight of non- volatile organic solute based on the colligative properties.	K4
	Berkely-Hartley and Cottrell's Method	Evaluate Osmotic pressure by Berkely-Hartley and Cottrell's Method.	K3
	Laws of osmotic pressure and its applications	Apply the laws of osmotic pressure for seawater purification.	K4
	Thermodynamic derivation of Lowering of Vapour Pressure, elevation of boiling point, depression of freezing point and osmotic pressure	Explain the effect of temperature, pressure on boiling point, freezing point and vapour pressure	K4
5.2	Binary liquid mixtures	Identify the composition of Binary Liquid mixtures.	K3
	Henry's law, Raoult's law deviation from Raoult's law	Explain the effect of pressure on miscibility of liquids and gas. Explain the significance of Raoult's law.	K3
	Ideal liquid mixtures (benzene and toluene) purified by fractional distillation	Describe the methods of purification of homogenous mixture of solvents	K5

Unit	Course Content	Learning Outcomes	BTLT
	Non ideal systems, azeotropes (HCl-water and ethanol-water systems).	Determine boiling point of pure and mixture of solvents. Differentiate positive and negative azeotropes.	K5

4. Mapping (CO, PO, PSO)

PHYSICAL CHEMISTRY – I Code: U22CH506												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	H	-	M	-	L	H	-	H	-	M	H
CO2	H	H	H	-	-	M	-	M	-	H	-	M	H
CO3	H	H	H	-	-	M	-	M	-	H	-	L	H
CO4	H	H	H	-	-	-	-	H	_	H	-	M	H
CO5	H	H	H	-	-	M	-	H	-	H	-	M	H
CO6	H	H	-H	-	-	H	-	H	-	H	-	L	H

L-Low M-Moderate H- High

Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : Mr. T. Arunachalam

Head, Department of Chemistry : Dr J. Princy Merlin

Core Practical – IV : Gravimetric Analysis

Semester: V **Code: U19CH5P4**
Credits: 3 Total Hrs.: 90
Hours/week : 6

Course outcomes:

After the completion of this course the students will be able to :

S.No.	Course Outcomes	Level
1	Apply the basic principles of Gravimetric Analysis	K3
2	Estimate the accurate quantity of the precipitate by avoiding post and co - precipitation errors	K4
3	Perform single stage organic transformations and Inorganic preparations using standard procedures	K4
4	Produce the maximum quantity of the organic compound as pure crystals	K3
5	Validate the purity of the given compounds by using physical constants	K4
6	Produce a valid and authentic scientific report of the findings in the prescribed format	K4

2A. Syllabus

Gravimetric Analysis - Principles of gravimetry - characteristics of precipitating agents –choice of precipitants–types of precipitants - condition of precipitation - Use of sequestering agents -Precipitation from homogeneous solution. Digestion, washing and ignition of the precipitate. Co-precipitation and post precipitation.

Experiments

I. Gravimetric Estimation

1. Estimation of lead as lead chromate
2. Estimation of barium as barium chromate
3. Estimation of calcium as calcium oxalate monohydrate
4. Estimation of sulphate as barium sulphate

II. Organic Preparation

Preparation of an organic compound by a single stage and recrystallization of the compound.

1. Preparation of salicylic acid from methyl salicylate
2. Preparation of acetophenone oxime from acetophenone

3. Preparation of m-nitromethylbenzoate from methylbenzoate

4. Preparation of benzoic acid from benzaldehyde

III. Inorganic Preparation

1. Preparation of coordination complexes

i) Preparation of Prussian blue

ii) Preparation of tetraaminecopper(II)sulphate

iii) Preparation of tristhioureacopper(I)chloride

2. Recording and interpreting the UV spectrum of the complex prepared (Demonstration only)

IV. Physical constant determination

1. Theory of measurement of physical parameters

Principle of physical measurements – Checking the purity of samples, handling of chemicals and the apparatus.

2. Determination of Physical Constant

Determination of melting and boiling points of simple organic compounds

2b. **Self-study Topic**:

https://byjus.com/chemistry/gravimetricanalysis/#:~:text=The%20principle%20of%20Gravimetric%20Analysis,quantity%20of%20an%20impure%20compound.

2C.Text Books

1. V.Venkateswaran, R.Veerasamy , A.R. Kulandaivelu, Basic Principles of Practical Chemistry- Second Edition , Sultan Chand & Sons , New Delhi,2006
2. Vogel, Text Book of Quantitative Chemical Analysis, 6th Edition, Pearson Education,2009.

2D.Reference Books

1. The Indian Pharmacopoea, 3rd Edition, Volume-II, Quality Specifications WorldHealth Organization , 1981.
2. A. V. Kasthuri, S. G.Wadodkar, S. B. Gokhale, Practical Pharmaceutical Chemistry-I,Nirali Publications, 13th Edition, 2007.

3. Specific Learning Outcomes (SLOs)

Units	Course content	Learning Outcomes	HBTLT

	Gravimetric Analysis - Principles of gravimetry - characteristics of precipitating agents Choice and types of precipitants - condition of precipitation - Use of sequestering agents Precipitation from homogeneous solution. Digestion, washing and ignition of the precipitate. Co-precipitation andpost precipitation.	Explain the different conditions involved in the Gravimetric analysis	K2

Units	Course content	Learning Outcomes	HBTLT
1.	**Gravimetric Estimation** Estimation of lead as lead chromate Estimation of barium as barium chromate Estimation of calcium as calcium oxalate monohydrate Estimation of sulphate as barium sulphate	estimate the amount of ions using the gravimetric method estimate the accurate quantity of the precipitate by avoiding post and co -precipitation errors	K4
2.	**Organic Preparation** Preparation of an organic compound by a single stage and recrystallization of the compound. Preparation of salicylic acid from methyl salicylate Preparation of acephenoneoxime from acephenone Preparation of m-nitromethylbenzoate from methylbenzoate Preparation of benzoic acid from benzaldehyde	Prepare the maximum quantity of the organic compound as pure crystals.	K4
3.	**Inorganic Preparation** Preparation of Prussian blue Preparation of tetraaminecopper(II)sulphate. Preparation of tristhioureacopper(I)chloride. Recording and interpreting the UV spectrum of the complex prepared (Demonstration only)	Prepare the coordination complexes by adopting suitable reaction conditions. Apply optimum conditions to obtain maximum yield of complexes Interpret the UV spectra of complexes	K3 K4 K3
4.	**Physical constant determination** **Theory of measurement of physical parameters** Principle of physical measurements Checking the purity of samples, handling of chemicals and the apparatus. Determinationof melting and boiling points of simple organic Compounds.	Detect the purity of the prepared organic compounds by determining their physical constants.	K4

4. Mapping (CO, PO, PSO)

Gravimetric Analysis Code: U19CH5P4													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	-	-	M	M		H	-	H	M	-	H
CO2	H	H	H	L	H	H	-	H	-	H	H	-	H
CO3	H	H	-	L	H	H	-	H	-	H	H	-	H
CO4	H	H	-	L	H	H	-	H	-	H	H	-	H
CO5	H	H	H	L	H	H	-	H	-	H	H	-	H
CO6	L	H	-	L	-	-	H	-	-	L	-	H	L

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : Mr. T. Arunachalam

Head, Department of Chemistry : Dr J. Princy Merlin

Elective Course – II : Analytical Chemistry

Semester : V **Code: U22CH5:2**
Credits : 4 **Total Hours: 60**
Hours/Week: 4

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Analyze the various types of data and make use of computers to represent the data	K4	I
2	Choose the suitable methodology for purification of compounds.	K3	II
3	Plan and carry out experiments based on the instrumental methods of analysis	K4	II
4	Apply the principles and methods estimate selected organic compounds in a given sample	K3	III
5	Apply the principles and applications of electro analytical and colorimetric methods	K3	IV
6	Apply a suitable chromatographic technique separate various substances present in a mixture.	K3	V

2A. Syllabus

Unit I - Data Handling **12 Hours**

1.1 Data Analysis

Data -definition – types of data – categorical or qualitative and numerical or quantitative, Data collection primary and secondary – variable – dependent and independent, Tabulation of data – conversion of table to diagrams and graphs – diagrams – bar and pie diagram – graphs – line and frequency distribution – linear graphs (identification of slope and intercept values) – use of error bars in presenting graphical data – using computers to prepare tables, spreadsheets and graphs. Curve Fitting by Least Square method (Best Fit Curve) - Problems.

1.2. **Error Analysis** - in chemical analysis, classification of errors, Precision, accuracy and rejection of data. Significant Figures in Scientific measurements, Mean, Mode, Median – Mean deviation and standard deviation – t-test and Q–test – Significance of Correlation and Regression coefficients.

Unit II - Analytical Methods **12 Hours**

2.1 **Organic estimations -** Principles and methods to estimate glucose, phenol, aniline, ketone, Estimation of oils and fats, Iodine value, Saponification value.

2.2 **Methods of purification**–steam distillation, vacuum distillation, fractional distillation, solvent extraction, crystallization and sublimation.

2.3 **Instrumental methods of analysis** using Atomic Absorption Spectroscopy – Fluorimetry – TDS analyzer – Determination of total dissolved salts in water samples - Flame photometer – Determination of Na and K in different samples - Nephelometer – Determination of sulphate ion in different samples

.

UNIT III - Analytical Techniques-I **12 Hours**

3.1. **Thermo-analytical Methods** - Principles involved in Thermo Gravimetric Analysis and Differential Thermal Analysis instrumentation - Characteristics of TGA (CaC_2O_4. H_2O, $CuSO_4.5H_2O$) and DTA curves (CaC_2O_4. H_2O) - Factors affecting TGA and DTA curves. Differential Scanning Calorimetry (DSC) – Voltammetry – Amperometry – Coulometry.

3.2 **Analytical electrochemistry** - Potentiometry (redox titration), conductometry (acid -base titration), electro – gravimetry (estimation of copper and silver).

Unit IV - Analytical Techniques-II **12 Hours**

4.1 **Colorimetric analysis -** Laws of colorimetry, principle, instrumentation, construction of standard graph and applications of colorimetry. Estimation of nickel using DMG and aluminium using oxine.

4.2 **Complexometric titrations** – Principle and applications, sequestering agents, chelate effect, Structure of EDTA and its complexes.

4.3 **Techniques for kinetic study**

Principles and techniques used to follow the kinetics of ordinary, fast and photochemical Reactions (Volumetry, Polarimetry, Actinometry - one example for each method) and flash photolysis.

Unit V - Chromatography **12 Hours**

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

5.2 **Paper chromatography** – principle, selection of solvents, development of chromatogram, application – Application: separation of amino acids only.

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

5.4 **Ion exchange chromatography** – principle, types of resins, Application: separation of lanthanides

2B. Topics for Self-Study

S.No.	Topics	Web Links
1.	Synthetic Approaches and Chemical Waste Management	https://onlinecourses.swayam2.ac.in/ugc19_bt18/preview https://www.inspirenignite.com/anna-university/hazardous-waste-management-env-7th-sem-syllabus-for-be-2017-regulation-anna-univ/ R.E.Landrefh and P.A.Rebers,‖ Municipal Solid Wastes-Problems & Solutions‖ ,Lewis, 1997 https://www.youtube.com/results?search_query=Biomedical+Waste+Management%3A
2.	Analytical Methods of Purification and data analysis	https://www.youtube.com/watch?v=PVv pEKeOzEM https://www.youtube.com/user/amritavlab/videos https://www.youtube.com/watch?v=_C XlmtfxuzQ https://www.youtube.com/watch?v=mk8tOD0t8M0 https://freevideolectures.com/course/3041/design-and-optimization-of-energy-systems/13 http://www.nitttrc.edu.in/nptel/courses/video/101104066/lec18.pdf
3.	Analytical Techniques-I TGA and DSC	https://www.youtube.com/watch?v=qaUAJ1RJqMU https://www.youtube.com/watch?v=itLVkpaB84Y https://www.youtube.com/watch?v=2C U3uvjKXlk https://www.youtube.com/watch?v=aT WVCfRlMX8 https://www.youtube.com/watch?v=gd1YQr-74sw https://www.youtube.com/watch?v=U0QtPokFAAI https://www.youtube.com/watch?v=tGHJ6LUUBIY
4.	UV Photolysis	https://www.youtube.com/watch?v=QaF2NGukCnY https://www.youtube.com/watch?v=akRcLMQUxm4 https://www.youtube.com/watch?v=34nLM_a7RLs https://www.youtube.com/watch?v=AlKW0o4pXEE
5.	Analytical Techniques-II Advances In Fast Ion Chromatography	https://www.youtube.com/watch?v=ci2uu9Cuf5s https://www.youtube.com/watch?v=iPpy4khqtks https://www.youtube.com/watch?v=qdmKGskCyh8 https://www.youtube.com/watch?v=VOSkyj1dtbc https://rnlkwc.ac.in/pdf/study-material/physiology/ion%20exchange,molecular%20sieve,affinity.pdf

2C. Text Books

1. D.A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, (2014). Fundamentals of Analytical Chemistry, India: Cengage Learning. Print **(Unit I-V)**
2. Gary D. Christian, (2011). Analytical Chemistry, (6th ed.), New York: John Wiley & Sons. Print.
3. V.K. Ahluwalia, Green Chemistry: A Textbook **(Unit I)**

4. R. Gopalan, P.S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 1997 **(Unit III-V)**
5. B.K. Sharma, Instrumental Methods of Chemical Analysis, Goel Publishing House, Meerut,1999 (Unit- II, III).

2D. Reference Books

1. Jeffery G.H., Bassett J., Mendham J., Denney R.C., (1989). Vogel's Textbook of Quantitative Chemical Analysis, (5th ed.), New York: Longman Scientific &Technical. Print.
2. H.H: Willard, D. Merrit and John A Dean, Instrumental methods of Analysis D. Van Nostrand Company, New York, 1998.

3. Specific Learning Outcomes (SLOs)

Unit	Course Content	Learning Outcomes	BTLT
	Unit– I Data Handling		
1.1	Data -definition – types of data - categorical or qualitative and numerical or quantitative, Data collection primary and secondary - variable - dependent and independent, Tabulation of data - conversion of table to diagrams and graphs - diagrams - bar and pie diagram - graphs - line and frequency distribution - linear graphs (identification of slope and intercept values) Presenting graphical data - using computers to prepare tables, spreadsheets and graphs. Curve Fitting by Least Square method (Best Fit Curve) - Problems	Define data Differentiate dependent and independent variable Analyse data with accuracy Convert tables into different charts Presenting graphical data - using computers to prepare tables, spreadsheets and graphs. Analyze data by curve fitting method	K2 K3 K3 K3 K4 K5
1.2	**Error Analysis** - in chemical analysis, classification of Errors, Precision, accuracy and rejection of data. Significant Figures in Scientific measurements Mean, Mode, Median - Mean deviation and standard deviation - t-test and Q-test Significance of Correlation and Regression coefficients.	Classify the types of error Analyze the given set of data statistically to identify errors. Differentiate Accuracy and precision Find out significant figures Calculate Mean, Mode, Median and standard deviation Apply Correlation and Regression coefficients in data analysis	K3 K3 K3 K4 K2
	Unit– II Analytical Methods		
2.1.	**Organic estimations** :Principles and methods to estimate glucose, phenol, aniline, ketone, Estimation ofoils and fats, lodine value, Saponification value.	Apply the principles and methods to estimate selected organic compounds in a given sample	K3
2.2.	**Methods of purification**: Steam distillation, vacuum distillation, fractional distillation, solvent extraction. crystallization and sublimation	Identify an appropriate purification technique.	K3

Unit	Course Content	Learning Outcomes	BTLT
2.3	**Instrumental methods of analysis** using Atomic Absorption Spectroscopy - Fluorimetry - TDS analyzer - Determination of total dissolved salts in water samples - Flame photometer - Determination of Na and K in different samples - Nephelometer- determination of sulphate ion in different samples .	Analyse sample using various instrumental methods such as AAS, TDS analysis, Nephelometry detc	K4
	UNIT– III Analytical Techniques-I		
3.1.	**Thermo-analytical Methods** Principles involved in Thermo Gravimetric Analysis and Differential Thermal Analysis instrumentation. Characteristics of TGA ($CaC_2O_4.H_2O$, $CuSO_4.5H_2O$) and DTA curves ($CaC_2O_4.H_2O$) - Factors affecting TGA and DTA curves.	Describe the thermal stability of a particular sample by using TGA and DTA process	K2
3.2.	**Analytical electrochemistry** Potentiometry (redox titration), conductometry (acid -base titration), electro - gravimetry (estimation of copper and silver)	Explain the method of determining the amount of ions present in the sample using suitable basic electro-analytical technique.	K2
	Unit- IV Analytical Techniques-II		
4.1.	**Colorimetric analysis**: Laws of colorimetry, principle, instrumentation, construction of standard graph and applications of colorimetry. Estimation of nickel using DMG and aluminium using oxine	Apply the Laws of Colorimetry in estimation of Ions**.**	K3
4.2.	**Complexometric titrations**: Principle and applications, sequestering agents, Structure of EDTA and its complexes	Apply the Principle and applications of sequestering agents	K3
4.3.	**Techniques for kinetics study:** Principles and techniques used to follow the kinetics of ordinary, fast and pho chemical Reactions Volumetry, Polarimetry, Actinometry - one example for each method) and flash photolysis	Outline the Principles and techniques used to follow the kinetics of Reactions	K2
	Unit– V Chromatography		
5.1.	**Column chromatography:** Principle, types of adsorbents, preparation of column, elution, R_f value and its significance, factors affecting R_f value, Application: separation of 2,4-dinitrophenyl hydrazones of butanone and acetophenone	Explain column chromatographic technique to separate and identify the compounds in a mixture	K2
5.2.	**Paper chromatography**: Principle, selection of solvents, development of chromatogram, application - Application: separation of amino acids only	Explain the paper chromatographic technique to separate organic compounds in a mixture	K2
5.3.	**Thin layer chromatography:** Principle, choice of adsorbent, preparation of plates, development and application - Application: separation of 2,4-dinitrophenylhydrazones of butanone and acetophenone only	Explain the Thin Layer chromatographic technique to separate organic compounds in a mixture	K2

Unit	Course Content	Learning Outcomes	BTLT
5.4.	**Ion exchange chromatography:** Principle, types ofresins, Application: separation of lanthanides	Apply the principles of Ion Exchange chromatography to separate and evaluate the presence of lanthanides	K3

4. Mapping (CO, PO, PSO)

ANALYTICAL CHEMISTRY Code: U22CH5:2													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H		H	H					H	H		H
CO2	H	H			H	H	L	H	H	H	H		H
CO3	H	H	H	H	H	H	L	H	H	H	H	H	H
CO4	H	H			H	H	L	H	H	H	H		H
CO5	H	H	H		H	H	L	H	H	H	H	H	H
CO6	H	H	H		H	H	L	H	H	H	H	H	H

L-Low M-Moderate H- High

5.Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : Dr. S. Ambika

Head, Department of Chemistry : Dr J. Princy Merlin

SBEC II : INDUSTRIAL CHEMISTRY - II

Semester : V **Code : U22CH5S2**
Credits : 2 **Total Hours: 30**
Hours/Week: 2

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Explain the terminology used in pharmaceutical chemistry.	K2	I
2	Relate the structure of heterocyclic drugs derived from pyridine, pyrimidine and quinoline and their therapeutic properties.	K2	I
3	Identify the diagnostic agents used and correlate their structure with their properties and uses	K2	II
4	Correlate the structure mechanism and drug action of Antibiotics	K3	II
5	Recognize the various organic diagnostic agents, anti-neoplastic agents narcotic drugs from non-narcotic drugs used as drugs.	K3	III
6	Understand the formulations of cosmetics – lip-care, skincare and perfumes.	K2	IV
7	Explain the various processes involved in pulp and in paper industry	K2	V

2A. Syllabus

Unit I - Pharmaceutical Chemistry -1 Drugs 6 hours

1.1 Terminology used in pharmaceutical chemistry : Drug and its formulations, Pre-requisites of a drug, pharmacopia, chemotherapy, pharmaceutics, LD-50 values - Routes of administration of drugs.

1.2 Heterocylic Drugs : Structure and uses of drugs derived from the following derivatives - Pyridine derivatives - Tripleenamine and mepyramine, Quinoline derivatives - Chloroquine and primaquine, Pyrimidine derivatives - barbiturates.

1.3 Sulpha Drugs : Chemistry of sulphonamides – sulphadiazine and prontosil – preparation and uses.

Unit II - Pharmaceutical Chemistry II - Organic diagnostic agents 6 hours

2.1 X-ray contrast media (radio opaque) Iodipamide, Evan's blue, Histamine, Xylose, CT and MRI scan (Basics only) Structure and uses of i) Narcoticdrugs– Morphine and SAR of morphine ii) Non- Narcotic drugs–ibuprofen.

2.2 **Antibiotics** – structure and mechanism of penicillin, structure of semi-synthetic penicilline – Ampicillin, structure and uses of Chloramphenical.

Unit III - Pharmaceutical Chemistry III - Anesthetics and Alkylating Agents 6 hours

3.1 **Anesthetics -** Stages of anesthesia - Preparation and uses of general and local gaseous anesthetics - Ether, halogenated Hydrocarbons – chloroform and trichloroethylene, Local anesthetics – Cocaine and it's any two derivatives-intravenous anesthetics – thiopentone sodium and propounded
– Structure and uses only.

3.2 **Anti-neoplastic agents** – Alkylating agents (Busulfan)–Ethylene imines– Nitrogen mustards–Cyclophosphoamide. Antimetabolites – Purine analogues, Immunotherapy.

Unit IV - Cosmetic Chemistry 6 hours

4.1 **Cosmetics -** Introduction about raw materials in cosmetics (oil, waxes, colour, preservative and fragrance). Pre-requisites for different cosmetics and applications - skin and hair care products **-** skin lighteners, sun screen lotions-skin toners- anti-wrinkling creams.

4.2 **Lip care** - lip gloss – lipsticks - lip liners, moisturizers, lip balm.

4.3 **Perfumes -** Fragrance - Raw materials for fragrance - natural, synthetic - Odour types -development of a fragrance - Perfumery in antiperspirants, skin creams, hair products, lipsticks and bath products - Stability testing

Unit-V Pulp and Paper Chemistry 6 hours

5.1 Raw materials, pulping process: Sulphite pulping, semi-chemical pulping, Kraft pulping process, Comparison of different types of pulps, Black liquor recovery process.

5.2 Types of paper products, various raw materials: Fibrous and Non-Fibrous

5.3 Wet process for paper manufacture

2B. Topics for Self-Study:

S.No.	Topics	Web Links
1	Heterocyclic Chemistry	https://youtu.be/o_tHj2GsPSc
2	Lipid disorders	https://youtu.be/XXEry4ZRMFI
3	Iron studies	https://youtu.be/_CWMUt8Xi_Y
4	Inhalational anaesthetic agents	https://youtu.be/RKdHImM6eYA
5.	Anticancer agents	https://youtu.be/6k2lUKEABQs

2C. Text Books

1. S. Jayashree Ghosh, Text book of Pharmaceutical Chemistry, S.Chand, 2008(Unit I-V)
2. Bentley and Drivers, A Textbook of Pharmaceutical Chemistry, 14th edition, Oxford university Press, 1996.
3. Handbook of Pulping and Papermaking by Biermann, Papermaking, ISBN-13: 978-0120973620.
4. Hiroshi Iwata and Kunio Shimada, Formulas, Ingredients and Production of Cosmetics: Technology of Skin- and Hair-Care, Springer, 2013
5. William DF and Schmitt WH, Chemistry and Technology of the Cosmetics and Toiletries Industry, Blackie Academic & Professional, 2nd edition,1996.
6. Hilda Butler, Poucher's Perfumes, Cosmetics & Soaps, 10th edition, Kluwer Academic Publishers, 2000.

2D. Reference Books

1. Indian Pharmacopoea, Govt. of India , Indian Pharmacopoean Commission, Vol.I,2010
2. N. Murugesan, *A Text book of Pharmacology* - 6th edition, Sathya Publishers, 2004
3. S. Lakshmi, *Pharmaceutical Chemistry*-2nd edition, S. Chand, 1998.
4. Alfred Burger, *Medicinal Chemistry*- 6th edition, Wiley – Interscience Publication, 2003.

3. Specific Learning Outcomes (SLOs)

Unit	Course Contents	Learning Outcomes	HBTLT
	Unit -1 Pharmaceutical Chemistry -1 Drugs		
1.1	**Terminology** used in pharmaceutical chemistry. Definition and explanation: Drug, pharmacopia, chemotherapy, pharmaceutics LD50 values. Routes of administration-oral, parenteral Bacteria-positive and negative.	Explains the various terminology used in pharmaceutical chemistry	K2
		Illustrate the routes of administration of drug.	K2
		Contrast the gram positive and negative bacteria	K2
1.2	**Heterocylic Drugs:** Structure and uses of drugs and mepyramine derivatives -barbiturates. Pyridine derivatives - Quinoline derivatives - Chloroquine and primaquine,Pyrimidine .	Illustrate the structure and utilities of drugs derived heterocyclic compounds	K2
		Explain the structure and uses of chloroquine, primaquine, barbiturates.	K2
	UNIT II - Pharmaceutical Chemistry II - Organic diagnostic agents		
2.1	Organic diagnostic agents X-ray contrast media (radio opaque) Iodipamide, Evan's blue, Histamine, Xylose, CT and MRI scan (Basics only)	Outline the uses of organic diagnosticagents	K2
		Explain the uses of CT & MRI scans.	K2
2.2	Structure and uses of i) Narcotic drugs - Morphine and SAR of morphine ii) Non-Narcotic drugs -ibuprofen iii)Antibiotics – structure and mechanism of penicillin, structure of semi- synthetic penicillin's-ampicillin, structure and uses of Chloramphenical.	Categorize the narcotic and non narcoticdrugs.	K3
		Outline the various medicinal applications of the drugs under study.	K2
		Relate the structure and function of ampicillin with penicillin. Correlate the structure mechanism and drug action of Antibiotics	K2
	Unit – 3 Anesthetics and Alkylating Agents		
3.1	**Anesthetics** Stages of Anesthesia - Preparation and uses of general and local gaseous anesthetics - Ether, halogenated Hydrocarbons - chloroform and trichloroethylene - Local anesthetics - Cocaine and its any two derivatives, intravenous anesthetics - thiopentone sodium and propounded - Structure and uses only.	Outline the stages of anesthesia	K2
		Categorize the type of gaseous anesthetics based on their uses along with the example.	K3
		Summarize the structure and uses of different classes of anesthetic agents	K2

Unit	Course Contents	Learning Outcomes	HBTLT
3.2	Anti-neoplastic agents - Alkylating agents (Busulfan)- Ethylene imines -Nitrogen mustards-Cyclophosphoamide. Antimetabolites-Purine analogues Immunotherapy.	Outline the uses of anti neoplastics in the treatment of cancer cells.	K2
		Explain immunotherapy and its uses.	K2
4.1 4.2 4.3	**Unit IV - Cosmetic Chemistry** **Cosmetics -** Introduction about raw materials in cosmetics (Pre-requisites for different cosmetics and applications - skin and hair care products **-** skin lighteners, sun screen lotions- skin toners- anti-wrinkling creams. **Lip care** - lip gloss - lipsticks -lip liners, moisturizers, lip balm. **Perfumes -** Fragrance - Raw materials for fragrance - natural, synthetic - Odour types - development of a fragrance - Perfumery, antiperspirants, skin creams, hair products, lipsticks and bath products - Stability testing	Outline the formulations of cosmetics and their Chemistry Describe the applications of cosmetics Prepare skin care products without any side effects Identify the ingredients in lip care products. Outline the constituents of different perfumes used in cosmetics and their chemistry Test the purity of skin care products Test the stability of cosmetics	K2 K2 K5 K2 K2 K5 K4
	Unit-V PULP AND PAPER CHEMISTRY		
5.1	Raw materials, pulping process: Sulphite pulping, semi-chemical pulping, Kraft pulping process, Comparison of different of pulps, Black liquor recovery process.	Outline the Raw materials used in pulping process Explain different pulping processes Differentiate pulps based on their chemical and physical properties	K2 K3 K4
5.2	Types of paper products, various raw materials: Fibrous and Non-Fibrous	Utility of different type of papers based on their chemical and physical properties	
5.3	Wet process for paper manufacture	Describe manufacturing processes	

4. Mapping (CO, PO, PSO)

INDUSTRIAL CHEMISTRY - II Code : U22CH5S2													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	-	M	-	-	L	-	-	H	-	-	H
CO2	H	H	-	M	-	-	L	-	-	H	-	-	H
CO3	H	H	-	M	-	-	L	-	-	H	-	-	H
CO4	H	H	-	M	-	-	L	-	_	H	-	-	H
CO5	H	H	-	M	-	-	L	-	-	H	-	-	H
CO6	H	H	-	M	-	-	L	-	-	H	-	-	H
CO7	H	H	-	M	-	-	L	-	-	H	-	-	H

L-Low M-Moderate H- High

5. Course Assessment Methods

Direct

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment, Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator :

Head, Department of Chemistry : Dr J. Princy Merlin

SBEC-III : APPLIED CHEMISTRY PRACTICAL

Semester : V **Code: U22CH5S3**
Credits : 2 **Total Hours : 30**
Hours/Week : 2

1. Course Outcomes

On successful completion of this course, the student will be able to

S. No.	Course Outcomes	Level
1	Apply the various techniques for the separation of organic compounds	K3
2	Find the suitable technique for the purification of organic compounds	K3
3	Choose the technique for the extraction of natural products	K3
4	Plan and carry out experiments based on the instruments methods of analysis	K3
5	Determine the quality of water used for different purposes	K3
6	Interpreting the UV spectra	K3

2A. Experiments

I. Techniques for Separation and Purification

1. Purification of organic compounds by Recrystallization Method using the following solvents:
   a. Water b. Alcohol c. Alcohol-Water
2. Determination of melting point
3. Determination of boiling point
4. Preparation of distilled, double distilled and de-ionized water
5. Solvent extraction technique for separation of organic mixture
6. Soxhlet extraction (Demonstration)

II. Applied Experiments

1. Preparation of buffer mixtures and determination of pH of various buffer mixtures
2. Determination of distribution coefficient of metals by paper chromatography.
3. Monitoring reaction progress using Thin Layer chromatographic technique.
4. Determination of water quality using Heber Water Quality Index method-HWQI
5. Determination of Calcium in commercial Milk Powder using EDTA
6. Identification of the various food additives present in processed food

7. Quick tests for common food adulterants: milk and milk products, oils and fats, sugars and confectionaries, food grains and spices
8. Synthesis of Diazonium Dyes
9. Determination of working range of indicators pH–acidity Vs. alkalinity
10. Demonstration of Recording and interpreting the UV spectrum of any one inorganic complex
11. Demonstration of quantitative determination of phytochemicals using HPLC

2B. Reference Book(s):

1. Donald L. Pavia, Gary M. Lampman, George and Kritz S., (2009). Organic Chemistry – A Lab Manual New Delhi: Sengage Learning. Print. Furniss B.S., (1989).
2. Vogel's Textbook of Organic Chemistry, (5th ed.), London: ELBS. Print.
3. Gnanapragasam N.S, Ramamurthy G, (2013). Organic Chemistry Lab Manual, Chennai: S. Viswanathan (Printers and Publishers) PVT.LTD. Print.
4. Ramanujam, V. V. (2012). Inorganic Semi Micro Qualitative Analysis, (3rd ed.), Chennai: The National Publishing Company. Print
5. Begum, R. (2008). A Textbook of Food, Nutrition and Dietetics, (3rd revised ed.), New Delhi: Sterling publishers Pvt. Ltd. Print.
6. Mudambi & Rao, (2006) Food Science, New Delhi: Wiley Eastern limited. Print

2C. Weblink(s):

Shilpa Shrivastava (2016) Qualitative analysis of Anions. Retrieved from https://www.chemistrynotmystery.com/2016/02/qualitative-analysis-of-anions.

3. Short Learning Outcomes (SLO's)

Unit	Course Contents	Learning Outcomes	HBTLT
1	Techniques for Separation and Purification	Apply the various techniques for the separation of organic compounds	K3
1	Techniques for Separation and Purification	Find the suitable technique for the purification of organic compounds	K3
1	Techniques for Separation and Purification	Choose the technique for the extraction of natural products	K3
2	Applied Experiments	Plan and carry out experiments based on the instruments methods of analysis	K3
2	Applied Experiments	Determine the quality of water used for different purposes	K3
2	Applied Experiments	Interpreting the UV spectra	K3
2	Applied Experiments	Determine the working range of indicators	K4
2	Applied Experiments	Determine the phytochemicals using HPTLC quantitatively	K4

4. Mapping (CO, PO, PSO)

APPLIED CHEMISTRY PRACTICAL Code: U22CH5S3													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	L		H	H		L		H	H		H
CO2	H	H	H		H	H		H		H	H		H
CO3	H	H	H		H	H		H		H	H	H	H
CO4	H	H	H		H	H		H		H	H		H
CO5	H	H	H		H	H	H	H		H	H	H	H
CO6	H	H	H	L	H	H		H		H	H		H

L-Low M-Moderate H- High

Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II
2. Model Exams I and II
3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : Dr. I. Sharmila Lydia

Head, Department of Chemistry : Dr J. Princy Merlin

CORE : PROJECT & RESEARCH ETHICS

Semester : V **Code: U22CH5PJ**
Credits : 3 **Total Hours : 75**
Hours/Week : 5

1. Course Outcomes

On completion of the Course the Student will be able to

S.No.	Course Outcomes	Level
1	Identify Simple scientific problems in the real-life situation related Chemical science	K5
2	Search relevant background Literature ensure the credibility of the research problem	K5
3	Develop a smart and achievable strategy solve the problem	K5
4	Develop a feasible, fool-proof and accurate method analyze the problem	K5
5	Critically analyze, corroborate with previously availableknowledge and arrive at scientific findings from the observed results	K6
6	Document, Publish and Present the findings scientifically in the relevant forums by taking Cognizance of the ethical & IPR related issues	K5

2A. Syllabus

Report Preparation and Research Ethics

Ethics of research – plagiarism – planning the introduction – body of the report – footnotes – endnotes – page and chapter format – margin – indentation – placement of tables and figures and numbering of tables and figures – writing bibliography – books, journals and websites – concepts of patents and patenting.

Group Projects - Components for Evaluation

Preparation of Report	–	20 Marks
Innovation in Choice of the problem and skills	–	10 Marks systematic analysis and recording
Regularity and involvement	–	10 Marks
Test on Research Ethics	–	20 Marks
External Viva-Voce	–	20 Marks
Internal Viva-voce	–	20 Marks

2B. Text Book(s):

1. Dawson and Catherine, (2002). Practical Research Methods, New Delhi: UBS, Publishers Distributors. Print.
2. Christian, G.D., (2011). Analytical Chemistry, (6th ed.), Kundli: John Wiley & Sons. Print.
3. Gurumani, N., (2010). Scientific thesis writing and paper presentation, Chennai: MJP Publishers. Print.
4. Best, J.W., (1978) Research and education, (3rd ed.), New Delhi: Prentice Hall of India private Ltd. Print.
5. Kumar and Ranjit, (2005), Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed.), Singapore: Pearson Education. Print.

2C. Weblink(s)

https://www.youtube.com/watch?v=yDC4EyKfa9I CC BY-NC 4.0

3. Short Learning Objectives (SLOs)

Unit	Course Contents	Learning Outcomes	HBTLT
	Project Work	Identify Simple scientific problems in the real-life situation related Chemical science	K5
	Project Work	Search relevant background Literature ensure the credibility of the research problem	K5
	Project Work	Develop a smart and achievable strategy solve the problem	K5
	Project Work	Develop a feasible, fool-proof and accurate method analyze the problem	K5
	Project Work	Critically analyze, corroborate with previously available knowledge and arrive at scientific findings from the observed results	K6
	Project Work	Document, Publish and Present the findings scientifically in the relevant forums by taking Cognizance of the ethical & IPR related issues	K5
	Project Work	Identify Simple scientific problems in the real-life situation related Chemical science	K5

4. Mapping (CO, PO, PSO)

PROJECT & RESEARCH ETHICS Code: U22CH5PJ													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	L		H	H		L		H	H		H
CO2	H	H	H		H	H		H		H	H		H
CO3	H	H	H		H	H		H		H	H	H	H
CO4	H	H	H		H	H		H		H	H		H
CO5	H	H	H		H	H	H	H		H	H	H	H
CO6	H	H	H	L	H	H		H		H	H		H

L-Low M-Moderate H- High

5.Course Assessment Methods

DIRECT

1. REVIEWS – I & II

2. Viva-voce

INDIRECT

1. Course-end survey

Course Co-ordinator : Dr. I. Sharmila Lydia

Head, Department of Chemistry : Dr J. Princy Merlin

CORE COURSE- VII : INORGANIC CHEMISTRY- II

Semester : VI **Code : U22CH607**
Credits : 6 **Total Hours : 90**
Hours/Week: 6

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Predict nuclear stability based on basic concepts in nuclear chemistry	K5	I
2	Explain detection separation and application of radio Isotopes.	K5	II
3	Explain semiconducting properties based on theories of metallic bonding	K4	III
4	Describe crystal packing of atoms in metals and their defects	K2	III
5	Distinguish the characteristics of the different types of Silicates	K4	IV
6	Correlate the features of photo physical processes and their applications.	K4	V

2A. Syllabus

Unit I - Nuclear Chemistry **18 Hours**

1.1. Introduction–composition of nucleus, fundamental particles and nuclear forces – Meson field theory.

1.2. Nuclear stability – n/p ratio, mass defect, binding energy, packing fraction and magic numbers, Harkin's rule, shell and liquid drop models.

1.3. Isotopes**,** Isobars, isotones and isomers with examples. Detection of Isotopes – Aston and Dempster methods and separation of isotopes, whole number rule. Deviation of atomic weights from whole number.

Unit II - Radioactivity and Nuclear Transformations **18 Hours**

2.1. Radioactivity–discovery, Types - detection and measurements (Wilson cloud chamber, G-M Counter and Cyclotron). Radioactive emanations – Theories of decay – Geiger-Nuttal rule- Range of alpha particles- units of radioactivity- rate of radioactive disintegration - half life – average life.

2.2. Nuclear transmutations–Use of projectiles–Q-value of nuclear reactions – thermos-nuclear reactions, Types of nuclear reactions – Nuclear reactors - Breeder reactors- trans-uranic elements, Stellar energy

2.3. Radioactive disintegration series (U, Th, Ac, Np) - Applications of radio isotopes in Medicine, Chemical Analysis (Isotopic Labelling), Archeology (Carbon dating) & Industry – Radioactive waste disposal.

Unit III - Metallic Bonding and Crystal defects **18 Hours**

3.1. Theories of metallic bonding– Electron gas, Pauling and Band theories, Semiconductors– Extrinsic and intrinsic, n-type and p-type semiconductors and their applications - Packing of atoms in metal (bcp, ccp, hcp) – Crystal defects: Stoichiometric and Non-Stoichiometric defects - Metal Excess and Metal Deficiency defects- Frenkel and Schottky defects.

3.2. Structure of alloys–Substitutional and interstitial solid solutions–Hume-Rothery rule.

3.3. Metallurgy: Occurrence of metals, Types of ores, Separation techniques based on gravity – Leaching, Froth Floatation, and Magnetic Separation- various metallurgical operations -concentration, calcinations, roasting, smelting and refining.

Unit IV - Silicon Polymers **18 Hours**

4.1. Silicones–manufacture, structure, properties and uses.

4.2. Silicates–Classification into discrete anions, one, two and three - dimensional structures with typical examples, composition, properties and uses of beryl, asbestos, molecular sieves, talc, mica, zeolites and ultramarines.

Unit V - Photochemistry **18 Hours**

5.1. Difference between thermal and photochemical reactions - Laws of Photochemistry – Quantum yield- Factors affecting Quantum Yield.

5.2. Photophysical and photochemical processes - Jablonski Diagram, Phosphorescence – Fluorescence - Factors affecting Photophysical Processes. Chemiluminescence-Bio-Luminescence-Photosensitizers-Photosynthesis, Quenching and its types.

5.3. Applications of Photochemistry, Chemical Actinometer (Uranyl oxalate and Ferric oxalate actinometers)

2B. Topics for Self-Study

S.No.	Topics	Web Links
1	How is Nuclear Stability Related to the Band of Stability and the Neutron to Proton Ratio	https://youtu.be/zAjNHmlUzaM
2	Harmful effects of radioactivity	https://youtu.be/SmgBoOR61bo
3	Metallurgical Reactors and Transfer Operations	https://youtu.be/8xDPihsuK7Q

S.No.	Topics	Web Links
4	Sodium Silicate As Binder In Sand Moulding Step-by-step intra oral repair of silicate/glass ceratomics	https://www.youtube.com/watch?v=icGgssNXWck https://youtu.be/IsgeFL2S0NI
5	Chemiluminescence	https://youtu.be/RMMZ3rnzUHM

2C. Text Books

1. B.R. Puri, L.R.Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers, New Delhi, 2020 **(Unit I- V)**
2. R.D. Madan and G.D. Tuli, *Inorganic Chemistry*, S. Chand & Co., New Delhi, 2010 **(Unit I-V)**
3. P.L. Soni and Mohan Katyal, *Text Book of Inorganic Chemistry*, Sultan Chand & Co.,New Delhi,2017**(Unit I- V)**.

2D. Recommended Reference Books

1. Gurdeep Raj, *Advanced Inorganic Chemistry*, Goel Publications, Meerut, 2014
2. J.D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, New Delhi, 2008
3. K. K. Rohatgi-Mukherjee, *Fundamentals of Photochemistry*, New Age International, NewDelhi,2017.

3. Specific Learning Outcomes (SLOs)

Unit	Course Content	Learning Outcomes	BTLT
1.1	Composition of nucleus, fundamental particles and nuclear forces - Meson field theory.	Classify the various fundamental particles and nuclear forces.	K2
1.2	Nuclear stability - n/p ratio, mass defect, binding energy, packing fraction and magic numbers	Predict nuclear stability based on basic concepts in nuclear chemistry	K5
	Harkin's rule, shell and liquid drop models	Compare shell and liquid drop models	K2
1.3	Isotopes, Isobars, Isotones and Isomers with examples.	Distinguish Isotopes, isobars, Isotones and isomers in a given set of nuclei.	K4
	Detection and separation of Isotopes - Aston and Dempster methods	Explain the experimental methods used for the detection and separation of Isotopes.	K3
	whole number rule. Deviation of atomic weights from whole number.	Calculate atomic weight of Isotopes from whole number rule.	K2
2.1	Radioactivity discovery, Types- detection and measurements (Wilson cloud chamber, GM Counter and Cyclotron).	Describe the various methods detect and measure Radioactivity.	K2

Unit	Course Content	Learning Outcomes	BTLT
	Radioactive emanations - Theories of decay	Differentiate the properties of α, β and γ emissions.	K3
	Geiger Natta rule- Range of alpha particles-	Relate the decay constant and range of α particles.	K2
	Units of radioactivity-rate of radioactive disintegration - half life - average life.	Calculate the half life and average life of a radioactive nucleus.	K4
2.2	Nuclear transmutations-Use of projectiles-Q-value of nuclear reactions	Distinguish exothermic and endothermic nuclear reactions.	K4
	Types of nuclear reactions - thermonuclear reactions	Explain the types of nuclear reaction.	K4
	Nuclear reactors - Breeder reactors- trans-uranic elements - Stellar energy.	Outline the working ofnuclear reactors .	K2
2.3	Radioactive disintegration series (U, Th, Ac,Np)	Discuss the different types of disintegration series.	K2
	Applications of radio Isotopes-Carbon dating	Calculate the age of a specimen from the given data	K5
	Radioactive waste disposal.	Summarize the importance and methodology of Radioactive waste disposal.	K2
3.1	Theories of metallic bonding- Electron gas, Pauling and Band theories	Discuss the theories of metallic bonding	K2
	Semi conductors-Extrinsic and intrinsic, n-type and p-type Semi conductors and their applications	Distinguish n-type and p-type Semi conductors along with their applications	K4
	Packing of atoms in metal (bcp,ccp,hcp)	Explain the packing of atoms in metal	K2
	Crystal defects : Stoichiometric and Non-Stochiometric defects - Metal Excess	Classify the various crystal defects.	K4
	and Metal Deficiency defects- Frenkel and Schottky defects.		
3.2	Structure of alloy substitutional and interstitial solid solutions-Hume Rothery rule.	Distinguish substitutional and interstitial solids.	K4
3.3	Metallurgy: Occurrence of metals, Types of ores	List out the various types of Ores. andtheir Occurrence.	K1
	Separation techniques based on gravity - Leaching, Froth Floatation and Magnetic Separation	Explain the various methods of separation in metallurgy	K2
	Metallurgical operations -concentration, calcination, roasting, smelting and refining.	Explain the chemical processes involved in metallurgy.	K4
4.1	Silicones-manufacture, structure, properties and uses.	Explain the manufacturing process of silicones along with their properties and uses.	K2

Unit	Course Content	Learning Outcomes	BTLT
4.2	Silicates-Classification in discrete anions, one, two and three dimensional structures with typical examples	Classify one, two and three dimensional structure of silicates with examples.	K4
	composition, properties and uses of beryl, asbestos, molecular sieves, talc, mica, zeolites and ultramarines.	Relate the composition, properties and uses of some important silicates.	K2
5.1	Difference between thermal and photo chemical reactions	Classify thermal and photo chemical reactions.	K2
	Laws of Photochemistry - Quantum yield- Factors affecting Quantum Yield.	Apply the laws of photochemistry calculate quantum yield..	K4
5.2	Photo physical and photo chemical processes – Jablonski Diagram, Phosphorescence - Fluorescence - Factors affecting Photo physical Processes.	Describe photo physical and processes by applying Jablonski Diagram.	K4
		List out the various factors affecting photo physical processes.	K1
	Chemiluminescence- Bio- Luminescence- Photo sensitizers - Photosynthesis, Quenching and its types.	Relate Chemiluminescence- Bio-Luminescence process. With day to day applications.	K4
		Explain the various types of Quenching.	K2
5.3	Applications of Photochemistry, Chemical Actinometer (Uranyl oxalate and Ferric oxalate actinometers)	Explain the applications of photo chemistry.	K4
		Describe the construction of actinometers.	K2

4. Mapping (CO, PO, PSO)

INORGANIC CHEMISTRY- II Code : U22CH607													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	-	-	-	-	H	-	H	-	-	H
CO2	H	H	H	L	-	-	-	H	-	H	-	-	H
CO3	H	H	H	M	-	-	-	H	-	H	-	-	H
CO4	H	H	H	M	-	-	-	H	-	H	-	-	H
CO5	H	H	H	M	-	-	-	M	-	H	-	-	H
CO6	H	H	H	M	-		-	M	-	H	-	-	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Dr. A. Sathiyan**

Head, Department of Chemistry : Dr J. Princy Merlin

CORE COURSE VIII: ORGANIC CHEMISTRY- II

Semester : VI **Code : U22CH608**
Credits : 6 **Total Hours : 90**
Hours/Week: 6

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Correlate the different organic reactions with the corresponding types of mechanisms.	K4	I
2	Predict the reactivity and orientation of different aromatic substrates wards Electrophiles and Nucleophiles	K5	II
3	Give reason for the formation of intermediates and products in a rearrangement reaction.	K4	III
4	Comprehend the preparation, properties, and structural elucidation of carbohydrates	K3	IV
5	Explain the chemistry of natural products (terpenes and Alkaloids	K2	V
6	Compare the properties and reactivities of five, six membered and fused heterocyclic compounds.	K2	V

2A. Syllabus

Unit I - Substitution and Elimination Reactions **18 Hours**

1.1. Aliphatic nucleophilic substitutions– stereochemical aspects and mechanism of SN1, SN2 and SNi reactions.

1.2. Elimination reactions–Hoffmann and Saytzeff's eliminations – Trans elimination: Mechanism of E1, E1CB and E2 reactions. Elimination vs. Substitution.

1.3. Aromatic Nucleophilic substitution reactions–Benzyne mechanism and intermediate Complex formation mechanism.

1.4. Aromatic Electrophilc substitution reactions –Orientation and Reactivity – Mechanism of Nitration, Bromination, Sulphonation, Iodination, Riemer-Tiemann, Kolbe's and Friedel-Craft's Reactions.

Unit II - Molecular Rearrangements **18 Hours**

2.1. Classification-anionotropic, cationotropic, intermolecular and intramolecular rearrangement.

2.2. Pinacol–pinacolone rearrangement (Mechanism, Evidence for carbocation intermediate Formation, Migratory aptitude). Beckmann, Benzidine, Hoffmann, Curtius, Benzilic acid rearrangements (Mechanism only), Claisen rearrangement (sigmatropic rearrangement), Cope rearrangement.

Unit III - Natural Products **18 Hours**

3.1. Natural products **-** Terpenes- classification – Isoprene rule – general reactions of terpenes – structural elucidation of citral, geraniol, nerol, menthol, α-terpeniol and α-pinene.

3.2. Alkaloids–General methods of isolation and structural elucidation of conine, piperine and nicotine.

Unit IV - Carbohydrates **18 Hours**

4.1. Classification of carbohydrates–Monosaccharides–preparation, properties and structural elucidation of glucose and fructose, epimerization, interconversion of glucose and fructose, chain-lengthening, chain shortening of aldoses, mutarotation and α, β – glycoside linkages, cyclic structure, pyranose and furanose forms of D –Glucose. Tests for Carbohydrates.

4.2. Disaccharides –Structure, Properties and general reactions- Maltose, Lactose & Sucrose. Sucrose – Manufacture, properties and structural elucidation.

4.3. Polysaccharides – structure and Properties of starch and cellulose (Structural Elucidation - not required).

Unit V - Heterocyclic Compounds **18 Hours**

5.1. Aromatic characteristics and basicity of heterocyclic compounds.

5.2. Five membered heterocyclic systems - preparation, properties and uses of furan, pyrrole, thiophene and imidazole. Electrophillic Substitution reactions of furan, pyrrole, thiophene and imidazole.

5.3 Six membered heterocyclic systems-structure, synthesis and reactions of pyridine, piperidine, purine and pyrimidine - Comparative basic characters of pyrrole, pyridine, piperidine with amines.

5.4 Fused rings- Synthesis of Quinoline, isoquinoline and indole by Skraup, Bischler-Napieralski and Fischer Indole synthesis, respectively and their reactions.

2B. Topics for Self-Study

S.No.	Topics	Web links
1	Elimination from cyclohexanes	https://chem.libretexts.org/Bookshelves/Organic_ Chemistry/Map% 3A_Organic_Chemistry_ (McMurry)/ 11% 3A_ Reactions_of_Alkyl_Halides-_Nucleophilic_ Substitutions_and_Eliminations/11. 11%3A_The_E2_ Reaction_and_Cyclohexane Conformation https://www.masterorganicchemistry.com/2012/ 10/18/the-e2-reaction-and-cyclohexane-rings/

S.No.	Topics	Web links
2	Favorskii rearrangement	http://www.chemvista.org/Favorskii%20rearrangement%20and%20mechanism.html
3	Zingiberene	https://www.slideshare.net/abdelrahman_asar/zingiberene https://en.wikipedia.org/wiki/Zingiberene
4	Lipids	https://www.britannica.com/science/lipid
5	Tetrazole synthesis	https://en.wikipedia.org/wiki/Tetrazole

2C. Text Books

1. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand & Co. Ltd., New Delhi, 2012 **(Unit- I, II)**
2. MK Jain and SC Sharma, Modern Organic Chemistry, Vishal Publishing &Co.,2017Bhupinder **(Unit- III, IV, V)**
3. R.T. Morrison & R.N. Boyd, Organic Chemistry, Pearson Education, New Delhi, 2016.
4. I.L. Finar, Organic Chemistry (Volume-2), Pearson Education, New Delhi, 2002

2D. Reference Books

1. Mehta& Manju Mehta, Organic Chemistry, PHI Learning Pvt. Ltd., 2015
2. L.G. Wade, Organic Chemistry, Pearson Education, New Delhi,2016
3. Seyhan N. Ege Organic Chemistry: Structure and Reactivity, Houghton Mifflin Harcourt (HMH); 5th Edition 2003
4. Paula Yurkanis Bruice, Organic Chemistry, Pearson Education, New Delhi, 2013
5. Gurdeep Chatwal, Organic Chemistry of Natural Products, Himalaya Publications, Mumbai, 2014.

3. Specific Learning Outcomes (SLOs)

Unit	Course Content	Learning Outcomes	HBTLT
I	**Substitution and Elimination Reactions**		
1.1	Nucleophilic Substitution reactions SN1, SN2 and SNi reactions mechanism and stereochemical aspects	Categorize Nucleophilic substitution reactions along with example.	K2
		Predict the stereochemistry for the products of substitution reactions.	K4
1.2	Elimination reaction - Hoffmann and Saytzeff's eliminations, Mechanism of E1, E1C Band E2 reactions. Elimination vs. Substitution.	Propose the mechanism of the reaction based on elimination product.	K4
		Compare and contrast Substitution and Elimination reactions	K2

Unit	Course Content	Learning Outcomes	HBTLT
1.3	Aromatic nucleophilic substitution reaction (SN) Benzyne mechanism and intermediate complex formation mechanism.	Predict the products of SN reactions in Aromatic compounds	K4
		Identify the type of intermediate and its stability.	K2
1.4	Aromatic Electrophilc substitution reactions- Orientation and Reactivity- Nitration, Bromination, Sulphonation, Iodination, Riemer-Tiemann, Kolbe's and Friedel Craft's Reactions.	Predict the reactivity and orientation of different aromatic system wards Electrophiles.	K5
II	**Molecular Rearrangements**		
2.1	Classification-anionotropic, cationotropic, intermolecular and intramolecular rearrangement.	Classify the type of rearrangement based on the nature of migrating group	K3
2.2	Mechanism, Evidence for carbocation intermediate formation and Migratory Aptitude of Pinacol-Pinacolone rearrangement	Propose the mechanism of pinacol-pinacolone rearrangement.	K4
		Apply the mechanism in different substrate.	K3
		Justify the formation of different intermediates and products in the rearrangement.	K4
	Mechanism of Beckmann rearrangement, Benzidine, Hoffmann, Curtius, B enzilic acid rearrangement, Claisen rearrange ment (Sigmatropic rearrangement), Cope rearrangement.	Apply the mechanism of different rearrangements for interconversion of functional groups.	K3
III	**Natural Products**		
3.1	Natural products -Terpenes - Isoprene rule - General reactions of Terpenes	Apply isoprene rule predict structure of Terpenes.	K3
		Write the reactions of Terpenes.	K2
	Structural elucidation of citral, geraniol, nerol, menthol, α-terpeniol and α- pinene	Apply reactions elucidate the structures of Terpenes	K3
3.2	Alkaloids - General methods of isolation and general methods of structural determination	Describe the methods of isolation of alkaloids determine the structure	K2
	Structural elucidation of conine, piperine and nicotine.	Apply reactions elucidate the structure of conine, piperine and nicotine	K3
IV	**Carbohydrates**		
4.1	Classification of carbohydrates-Monosaccharides-preparation, properties	Classify carbohydrates	K3
		Write the preparatory methods and reactions of monosaccharides	K2
	Structural elucidation of glucose and fructose	Discuss the structural elucidation of Glucose and Fructose	K2

Unit	Course Content	Learning Outcomes	HBTLT
	Epimerization, interconversion of glucose and fructose, chain lengthening, chain shortening of aldoses,	Interconvert carbohydrates.	K3
	mutarotation and α, β - glycoside linkages	Explain the optical properties and nature of linkage in carbohydrates	K2
	Cyclic structure, pyranose and furanose forms of D -Glucose. Tests for Carbohydrates.	Compare the structure of different forms of D-glucose	K2
4.2	Disaccharides -Structure, Properties general reactions- Maltose, Lactose & Sucrose	Explain the structure and properties of Dissacharides	K2
		Write the general reactions of Dissacharides	K2
	Sucrose - Manufacture, properties and structural elucidation	Explain the steps involved in the manufacture of Sucrose	K2
		Apply reactions elucidate the structure of Sucrose	K3
	Polysaccharides - structure and Properties of starch and cellulose	Describe the structure and properties of polysaccharides	K2
V	**Heterocyclic Compounds**		
5.1	Aromatic characteristics and basicity of heterocyclic compounds	Predict the basicity of heterocyclic compounds based on aromatic character	K3
5.2	Five membered heterocyclic systems - preparation, properties and uses of furan, pyrrole, thiophene and imidazole	Compare the reactivity of five membered heterocyclic system.	K2
	Electrophilic Substitution reactions of furan, pyrrole, thiophene and imidazole.	Predict the products of Electrophilic substitution reactions of five membered Heterocyclic compounds	K5
5.3	Six membered heterocyclic systems- structure, synthesis and reactions of pyridine, piperidine, purine and pyrimidines	Explain the Synthesize of six membered heterocyclic compounds	K2
		Explain the reactions of six membered heterocyclic compounds with one and two heteroatoms	K2
	Comparative basic characters of pyrrole, pyridine, piperidine with amines.	Predict the basicity of five and six membered heterocyclic compounds with amines	K3
5.4	Fused rings- Synthesis of Quinoline, isoquinoline and indole by Skraup, Bischler Napieralski and Fischer Indole synthesis respectively and their reactions	Write the Synthesis and the reactions of bicyclic heterocyclic compounds	K2

4. Mapping (CO, PO, PSO)

ORGANIC CHEMISTRY- II Code : U22CH608													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H			M		L	H	-	H			H
CO2	H	H			M		L	H	-	H			H
CO3	H	H			M		L	H	-	H			H
CO4	H	H			M		L	H	_	H			H
CO5	H	H			-		L	H	-	H			H
CO6	H	H		-	M		L	H	-	H			H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator **:**

Head, Department of Chemistry : Dr J. Princy Merlin

Core Course IX : PHYSICAL CHEMISTRY – II

Semester : V **Code: U22CH609**
Credits : 6 **Total Hours : 90**
Hours/Week: 6

1. Course Outcome:

After the completion of this course, the student will be able to

S.No.	Course Outcomes	Level	Unit
1	Explain the concepts of Electrochemistry and its applications	K4	I
2	Describe the construction of different kinds of electrochemical cells	K2	II
3	Predict the thermodynamic quantities of cell reactions to identify the feasibility of reactions	K3	II
4	Illustrate the principle of Molecular Spectroscopy (UV-Vis, IR, Raman, NMR and ESR) and the spectra of selected molecules	K3	III
5	Identify the functional groups and structure of simple molecules using IR spectroscopy	K2	IV
6	Interpret the NMR & ESR spectral data arrive at the structure of molecules	K3	V

2A. Syllabus

Unit I - Electrical Conductance **18 Hours**

1.1. Conduction in metals and in electrolyte solution, Ohm's Law & Faraday's Laws – specific conductance, molar conductance and equivalent conductance, Measurement of equivalent conductance, variation of equivalent conductance with concentration.

1.2. Migration of ions –Kohlrausch's law and its applications to determine λ^0 of weak electrolyte- Arrhenius theory of electrolytic dissociation – weak and strong electrolytes according Arrhenius theory – Ostwald's dilution law – its uses to determine Ka of weak acids and K_{sp} of sparingly soluble salts and limitations.

1.3. The elementary treatment of Debye – Huckel-Onsagar equation for strong electrolytes. Conductometric titrations: acid-base, precipitation with examples. Transport number and Hittorf's rule-determination of transport number by Hittorf's method and moving Boundary method.

UNIT II - Equilibria in Electrochemical Cells **18 Hours**

2.1. Electrolytic and galvanic cells–Reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurements – Computation of cell e.m.f.- Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH, ΔS and K)- Problems.

2.2. Derivation of Nernst equation, single electrode potential and Applications of Nernst equation - Standard electrode potentials- Electrochemical series and its significance. Types of reversible electrodes – Cell construction- cell reaction with Nernst equation - Reference electrodes: Standard hydrogen electrode (SHE) and Standard Calomel electrode (SCE) - Western Cadmium cell.

2.3. Concentration cells – Types, emf of concentration cells with and without transference and its derivation – liquid junction potential and its derivation – applications of concentration cells – Applications of emf measurements: determination of valency, transport number and solubility product, Potentiometric titrations – Redox and Acid- Base Titrations.

UNIT III - Molecular Spectroscopy –I **I8 Hours**

3.1. Definition of spectrum. Electromagnetic radiation, quantization of different forms of energies in molecules (translational, rotational vibrational and electronic), Born Oppenheimer approximation, factors affecting line width and intensity.

3.2. UV-Visible spectroscopy–types of electronic transitions–Franck Condon principle – predissociation spectra and dissociation energy. Applications – Beer Lambert's law - OD, chromophore, auxochrome, bathochromic and hypsochromic shifts and effect of substituents-UV Instrumentation (Block diagram only)- Interpretation of UV Spectra of simple compounds (Benzene, Naphthalene, Anthracene, $[Cu(NH_3)_6]^{2+}$, $[Cu(H_2O)_6]^{2+}$)

UNIT IV - Molecular Spectroscopy – II **18 Hours**

4.1. Infrared spectroscopy–modes of vibration of diatomic, linear tri-atomic (CO_2) and non- linear tri-atomic (H_2O) molecules. Stretching and bending vibrations - selection rules, expression for vibrational frequency (derivation not required). Calculation of force constant - Applications of IR spectra (group frequencies, fingerprint and hydrogen bonding only)- IR Instrumentation (Block diagram only)- Interpretation of IR Spectra of simple compounds (Aniline, Benzoic Acid, Propanol, Acetone & Acetylene)

4.2. Raman spectroscopy - conditions - Rayleigh and Raman scattering, selection rules Classical and quantum theory - Stokes and Anti-Stokes lines. Differences between Raman and IR spectroscopy - Rotational Raman spectra of non-centro symmetric molecules (HCl only). Mutual exclusion principle (CO_2 and N_2O).

UNIT V - Molecular Spectroscopy – III **18 Hours**

5.1. NMR Spectroscopy - magnetic and non - magnetic nuclei- selection rules - principle of nuclear magnetic resonance - ring current - shielding mechanism- chemical shift - factors affecting chemical shift - number of signals - spin-spin coupling - splitting of signals - NMR spectra of methyl halides, ethylene, acetylene and benzene - Chemical exchange - NMR spectrum of ethyl alcohol in detail.

5.2. ESR spectroscopy - selection rules - theory of ESR spectra - hyperfine splitting - ESR spectra of simple radicals- $^{\cdot}CH_3$, $^{\cdot}CD_3$, naphthalene radical ions only.

2B. Topics for Self-Study

S.No.	Topics	Web Links
1	Conductometric Sensors	https://youtu.be/mulkGSJai3A
2	Ion Selective Electrodes	https://www.youtube.com/watch?v=LVocg2RjDMM
3	Chemical Reagents in UV Visible Spectroscopy	https://www.youtube.com/watch?v=UTRiVd-V3Cw
4	Challenges in application of Raman spectroscopy to biology and materials	https://pubs.rsc.org/en/content/articlelanding/2018/ra/c8ra04491k
5	2D NMR Spectroscopy for structural studies of biomolecules	https://nptel.ac.in/courses/104108097

2C. Text Books

1. B. R. Puri, L.R. Sharma and Madan. S. Pathania, *Principles of Physical Chemistry*,42nd Edition, Vishal Publishing Co., Jalandhar, 2017 **(Unit I-V)**
2. B.S. Bhal G.D. Tuli and Arun Bhal, *Essentials of Physical Chemistry*, S. Chand & Co., New Delhi, 2010 **(Unit- I, II)**
3. Gurdeep Raj, *Advanced Physical Chemistry*, Goel Publishing House, Meerut, 2016.

2D. Recommended Reference Books

1. P. Atkins and J. Paula, *Physical Chemistry*, Oxford University Press, New Delhi, 2018
2. G.W. Castellan, *Physical Chemistry*, 3rdEdition, Narosa Publishing House, New Delhi, 2004
3. K. Kundu and S.K. Jain, *Physical Chemistry*, S. Chand & Co., Ltd., New Delhi, 2003

4. K.L. Kapoor, *Text Book of Physical Chemistry*, Macmillan, New Delhi, 2017
5. G. Aruldhas, *Molecular Structure and Spectroscopy*, Prentice Hall of India, New Delhi, 2007.

3. Specific Learning Outcomes (SLOs)

Unit/ Section	Course Content	Learning Outcomes	BTLT
Unit– I Electrical Conductance			
1.1	Specific Conductance and equivalent conductance - Measurement of equivalent conductance, variation of equivalent conductance with concentration.	Calculate Specific Conductance and equivalent conductance of the given electrolyte.	K4
1.2	Migration of ions - Kohlrausch's law and its applications to determine λ0 of weak electrolyte	Evaluate the λ0 value of Weak electrolyteusing Kohlrausch's law	K4
	Arrhenius theory of electrolytic dissociation – weak and strong electrolytes	Compare the weak and strong electrolytes by Arrhenius theory	K2
	Ostwald's dilution law - its uses to determine Ka of weak acids and K_{sp} of sparingly soluble salts and limitations	Determine the dissociation constant and solubility product by Ostwald's dilution law	K4
1.3	The elementary treatment of Debye - Huckel Onsagar equation for strong electrolytes.	Verify the Debye – Huckel Onsagar equation for strong electrolytes	K3
	Conductometric titrations - acid - base, precipitation with examples	Apply Conductometric method for estimation of acids, bases and salts	K3
	Transport number and Hittorf's rule-determination by Hittorf's method and moving boundary method	Calculate the Transport number by Hittorf's and boundary method	K3
UNIT– II Equilibria in Electrochemical Cells			
2.1	Electrolytic and galvanic cells-Reversible and irreversible cells. Conventional representation of electrochemical cells.	Distinguish between the cell reactions taking place in Electrolytic cells and Galvanic cells	K2
	Electromotive force of a cell and its measurements - Computation of cell e.m.f.- Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH, ΔS and K)- Problems.	Calculate the thermodynamic quantities of cell reactions to identify the feasibility of reactions.	K2
		Predict the thermodynamic quantities of a given system using emf data	K3
2.2	Derivation of Nernst equation - Single electrode potential and Applications of Nernst equation Standard electrode potentials- Electrochemical series and its significance.	Derive Nernst equation.	K2
		Explain the Standard electrode potential and its application	K2
		Describe the significance of the electrochemical series	K2

Unit/ Section	Course Content	Learning Outcomes	BTLT
		Apply electrochemical series and find the redox reactions taking place in electrochemical	K3
	Types of reversible electrodes - Cell construction- cell reaction with Nernst equation- Reference electrodes: Standard hydrogen electrode and Calomel electrode -	Classify the reversible electrodes	K2
		Explain the working principle of SHE and calomel electrode	K2
	Western Cadmium cell.	Construct the electrochemical cells setup	K3
2.3	Concentration cells- Types, emf of concentration cells with and without transference and its derivation. Liquid junction potential and its derivation - Applications of concentration cells	Derive the cell EMF expression for concentration cells with and without transference.	K2
		List out the applications of concentration cells	K2
	Applications of emf measurements: determination of valency, transport number and solubility product, Potentiometric titrations - Redox and Acid-Base Titrations	Calculate the valency, transport number and solubility product using emf data	K2
		Apply the principles of potentiometric redox and potentiometric acid -base titrations	K3
Unit– III Molecular Spectroscopy – I			
3.1	Definition of spectrum.Electromagnetic radiation,quantization of different forms of energies in molecules(translational, rotational vibrational and electronic)	Explain the quantization of differentforms of energies in molecules	K2
	Born Oppenheimer approximation, factors affecting line width and intensity.	Explain Born Oppenheimerapproximation.	K2
		Summarize the factors affecting linewidth and intensity.	K2
3.2	UV-Visible spectroscopy - Typesof electronic transitions - Franck Condon principle- predissociation spectra and dissociation energy.	Outline the various types of electronic transitions.	K2
		Explain the basics of electronic spectra and Franck-Condon principle.	K2
		Summarize the factors influencing predissociation of molecules.	K2
		Calculate the dissociation energy of molecules	K3
	Applications - Beer Lambert's law OD, chromophore, auxochrome, bathochromic and hypsochromic shifts and effect of substituents	Apply Beer Lambert's law for the Quantitative analysis of given samples.	K3
		Explain the effect of substituent's on absorption	K2
	Interpretation of UV Spectra of simple compounds (Benzene, Naphthalene, Anthracene, $[Cu(NH_3)_6]_{2+}$, $[Cu(H_2O)_6]^{2+}$)	Interpret UV Spectra of simple compounds (Benzene, Naphthalene, Anthracene, $[Cu(NH_3)_6]_{2+}$, $[Cu(H_2O)_6]^{2+}$)	K4

Unit/ Section	Course Content	Learning Outcomes	BTLT
Unit– IV Molecular Spectroscopy - II			
4.1	Infrared spectroscopy- modes of vibration of diatomic, linear tri- atomic (CO_2) and non-linear tri- atomic (H_2O) molecules. Stretching and bending vibrations	Identify the different modes of IR vibration in linear and nonlinear molecules.	K2
	Selection rules, expression for vibrational frequency (derivation not required).	Explain the Selection rules and expression for vibrational frequency	K2
	Calculation of force constant - Applications of IR spectra (group frequencies, finger print and hydrogen bonding only).	Calculate force constant for different types of bond	K3
4.2	Raman spectroscopy -conditions - Rayleigh and Raman scattering, selection rules Classical and quantum theory - Stokes and Anti- Stokes lines.	Explain different spectral lines observed in Raman spectra	K2
	Differences between Raman and IR Spectroscopy	Compare Raman and IR spectroscopy	K2
	Rotational Raman spectra of non-centrosymmetric molecule (HCl only). Mutual exclusion principle(CO_2 and N_2O).	Explain Mutual exclusion principle	K2
		Explain IR & Raman spectra of HCl.	K2
	IR Instrumentation (Block diagram)	Explain the components of a IR spectrophotometer	K2
	Interpretation of IR Spectra of simple compounds (Aniline, Benzoic Acid, Propanol, Acetone & Acetylene)	Interpret IR Spectra of simple compounds	K2
Unit– V Molecular Spectroscopy - III			
5.1	NMR Spectroscopy - magnetic and non - magnetic nuclei- selection rules -	Explain the importance of magnetic and non magnetic nuclei	K2
	principle of nuclear magnetic resonance - ring current - shielding mechanism- chemical shift- factors affecting chemical shift - number of signals - spin-spin coupling - splitting of signals	Describe chemical shift and factors affecting chemical shift.	K2
		Illustrate spin-spin coupling.	K2
		Find out the number of NMR signals givenby various compounds.	K3
	NMR spectra of methyl halides, ethylene, acetylene and benzene- Chemical exchange - NMR spectrum of ethyl alcohol in detail	Interpret the NMR spectra of methyl halides, ethylene, acetylene and benzene.	K3
		Explain the NMR spectra of ethyl alcohol.	K2
5.2	ESR spectroscopy - selection rules-Theory of ESR spectra - hyperfine splitting	Explain hyperfine splitting in ESR spectroscopy.	K2
	ESR spectra of simple radicals- $^{\cdot}CH_3$, $^{\cdot}CD_3$, naphthalene radical ions only.	Interpret the ESR spectra of CH3, $CD_3$and naphthalene radial.	K3

4. Mapping (CO, PO, PSO)

PHYSICAL CHEMISTRY – II Code: U22CH609													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	H		M	M	L	H	-	H	M	M	H
CO2	H	H	H		M	M	L	M	-	H	M	M	H
CO3	H	H	H		M	M	L	M	-	H	-	L	H
CO4	H	H	H		M	-	L	H	_	H	-	M	H
CO5	H	H	H		M	M	L	H	-	H	M	M	H
CO6	H	H	H	-	M	H	L	H	-	H	M	L	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : Dr. K. Sugumar

Head, Department of Chemistry : Dr J. Princy Merlin

ELECTIVE COURSE – III : BIOCHEMISTRY

Semester : VI **Code : U22CH6:3**
Credits : 5 **Total Hours : 75**
Hours/Week: 5

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Explain cell structure and functions of cell organelles Comprehend the role of Hemoglobin in oxygen transport mechanism.	K2	I
2	Describe structure and functions of Proteins	K2	II
3	Comprehend the dependence of body on carbohydrates and lipids for energy generation	K2	III
4	Elucidate the role of enzymes and Hormones in major metabolic pathways	K2	IV
5	Recognize nitrogen metabolism and the biological role of neurotransmitters	K2	IV
6	Discuss the Structure, functions and process of genetic transformation	K2	V

2A. Syllabus

Unit I - Organelles of Living Systems **15 Hours**

1.1. Living System: Basic Building Block of living Systems - Cells, structure of cell (diagram)- Basic functions of the Cell components- nucleus, mitochondria, chloroplast, cytoplasm, ribosomes, Golgi bodies, lysosomes

1.2. Blood and its components- Composition - Blood plasma - Functions of Heamoglobin - transport of oxygen - Rh Factor - Blood Pressure - Normal - High, Low and its control mechanism.

1.3. Clinical Estimation of biomolecules-Glucose - Cholesterol and Hemoglobin

Unit II - Amino Acids and proteins **15 hours**

2.1 Amino Acids - Preparation and reactions of Amino acids - Essential and non-essential Amino acids, isoelectric point, Zwitter ions, peptide bond, function of few peptides (Enkephalins, Bradykinin, Gramicidin -S, aspartame, Glutathionine), Synthesis of Peptides- Sangers-Merrifield.

2.2. Proteins - primary, secondary and tertiary structures and function – Ramachandran plot and significance of ψ and φ values.

Unit III - Carbohydrates and Lipids **15 Hours**

3.1. **Carbohydrate**s - As a basic building block– role of mono and disaccharides in biological systems - glycolysis and glycogenesis – a detailed study of glycolysis – glycogen storage, deficiency - diseases – hypoglycemia – Cori's disease – Andersen's disease.

3.2. **Lipids and Fatty acids** - Classification of lipids- simple lipids (Fats), compound lipids (phospho, glyco, sulpho lipids and lipoproteins) and derived lipids (fatty acids and glycerol)– chemical composition (simple and triglycerides) and biological significance of fats. Fatty acids–types (Saturated, unsaturated and cyclic) –Essential and non- essential fatty acids. Cholesterol– LDL, VLDL and HDL – Hypercholesterolemia.

Unit IV - Metabolic Pathways, Enzymes and Hormones **15 Hours**

4.1 **Metabolic Pathways**: Major metabolic pathways of life - Importance of catabolism, anabolism, aerobic metabolism vs. anaerobic metabolism, TCA Cycle, Cancer cell Metabolism -.Nitrogen metabolism – introduction – urea cycle.

4.2 **Enzymes and Hormones** - Simple, apoenzyme and holoenzymes, classification of enzymes –Enzyme regulation, competitive and non competitive inhibitors - function of few enzymes in pancreatic juice. Hormones – importance, function and structure of few hormones: autocrine, paracrine and endocrine hormones (adrenalin, thyroxin, insulin, estrone and testosterone)

4.3 **Neurotransmitters** - Importance–structure and function of acetylcholine – GABA.

Unit V - Nucleic Acids **15 Hours**

5.1 **Basic structural unit of nucleic acids:** Nucleotides – Nucleosides – heterocyclic bases and sugars in nucleic acids – RNA & DNA

5.2 **Structure of Nucleic acids**: Structure of DNA – Replication – transcription – translation (a detailed study) m-RNA, r-RNA and t-RNA – structure and functions.

2B. Topics for Self-Study:

S. No.	Topics	Weblinks
1.	Biomolecules classification	https://youtu.be/YO244P1e9QM
2.	Nonpolar and Uncharged Polar Amino Acids	https://youtu.be/cL2_e83v3js
3.	The science of cooking-Fats and Oils	http://home.sandiego.edu/~josephprovost/BCB T100/BCBT100%20Lect%202%20class%20notes.pdf
4.	Enzymes- a fun introduction	https://youtu.be/XTUm-75-PL4

S. No.	Topics	Weblinks
5.	How to remember hormone and their functions with easy trick	https://youtu.be/VthJDIFweH4
6.	Nucleic acids-how to use computer coding to create shapes using DNA	https://bio.libretexts.org/Courses/Community_College_of_Vermont/Human_Biology_(Gab or_ Gyurkovics)/02%3A_Chemistry_of_Life/ 2. 08%3A_Nucleic_Acids
7.	Explainer: What is neurotransmission?	https://www.sciencenewsforstudents.org/article/explainer-what-neurotransmission

2C. Text Book(s):

1. L. Veerakumari, *Biochemistry*, MJP Publishers, Chennai, 2004 **(Unit I-V).**
2. B.D. Hames and N.N. Hooper, *Instant Notes on Biochemistry*, 2nd Edition, Viva Books Pvt. Ltd ., 2011.
3. Donal Voet and Judith G. Voet, *Biochemistry*, John Wiley & Sons Inc., New York, 2008.

2D. Reference Books:

1. Patricia Trueman, *Nutrient Biochemistry*, MJP publishers, Chennai, 2006
2. Albert, L.Lehninger, Michael, M.Cox, David L. Nelson, *Principles of Biochemistry*, PrenticeHall, Second Edition, Worth Publishers, 2000
3. Eric E. Conn, Paul K. Stumpf, George Bruening and Roy H. Doi, *Outlines of Biochemistry*,Wiley Student Edition, Singapore, 2006.

3. Specific Learning Outcomes (SLOs)

Unit/ Section	Course Content	Learning outcomes	BTLT
	Unit-1 Organelles of Living Systems		
1.1	Structure of cell (diagram)- Basic functions of the Cell components - nucleus, mitochondria,chloroplast, cytoplasm, ribosomes, golgi bodies, lysosomes	Explain the structure of a cell and basic functions of its components	K2
1.2	Blood and its components- Composition - Blood plasma - Functions of Heamoglobin - transport of oxygen - Rh Factor - Blood Pressure - Normal - High, Low and its control mechanism.	Classify the blood groups and Rh factor. Comprehend the role of Hemoglobin in oxygen transport mechanism.	**K2**
1.3	Clinical estimation of Glucose, cholesterol and haemoglobin.	Describe the standard clinical procedure to estimate the amount of Glucose, cholesterol and hemoglobin in serum.	**K2**

Unit/ Section	Course Content	Learning outcomes	BTLT
Unit-2	**Amino acids and Proteins**		
2.1	Preparation and reactions of Amino acids	Summarize the chemistry of amino Acids	K2
	Essential and non-essential aminoacids	Classify the amino acids	
	Definitions: isoelectric point, Zwitter ions and peptide bond	Summarize the general characteristics of amino acids	K2
2.2	Functions of few peptides (Enkephalins, Bradykinin, Gramicidin -S, aspartame, glutathionine)	Outline the functions of somepeptides	K2
	Synthesis of Peptides- Sangers-Merrifield	Describe the synthesis of peptides	K2
2.3	Proteins - primary, secondary and tertiary structures andfunction	Explain the structure and the functions of proteins	K2
	Ramachandran plot and significance of ψ and φ values	Examine the amino acid backbones based on Ramachandran plot	K2
Unit-III Carbohydrates and lipids			
3.1	**Carbohydrates -** As a basic building block- role of mono and disaccharides in biological systems - glycolysis and glycogenesis	Explain the importance and process of glycolysis and glycogenesis in biological systems	K2
	A detailed study of glycolysis – glycogen storage	Describe the role enzymes in the glycolysis cycle	K2
	Deficiency diseases- hypoglycemia - Cori's disease -Andersen's disease	Outline the effect of carbohydrate deficiency	K2
3.2	Classification of lipids- simple lipids **(**Fats), compound lipids (phospho, glyco, sulpho lipids and lipoproteins) and derived lipids (fatty acids and glycerol)	Classify lipids based on theirstructure	K2
	Chemical composition(simple and triglycerides) and biological significance of fats	Explain the chemical composition and biological role of fats	K2
	Fatty acids -types(saturated, unsaturated and cyclic) -Essential and non-essential fatty acids	Recognize the biological role of fatty acids of varied chemical nature	K2
	Cholesterol - LDL, VLDL and HDL	Describe the effects of different types of cholesterol	K2
	Hypercholesterolemia	Demonstrate the effects of high- levels of blood cholesterol	K2
Unit-IV Enzymes and Hormones			
4.1	Major metabolic pathways of life - Importance of catabolism and anabolism	Explain the chemistry of metabolic pathways of life	K2

Unit/ Section	Course Content	Learning outcomes	BTLT
	Aerobic metabolism vs. anaerobic metabolism,	Contrast aerobic and anaerobic metabolism	K2
	TCA Cycle	Describe the TCA cycle	K2
	Cancer cell Metabolism	Outline the cancer cell metabolism	K2
	Nitrogen metabolism - introduction - urea cycle	Outline the process of nitrogen metabolism	K2
4.2	Enzymes and hormones - Simple, apoenzyme and holoenzymes	Differentiate the different forms of enzyme	K2
	Classification of enzymes - Enzyme regulation, competitive and non-competitive inhibitors	Identify enzyme inhibition mechanisms	K2
	Function of few enzymes in pancreatic juice	Outline the functions of a few enzymes in pancreatic juice	K2
	Hormones - importance, function and structure of few hormones: autocrine, paracrine and endocrine hormones (adrenalin, thyroxin, insulin, estrone and testosterone)	Infer the importance of hormonal balance in overall health	K2
4.3	Neurotransmitters - Importance - structure and function of acetylcholine - GABA	Describe the biological role of neurotransmitters	K2
Unit-V	**Nucleic Acids**		
5.1	Nucleotides - Nucleosides -heterocyclic bases and sugars in nucleic acids -RNA and DNA	Illustrate the components of RNA and DNA	K2
5.2	Structure of DNA	Explain the structure of DNA	K2
	Replication-transcription -translation (a detailed study)	Compare the processes of replication, transcription and translation	K2
5.3	m-RNA, r-RNA and t-RNA - structure and functions	Explain the structure and functions of different types of RNA	K2

4. Mapping (CO, PO, PSO)

BIOCHEMISTRY Code : U22CH5:2													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L	-	-	-	L	-	H	-	-	H
CO2	H	H		L	-	-	-		-	H	-	-	H
CO3	H	H		L	-	-	-		-	H	-	-	H
CO4	H	H		L	-	-	-		-	H	-	-	H
CO5	H	H		L	-	-	-		-	H	-	-	H
CO6	H	H		L	-		-		-	H	-	-	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : Dr. I. Sharmila Lydia

Head, Department of Chemistry : Dr J. Princy Merlin

CORE PRACTICAL – V : PHYSICAL CHEMISTRY PRACTICAL

Semester : VI **Code:U22CH6P5**
Credits : 3 **Total Hours : 45**
Hours/Week: 5

1. Course Outcomes

After completing the course, the students will be able to

S.No.	Course Outcomes	Level
1	Determine the rate constant and order of chemical reactions	K4
2	Determine the molecular weight and transition temperature of unknown compounds using colligative properties	K4
3	Evaluate the critical solution temperature of the given partially miscible liquid systems and the effect of impurities on their critical solution temperature	K5
4	Operate the conductometer, potentiometer and photo colorimeter estimate the strength of unknown solution	K2
5	Evaluate the efficiency of a buffer in resisting changes pH	K5
6	Apply the principles of Chromatography identify the components of the given sample	K3

2A. Syllabus

Principles of Physical Chemistry Experiments: Definitions, Laws and Principles – Units - Preparation of solutions - curve fitting and Interpretation of Graphs.

Experiments:

1. Kinetics study of Acid catalyzed hydrolysis of an ester.
2. Determination of Molecular Weight by Rast method.
3. Determination of Effect of impurity on CST.
4. Construction of Phase diagram of a Simple eutectic system.
5. Determination of transition temperature of a salt hydrate.
6. Conductometric determination of cell constant and limiting molar conductance of a strong electrolyte.
7. Conductometry – acid base titration.
8. Potentiometry – Redox titration.
9. Verification of Beer - Lamberts' law using photo colorimeter.
10. Determination of pH by potentiometry.
11. Determination of water of crystallization and the formula of salt hydrates.

2C. Text Books

1. V. Venkateswaran , R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi,1997.
2. R. Gopalan, P.S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 1997.
3. B.K. Sharma, Instrumental Methods of Chemical Analysis, Goel Publishing House, Meerut, 1999.

2D. Reference Books

1. Douglas A Skoog, Donald M. West, F. James Holler, Stanely R. Crouch, Fundamentals of Analytical Chemistry, Thompson Books, Bangalore, 2014
2. H.H: Willard, D. Merrit and John A Dean, Instrumental methods of Analysis D. Van Nostrand Company, New York, 1998.

3. Specific Learning Outcomes (SLOs)

Unit/ Section	Course Content	Learning outcomes	BTLT
	Principles of Physical Chemistry Experiments: Definitions, Laws- Units - Preparation of solutions - Curve fitting and Interpretation of Graphs.	Verify laws pertaining to physical chemistry experiments.	K4
		Prepare normal and molar solutions	K4
		Determine the rate constant and order of chemical reactions.	K4
	Conductometry - acid base titration.	Operate the conductometer, potentiometer and photo colorimeter	K4
	Potentiometry - Redox titration.	Estimate the strength of unknown solution using conductometer, potentiometer and photo colorimeter.	K4
	Verification of Beer - Lamberts' law using photo colorimeter.	Determine the molecular weight colligative properties	K4
	Buffer solution	Evaluate the efficiency of a buffer in resisting changes pH	K5

4. Mapping (CO, PO, PSO)

PHYSICAL CHEMISTRY PRACTICAL Code: U22CH6P5													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	-	L	-	-	H	L	H	-	H	H	M	H
CO2	H	L	M	-	-	H	-	H	-	H	M	-	H
CO3	H	M	H	-	-	M	-	H	-	H	M	L	H
CO4	H	M	H	-	-	H	-	H	_	H	M	L	H
CO5	H	M	H	L	-	M	-	H	-	H	M	L	H
CO6	H	H	H	M	-	H	-	H	-	H	M	L	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II
2. Model Exams I and II
3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator : **Dr. K. Sugumar**

Head, Department of Chemistry : Dr J. Princy Merlin

Elective Course II : FORENSIC CHEMISTRY

Semester : V **Code :** U22CH5:A
Credits : 4 **Total Hours :60**
Hours/Week: 4

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Analyze the common adulterants in food	K4	I
2	Apply the basic analytical instrument techniques to identify the chemical substances.	K3	II
3	Distinguish the discovery of a committed crime, identification of suspects, and the gathering of evidence	K4	III
4	Examine the suspects by their fingerprints, DNA and body fluids	K3	III
5	Detect forgery in bank cheques / drafts and educational records	K5	IV
6	Explain the basic principles to detect the gold purity in 22 carat ornaments and gold-plated jewels	K3	IV
7	Detect the steroid consumption among athletes and race horses.	K5	V

2A. Syllabus

Unit– I Food Adulteration **15 Hours**

1.1 Contamination of wheat, rice, dhal, milk, butter, etc. with c lay, sand, stone, water and toxic chemicals (e.g. Kasseri dhal with mentanil yellow).

1.2 Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol), chemical poisons (KCN). First aid and Antidotes for poisoned persons.

1.3 Heavy metal (Hg, Pb, Cd) contamination of Sea food. Use of neutron activation analysis in detecting poisoning (e.g., As in human hair)

Unit II Transportation **15 Hours**

2.1 Drunken driving: Breath analyzer for ethanol. Incendiary and timed bombs in road and railway tracchemistryks. Defusing live bombs.

2.2 Hit -and-go traffic accidents : Paint analysis by AAS, Soil of toxic and corrosive chemicals (e.g., conc.acids) from tankers.

Unit III Crime Detection **15 Hours**

3.1 Accidental explosions during manufacture of matches and fire -works (as in Sivakasi). Human bombs, possible explosives (gelatin sticks, RDX). Metal detector devices and other security measures for VVIP. Composition of bullets and detection of powder burns.

3.2 Scene of crime: finger prints and their matching using computer records. Smell tracks and police dogs. Analysis of blood and other body fluids in rape cases. Identification of blood types. DNA finger printing for tissue identification in disembered bodies. Blood stains on clothing. Cranial analysis (head and teeth).

Unit IV Forgery and Counterfeiting **15 Hours**

4.1 Detecting forgery in bank cheques / drafts and educational records (mark lists, certificates), using UV-light. Alloy analysis using AAS to detect counterfeit coins. Checking silverline wetter mark in currency notes.

4.2 Jewellery : Detection of gold purity in 22 carat ornaments, detecting gold plated jewels, authenticity of diamonds (natural, synthetic, glassy).

Unit V Medical Aspects **15 Hours**

5.1 AIDS : Cause and prevention . Misuse of scheduled drugs. Burns and their treatment by plastic surgery.

5.2 Metabolite analysis using mass spectrum - gas chromotography. Detecting steroid consumption among athletes and race horses.

2B. Topics for Self-Study

S.No.	Topics	Web Links
1	Food Adulteration	https://www.youtube.com/watch?v=l0BthUI_MMA
2	How do Breath analyzers work? | Chemistry behind the breathalyzer | Alcohol testing Devices|In English.	https://www.youtube.com/watch?v=MwWAKQV-vqw
3	Types of Security Metal Detector	https://www.youtube.com/watch?v=xMWu7rLos6U
4	Gold Testing Machine Video Demonstration | 30+ Metals Detection | Maxsell Aurum #DemoGoldTester	https://www.youtube.com/watch?v=pwRq--Wm1do
5	Innovating how Steroids are Detected in Urine	https://www.youtube.com/watch?v=xNgsltHWZfo

2C. Text Book

P.C. Dikshit, Textbook of Forensic Medicine and Toxicology- 2 edition, Peepee Publishers and Distributors (P) Ltd, 2013

2D. Recommended Reference Books

1. K. S Narayan Reddy - The Essentials of Forensic Medicine and Toxicology- 33rd edition, Jay Pee Brothers, 2014
2. Jay Seigal, Forensic Chemistry: Fundamentals and Applications, John Wiley & Sons 2015

3. Specific Learning Outcomes (SLO)

Unit	Course Content	Learning Outcomes	BTLT
1.1	Contamination of wheat, rice, dhal, milk, butter, etc. with c lay, sand, stone, water and toxic chemicals (e.g. Kasseri dhal with mentanil yellow)	Identify the common Adulteration in food product such as wheat, rice, dhal, milk, butter.	K4
1.2	Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol), chemical poisons (KCN). First aid and Antidotes for poisoned persons.	Distinguish the food poisons	K4
1.3	Heavy metal (Hg, Pb, Cd) contamination of Sea food. Use of neutron activation analysis in detecting poisoning (e.g., As in human hair)	Detect the heavy metals in sea food by using neutron activation analysis	K5
2.1	Drunken driving: Breath analyzer for ethanol.	Explain the basic principle of breath analyzer.	K3
	Incendiary and timed bombs in road and railway tracks.	Differentiate incendiary and timed bombs.	K4
	Defusing live bombs	Explain the principle of defusing live bombs.	K3
2.2	Hit -and-go traffic accidents : Paint analysis by AAS, Soil of toxic and corrosive chemicals (e.g., conc.acids) from tankers.	Apply the basic analytical instrument techniques to identify the chemical substances.	K3
3.1	Accidental explosions during manufacture of matches and fire -works (as in Sivakasi).	Explain the Accidental explosions during manufacture of matches and fire -works (as in Sivakasi)	K3
	Human bombs, possible explosives (gelatin sticks, RDX).	Classify explosives	K4
	Metal detector devices measures for VVIP. and other security	Compare the Metal detector devices and other security measures for VVIP.	K4
	Composition of bullets and detection of powder burns.	Explain the Composition of bullets and detection of powder burns.	K3

Unit	Course Content	Learning Outcomes	BTLT
3.2	Scene of crime: finger prints and their matching using computer records. Smell tracks and police dogs.	Integrate the crime scene involving finger prints, and their matching using computer records and identify the suspects by smell tracks and police dogs.	K4
	Analysis of blood and other body fluids in rape cases. Identification of blood types.	Identify the blood and other body fluids in rape cases.	K4
	DNA finger printing for tissue identification in disembered bodies.	Identify the disembered bodies by DNA finger printing	K4
	Blood stains on clothing. Cranial analysis (head and teeth).	Explain the cranial analysis	K3
4.1	Detecting forgery in bank cheques / drafts and educational records (mark lists, certificates), using UV-light.	Detect forgery in bank cheques / drafts and educational records	K5
	Alloy analysis using AAS to detect counterfeit coins. Checking silverline wetter mark in currency notes.	Distinguish the original coin and counterfeit coins by AAS technique	K4
4.2	Jewellery : Detection of gold purity in 22 carat ornaments, detecting gold plated jewels, authenticity of diamonds (natural, synthetic, glassy).	Detect the gold purity in 22 carat ornaments and gold-plated jewels	K5
5.1	AIDS : Cause and prevention	Explain the cause and prevention of AIDS	K3
	Misuse of scheduled drugs	Classify scheduled drugs	K4
	Burns and their treatment by plastic surgery.	Justify Burns and their treatment by plastic surgery.	K5
5.2	Metabolite analysis using mass spectrum - gas chromotography.	Evaluate the Metabolite analysis using mass spectrum and gas chromotography	K5
	Detecting steroid consumption among athletes and race horses.	Compare the steroid consumption of athletes and race horses	K4

4. Mapping (CO, PO, PSO)

FORENSIC CHEMISTRY Code : U22CH5:A													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H		H		M	H	-	L	-	H	-		M
CO2	H		H		H	H	-	L	-	H	H		H
CO3	H		H		L	H	-	M	-	H	-	M	-
CO4	H		H	M	H	H	-	H	-	H	H	M	H-
CO5	H		H	M	L	H	-	M	-	H	-		-
CO6	H		H		L	H		H	-	H	-		H
CO7	H		H	M	H	H		H		H			M

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator :

Head, Department of Chemistry : Dr J. Princy Merlin

ELECTIVE COURSE II : POLYMER CHEMISTRY

Semester : V **Code: U22CH5:B**
Credits : 4 **Total Hrs.: 60**
Hours/Week: 4

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Distinguish polymers based on their structures	K2	I
2	Evaluate molecular mass of polymers by adopting various methodologies	K5	I
3	Interpret kinetics and mechanism of polymerization processes	K3	II
4	Predict the suitable methodology for polymerization process	K3	III
5	Describe about thermo/thermosetting polymers, elastomers and conducting polymers	K1	IV
6	Appraise an appropriate processing method to prepare a polymer.	K4	V

2A. Syllabus

Unit– I Introduction to Polymer **15 Hours**

1.1. Monomers, Oligomers, Polymers and their characteristics.

1.2. Classification of polymers: Natural synthetic, linear, cross linked andnetwork; plastics, elastomers, fibres, Homopolymers and Co-polymers.

1.3. Bonding in polymers : Primary and secondary bonding forces in polymers ; cohesive energy and decomposition of polymers.

1.4. Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers and determination by (i) viscosity (ii) Light scattering method, (iii) Gel Permeation Chromatography (iv) Osmometry and ultracentrifuging.

Unit– II Kinetics and Mechanism For Polymerization **15 Hours**

2.1. Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers : Ziegler Natta polymers.

2.2. Polycondensation – non-catalysed, acid-catalysed polymerization, molecular weight distribution Step growth polymers.

Unit– III Techniques of Polymerization and Polymer Degradation 15 Hours

3.1 Bulk, Solution, Emulsion, Suspension, Melt polycondensation, solution polycondensation interfacial and gas phase polymerization.

3.2. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photo degradation, Photo stabilizers.

Unit – IV Industrial Polymers 15 Hours

4.1. Raw material, preparation, fibre forming polymers, elastomeric material.

4.2. Thermoplastics : Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester.

4.3. Thermosetting Plastics: Phenol formaldehyde and epoxide resin.

4.4. Elastomers : Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene. Conducting Polymers : Elementary ideas ; examples : polysulphur nitriles, polyphenylene, poly pyrrole and poly acetylene.

Unit– V Introduction to Polymer Processing 15 Hours

5.1. Compounding: Polymer Additives: Fillers, Plasticizers antioxidants and thermal stabilizers fire retardants and colourants.

5.2. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding, extrusion moulding and reinforcing.

2B. Topics for Self-Study

S.No.	Topics	Web Link
1	Types of polymerization	https://www.youtube.com/watch?v=JmkHAY5EyCE
2	Polymerization	https://www.youtube.com/watch?v=rVjfjLZnoFg
3	Conducting Polymers	https://www.youtube.com/watch?v=HE2zRQVhImw
4	Polymers In Medicines and Surgery - Polymers - Engineering Chemistry	https://www.youtube.com/watch?v=noCPqonPWLQ

2C. Text Books

1. V.R. Gowariker, Polymer Science, Wiley Eastern, 1995.
2. F. N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971.

2D. Recommended Reference Books

1. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Limited, 1996.
2. A. Kumar and S. K. Gupta, Fundamentals Polymer Science and Engineering, Tata McGraw- Hill, 1978.

3. Specific Learning Outcomes (SLO)

Unit	Course Content	Learning Outcomes	BTLT
1.1	Monomers, Oligomers, Polymers and their characteristics.	Explain the characteristics of monomers, oligomers and polymers	K2
1.2	Classification of polymers: Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers.	Appraise the nature of the polymers	K5
1.3	Bonding in polymers : Primary and secondary bonding forces in polymers ; cohesive energy and decomposition of polymers.	Interpret the nature of bonding in polymers.	K3
1.4	Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers and determination by (i) viscosity (ii) Light scattering method, (iii) Gel Permeation Chromatography (iv) Osmometry and ultracentrifuging.	classify the polymers based on their molecular weight	K4
2.1	Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers : Ziegler Natta polymers	Predict the type of polymerization	K3
2.2	Polycondensation – non-catalysed, acid-catalysed polymerization, molecular weight distribution Step growth polymers.	Illustrate polycondensation process	K2
3.1	Bulk, Solution, Emulsion, Suspension, Melt polycondensation, solution polycondensation interfacial and gas phase polymerization.	Explain the polymerization techniques	K4
3.2	Types of Polymer Degradation, Thermal degradation, mechanical degradation, photo degradation, Photo stabilizers.	Examine the properties of polymers	K3
4.1	Raw material, preparation, fibre forming polymers, elastomeric material.	Select the starting raw material for the desired fibres	K2
4.2	Thermoplastics : Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester.	Evaluate the properties of thermoplastics	K4
4.3	Thermosetting Plastics: Phenol formaldehydeand epoxide resin.	Establish the difference between thermoplastics and thermosetting plastics	K3

Unit	Course Content	Learning Outcomes	BTLT
4.4	Elastomers : Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene. Conducting Polymers : Elementary ideas ; examples : polysulphur nitriles, polyphenylene, poly pyrrole and poly acetylene.	Categorize the rubber as natural and synthetic	K4
5.1	Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants and thermal stabilizers, fire retardants and colourants.	Prepare polymers with desired properties.	K3
5.2	Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding, extrusion moulding and reinforcing.	Analyze an appropriate processing technique to prepare polymers with appreciable properties	K4

4. Mapping (CO, PO, PSO)

POLYMER CHEMISTRY CODE: U22CH5:B													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	M	-	-	-	H	-	H	-	-	H
CO2	H	H	H	M	-	-	-	H	-	H	-	-	H
CO3	H	H	H	M	-	-	-	H	-	H	-	-	H
CO4	H	H	H	M	-	-	-	H	-	H	-	-	H
CO5	H	H	H	M	-	-	-	M	-	H	-	-	H
CO6	H	H	H	M	-		-	M	-	H	-	-	H

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)
3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator :

Head, Department of Chemistry : Dr J. Princy Merlin

Elective Course III : AGRICULTURAL CHEMISTRY

Semester : VI **Code: U22CH6:A**
Credits : 5 **Total Hours: 90**
Hours/Week: 6

1. Course Outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	To classify soil based on their chemical composition and physical properties	K2	I
2	To analyze the soil pH and fertility.	K4	I
3	To understand the types of fertilizers and their mechanism of action	K1	II
4	To prepare manures from organic waste	K4	II
5	To know about the different types of chemicals used in pest control.	K2	III & IV
6	To understand the activity of plant growth regulators	K1	V

2A. Syllabus

Unit I Soil Chemistry **18 Hours**

1.1. Soil analysis, Composition of soil: Organic and Inorganic constituents, Soil acidity, buffering capacity of soils. Liming of soil.

1.2. Absorption of cations and anions, availability of soil nutrients to plants.

Unit II Fertilizers and Manures **18 Hours**

2.1. Effect of Nitrogen, potassium and phosphorous on plant growth – commercial method of preparation of urea, triple superphosphate. Complex fertilizers and mixed fertilizers – their manufacture and composition.

2.2. Secondary nutrients – micronutrients and their functions in plants. Use of fertilizers: urea, DAP, Super phosphate, Gypsum, NPK-mixed fertilizers, Optimal addition of Fertilizers to obtain estimated yield.

2.3. Bulky organic manures – Farm yard manure – handling and storage, Oilcakes, Blood meal – fish manures.

Unit III Pesticides and Insecticide **18 Hours**

3.1. Pesticides – classification of Insecticides, fungicides, herbicides as organic and inorganic – general methods of application and toxicity, Safety measures when using pesticides.

3.2. Insecticides: Plant products – Nicotine, pyrethrin – Inorganic pesticides – borates, Organic pesticides – D.D.T. and BHC, Plant derivatives: pyrethrine, Nicotine and rotenone, Synthetic organic: carbophos, carbaryl, p-DCB, dimethoate, butachlor, Endrin, Aldrin (Chemical name, Structures and uses).

Unit IV Fungicides and Herbicides 18 Hours

4.1. Fungicides: Inorganic (Bordeaux Mixture) and organic (dithiocarbamate), Industrial fungicides: creosote fractions.

4.2. Herbicides and weedicides: Selective and non-selective, 2, 4-Dicholorophenoxyacetic acid and 2, 4, 5-Tricholorophenoxyaceticacid (structure and function)

4.3. Intenerated pest management, Sex attractants for insect control, Sustainable agriculture.

UNIT V Plant Growth Regulators 18 Hours

5.1. 3-Indole acetic acid: naphthalene acetic acid: Ethepon (2-chloroethyl phosphoric acid): Alar (succinicacid-2, 2-dimethyhydrzine :) their function.

5.2. Plant hormones: Gibberlin, Cyclocel, Phosphon, dwarfing compound (CCC:2-Chlorethyltrimethyl ammonium chloride). Defoliants.

2B. Topics for Self-Study

S.No.	Topics	Web Links
1	Soil Chemistry	https://youtu.be/M7YRIdk5q70
2	Soil biology, chemistry and physics	https://youtu.be/ogSlDL9JtJI
3	Understanding our Soil: The Nitrogen Cycle, Fixers and Fertilizers	https://youtu.be/A8qTRBc8Bws
4	Mode of action: Herbicides and Insecticides	https://youtu.be/QtC14bq42aw
5	How does Pesticide work?	https://youtu.be/n7nG-gHcv4I

2C. Text Books

1. Brian Bechdal, Textbook of Soil Science, Callisto Reference, United States. 2016.
2. Ranjan Kumar Basak, Fertilizers – A Text book, Kalyani Publishers, 2007.
3. Rakshit A., Manures, Fertilizers and Pesticides, CBS Publishers, 2015.
4. P.C. Das, Manures and Fertilizers, Kalyani Publishers, 2009.
5. N.K. Roy, Chemistry of Pesticides, CBS Publishers, 2016.

2D. Recommended Reference Books

1. G.T. Austin, Shreve's Chemical Process Industries-5th edition, Mc-Graw-Hill, 1984.
2. B.A. Yagodin, Agricultural Chemistry- Volumes I & II, Mir Publishers, Moscow, 1976.

3. Specific Learning Outcomes (SLO)

Unit	Course Content	Learning Outcomes	BTLT
1.1	Soil analysis, Composition of soil: Organic and Inorganic constituents, Soil acidity, buffering capacity of soils. Liming of soil.	Classify soil in to acid, alkaline and saline soils	K2
		Explain the process of liming of soil	K3
1.2	Absorption of cations and anions, availability of soil nutrients to plants.	Explain the formation of soil colloids	K3
		Account for the ion exchange capacity of soil colloids	K3
		Evaluate the soil fertility	K4
2.1	Effect of Nitrogen, potassium and phosphorous on plant growth – commercial method of preparation of urea, triple superphosphate. Complex fertilizers and mixed fertilizers – their manufacture and composition.	Classify the nitrogenous, potassium and phosphorous fertilizers	K2
		Describe the preparation of N, P and K fertilizers	K4
		Explain the mode of action of NPK fertilizers and their advantages.	K4
2.2	Secondary nutrients – micronutrients and their functions in plants. Use of fertilizers: urea, DAP, Super phosphate, Gypsum, NPK-mixed fertilizers, Optimal addition of Fertilizers to obtain estimated yield.	Identify the deficiency symptoms of secondary nutrients in plants.	K2
2.3	Bulky organic manures – Farm yard manure – handling and storage, Oil cakes, Blood meal – fish manures.	Compare the properties and advantages of Fertilizers and manures	K4
		Prepare organic manures from farm and domestic wastes.	K5
3.1	Pesticides – classification of Insecticides, fungicides, herbicides as organic and inorganic – general methods of application and toxicity, Safety measures when using pesticides.	Classify Pesticides	K2
		Explain the method of preparation of various pesticides	K4
3.2	Insecticides: Plant products – Nicotine, pyrethrin – Inorganic pesticides – borates, Organic pesticides – D.D.T. and BHC, Plant derivatives: pyrethrine, Nicotine and rotenone, Synthetic organic: carbophos, carbaryl, p-DCB, dimethoate, butachlor, Endrin, Aldrin (Chemical name, Structures and uses).	Account for the usefulness of natural and synthetic insecticides.	K2

Unit	Course Content	Learning Outcomes	BTLT
4.1	Fungicides: Inorganic (Bordeaux Mixture) and organic (dithiocarbamate), Industrial fungicides: creosote fractions.	Describe the preparation, properties and uses of organic and inorganic fungicides	K4
4.2	Herbicides and weedicides: Selective and non-selective, 2, 4-Dicholorophenoxyacetic acid and 2, 4, 5-Tricholorophenoxyaceticacid (structure and function)	Explain the structure and functioning of herbicides and weedicides.	K3
		Differentiate selective and non-selective herbicides	K4
4.3	Intenerated pest management, Sex attractants for insect control, Sustainable agriculture.	Discuss about the pest control and pest management.	K3
		Arrive at the requisites of sustainable agriculture.	K4
5.1	3-Indole acetic acid: naphthalene acetic acid: Ethephon (2-chloroethyl phosphoric acid): Alar (succinicacid-2, 2-dimethyhydrzine) their function.	Explain the role of plant growth regulators.	K4
5.2	Plant hormones: Gibberlin, Cyclocel, Phosphon, dwarfing compound (CCC:2-Chlorethyltrimethyl ammonium chloride). Defoliants.	Classify the various plant hormones and explain their functions in plant growth.	K2

4. Mapping (CO, PO, PSO)

AGRICULTURAL CHEMISTRY CODE :U22CH6:A												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	L	M	M	M	M	H	M	M	M
CO2	H	H	M	H	L	M	M	M	M	H	M	M	M
CO3	H	H	H	M	H	H	M	M	M	H	M	M	M
CO4	H	H	H	H	H	H	M	M	M	H	M	M	M
CO5	H	H	H	M	M	M	M	M	M	H	M	M	M
CO6	H	H	H	M	M	M	M	M	M	H	M	M	M

L-Low M-Moderate H- High

5. Course Assessment Methods

DIRECT

1. Continuous Assessment Tests – I & II

2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)

3. End Semester Examination

INDIRECT

1. Course-end survey

Course Co-ordinator :

Head, Department of Chemistry : Dr J. Princy Merlin

Elective Course III : DAIRY CHEMISTRY

Semester : VI **Code: U22CH6:B**
Credits : 5 **Total Hours: 90**
Hours/Week: 6

1. Course outcomes

After the successful completion of this course the students will be able to

S.No.	Course Outcomes	Level	Unit
1	Predict Physio- Chemical changes and processing parameters of milk	K5	I
2	Explain physical and chemical properties of milk proteins	K2	II
3	Analyze the composition and methods of separation of Cream and Butter	K4	III
4	Explain the need and method for the preparation of milk powder	K4	IV
5	Prepare Dairy detergents and understand washing procedure	K3	V
6	Discuss the modern washing procedure and sterilization	K2	V

2A. Syllabus

Unit I **18 Hours**

Milk: General composition of milk, Factors affecting the gross composition of milk, physico-Chemical changes taking place in milk due to processing parameters-boiling - pasteurization- sterlilzation and homogenization.

Unit II **18 Hours**

Milk lipids-terminology and definitions-Milk proteins: Physical properties of milk proteins-Electrical properties and hydration, solubility. Reaction of milk prote ins with formaldehyde and ninhydrin.- Milk carbohydrate-Lactose- Estimation of lactose in milk-Milk vitamins-water and soluble vitamins, effect of heat and light on vitamins. Ash and mineral matters in milk.

Unit III **18 Hours**

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

Unit IV **18 Hours**

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

Unit V **18 Hours**

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

2B. Topic for self-study

S.No.	Topics	Web Links
1	Processing Raw Organic Milk at Home	https://www.youtube.com/watch?v=ZF1kOgWeZgI
2	How to detect adulteration in milk	https://www.youtube.com/watch?v=4Ljlq_CmAnk
3.	Milk Powder Manufacturers In India - Milk Powder Business In India	https://www.youtube.com/watch?v=awfw3rojSLI
4.	Determining the sodium hypochlorite content in a bleach	https://www.youtube.com/watch?v=rIiIAfH3pWk

2C. **Recommended Reference Books**

1. Sukumar De , Outlines of Diary Technology, Oxford Publishers,2001
2. Robert Jenness & S.Patorn, Principles of Dairy Chemistry, John Wiley & Sons Inc, 1959
3. K.S. Rangappa and K.T. Achaya ,Indian Diary products, Asia Publishing House, 1975

3. Specific learning outcomes

Unit	Course Content	Learning Outcomes	Blooms Taxonomic levels of Transaction
I	General composition of milk, Factors affecting the gross composition of milk	Summarize the various composition of milk	K2
	Physico-Chemical changes taking place in milk due to processing parameters-boiling - pasteurization	Predict the physical and chemical changes due to various parameters in milk.	K5
	Sterilization and homogenization.	Explain the sterilization and homogenization of milk.	K4
II	Milk lipids-terminology and definitions	Explain the terminology and definition of milk lipids	K2
	Physical properties of milk proteins-Electrical properties and hydration, solubility.	Explain the properties of milk proteins	K2
	Reaction of milk proteins with formaldehyde and ninhydrin.	Discuss the reactions of milk protein	K2

	Milk carbohydrate-Lactose- Estimation of lactose in milk-	Estimate the lactose present in the milk	K2
	Milk vitamins-water and soluble vitamins, effect of heat and light on vitamins. Ash and mineral matters in milk	Discuss the milk vitamins and effect of heat and light on vitamins.	K2
III	Creams: Definition-composition-chemistry of creaming process- gravitational and centrifugal methods.	Analyze the composition and separation of cream	K4
	separation of cream-Factors influencing cream separation (Mention the factors only)-Cream neutralization	Analyze the composition and separation of cream	K4
	Estimation of fat in cream. Butter: Definition- % composition-manufacture-Estimation of fat, acidity, salt and moisture content-Desi butter.	Estimate fat in cream and moisture in Butter	K2
IV	Milk powder: Definition-need for making powder-drying process- spraying, drum drying, jet drying and foam drying-principles involved in each.	Explain the process of making milk powder	K4
	Manufacture of whole milk powder by spray drying process- keeping quality of milk powder.	Explain the manufacture milk powder	K4
	Ice cream: Definition-percentage composition-types- ingredients needed -manufacture of ice-cream stabilizers-emulsifiers and their role.	Explain the composition and ingredients in ice cream	K4
V	Dairy Detergents: Definition-characteristics .	Prepare the dairy detergents	K3
	Washing procedure (modern method) sterilization-chloramin-T and hypochlorite solution	Discuss the washing procedure and sterilization using hypochlorite solution	K2

4. Mapping Scheme For COs, POs And PSOs

L-Low M-Moderate H- High

DAIRY CHEMISTRY Code: U22CH5:B													
Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	M										
CO2		H	H		M	M							
CO3	M	M		L	H			M	L				
CO4	H	H	L		H	H	M	M				M	
CO5	M	H	H						L			M	
CO6	H	H	M		M	L							

5. Course Assessment Methods

DIRECT:

1. Continuous Assessment Tests – I & II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Proto-type or Product Demonstration etc. (as applicable)
3. End Semester Examination

INDIRECT:

1. Course-end survey

Course Co-ordinator: **Mr. T. ARUNACHALAM**

Head, Department of Chemistry: Dr J. Princy Merlin