

2025



THANTHAI HANS ROEVER COLLEGE



(Autonomous)

Nationally Re-Accredited by NAAC

UGC Recognized 2(f) and 12(B) Institution

Affiliated to Bharathidasan University, Tiruchirapalli

Perambalur-621 220, Tamil Nadu, India

PG & Research Department of Chemistry



B.Sc- Chemistry

CHOICE BASED CREDIT SYSTEM SYLLABUS & LOCF

SEMESTER PATTERN

Vision

To blossom as an institution of excellence, enabling, empowering and enlightening the youth and shaping them as fully developed human beings with the capacity to unfold their full mental potentiality resulting in the attainment of the wisdom to live constructively and meaningfully.

Mission

- To provide congenial and stress-free environment and opportunities for the enhancement of knowledge and acquisition skills through the best exposure and training possible.
- To offer multifaceted and need-based academic programmes and to promote extension activities.
- To adopt technology-enabled new methods, approaches and techniques so that the teaching-learning process becomes learner-centred and learner-friendly.
- To maximize the participation of all the stakeholders in the development of the institution and the region.
- To sensitize the youth towards inclusive growth for socio-economic change, sustainable development, gender equality, eco-friendliness, etc.
- To enable the youth to experience the effects of globalization and facilitate them to grow as responsible citizens and leaders.
- To inspire them, through value-based education, to embrace the entire humanity while firmly rooted in the Indian ethos.
- To provide regular placement training and placement opportunities.
- To kindle the spirit of creativity and enhance research activities and enable them to attain international standards.

Programme Outcomes (POs)

PO1: Students will possess fundamental subject knowledge required for higher studies, professional courses, and applied fields.

PO2: Students will acquire practical skills and technical competence, along with multidisciplinary domain knowledge.

PO3: Students will develop scientific aptitude with analytical, critical thinking, and problem-solving skills.

PO4: Students will employ modern digital tools and computational techniques for data analysis, research, and creative design.

PO5: Students will gain competence to pursue higher learning, research, careers, or entrepreneurship opportunities.

PO6: Students will demonstrate effective communication, teamwork, and leadership skills in academic and professional settings.

PO7: Students will be able to apply theoretical concepts to real-life situations, providing innovative and sustainable solutions.

PO8: Students will imbibe ethical values, social responsibility, and an appreciation for cultural diversity and environmental sustainability

Program Specific Outcomes (PSOs)

PSO1: Students acquire in-depth knowledge of the fundamental concepts in all disciplines of chemistry.

PSO2: Students can disseminate the basics of chemistry and advanced topics and analytical skills in organic, inorganic and physical chemistry.

PSO3: Students will be able to develop creativity in academics and research.

PSO4: Students will be able to apply digital tools to collect, analyse and interpret data and present scientific findings.

PSO5: Gain competence to pursue higher education and career opportunities in chemistry and allied fields.

Choice-Based Credit System – Learning Outcome-Based Curriculum Framework

(For the candidate admitted from the academic year 2025 -2026)

Semester	Part	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
							CIA	ESE	Total
I	I	25UT1/H1	General Tamil-I (Tamil IlakiyaVaralaru – I)	6	3	3	25	75	100
	II	25UE1	English – I	6	3	3	25	75	100
	III	25UCH1CC1	General Chemistry-I	6	5	3	25	75	100
		25UCH1CP1	Quantitative Inorganic Estimation Practical	3	3	3	40	60	100
		25UPH1AC1	Allied Physics – I	4	4	3	25	75	100
		25UPH2AP1	Allied Practical – I	3	--	--	--	--	--
	IV	25UVE	Value Education	2	2	3	25	75	100
			Value Added Course*	--	2*	3	50	50	100*
Total				30	20	-	-	-	600
II	I	25UT2/H2	General Tamil – II (Tamil IlakiyaVaralaru-II)	6	3	3	25	75	100
	II	25UE2	English – II	6	3	3	25	75	100
	III	25UCH2CC2	General Chemistry-II	5	5	3	25	75	100
		25UCH2CP2	Qualitative Organic Analysis Practical	3	3	3	40	60	100
		25UPH2AC2	Allied Physics-II	3	3	3	25	75	100
		25UPH2AP1	Allied Practical –I	3	2	3	40	60	100
	IV	25UCH2NME1	Diary Chemistry (NME-1)	2	2	3	25	75	100
		25UES	Environmental Studies	2	2	3	25	75	100
			Value Added Course*	--	2*	3	50	50	100*
Total				30	23	-	-	-	800
III	I	25UT3/H3	General Tamil – III (TamilagaVaralarumPanpadum)	6	3	3	25	75	100
	II	25UE3	English – III	6	3	3	25	75	100
	III	25UCH3CC3	General Chemistry – III	4	4	3	25	75	100
		25UCH3CP3	Qualitative Inorganic Analysis Practical	3	3	3	40	60	100
		25UZO3AC3	Allied Zoology – I	4	3	3	25	75	100
		25UZO3AP2	Zoology Allied Practical – I	3	--	--	--	--	--
	IV	25UCH3NME2	Cosmetics And Personal Grooming (NME - 2)	2	2	3	25	75	100
		25UCH3SE1	Workplace Ethics	2	2	3	25	75	100
		Value Added Course*	--	2*	3	50	50	100*	
Total				30	20	-	-	-	700

Semester	Part	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
							CIA	ESE	Total
IV	I	25UT4/H4	General Tamil - IV (TamilumAriviyalum)	6	3	3	25	75	100
	II	25UE4	English – IV	6	3	3	25	75	100
	III	25UCH4CC4	General Chemistry – IV	5	4	3	25	75	100
		25UCH4CP4	Physical Chemistry Practical	3	3	3	40	60	100
		25UZO4AC4	Allied Zoology-II	4	3	3	25	75	100
		25UZO4AP2	Zoology Allied Practical-I	3	2	3	25	75	100
	IV	25UCH4SE2	Entrepreneurial Skills In Chemistry	2	2	3	25	75	100
		25UHW	Health and Wellness	1	1	--	--	--	100
		Value Added Course*	--	2*	3	50	50	100*	
Total				30	21	-	-	-	800
V	III	25UCH5CC5	Organic Chemistry – I	5	5	3	25	75	100
		25UCH5CC6	Inorganic Chemistry –I	4	4	3	25	75	100
		25UCH5CC7	Physical Chemistry –I	5	5	3	25	75	100
		25UCH5CP5	Gravimetric Estimation, organic preparation and physical constant determination practical	6	4	3	40	60	100
		25UCH5DE1	Industrial Chemistry	4	4	3	25	75	100
		25UCH5DE2	Agricultural chemistry	4	4	3	25	75	100
	IV	25USS	Soft Skills	2	2	3	25	75	100
		25USI	Summer Internship	--	2*	3	--	--	100
		Value Added Course*	--	2*	3	50	50	100*	
Total				30	28	-	-	-	800
VI	III	25UCH6CC8	Organic Chemistry –II	6	5	3	25	75	100
		25UCH6CC9	Inorganic Chemistry –II	6	5	3	25	75	100
		25UCH6CC10	Physical Chemistry –II	6	5	3	25	75	100
		25UCH6DE3	Green Chemistry	4	4	3	25	75	100
		25UCH6DE4	Nanoscience and Technology	4	4	3	25	75	100
		25UCH6PW	Project With Viva Voce	3	3	3	20	80	100
	V	25UGS	Gender Studies	1	1	3	25	75	100
			Extension Activity	--	1	--	--	--	--
		Value Added Course*	--	2*	3	50	50	100*	
Total				30	28	-	-	-	700
Total				180	140				4400

List of Value Added Courses

Course Code	Course Title
25UCHVA1	Chemistry of home care products
25UCHVA2	Reagents preparations and their validation
25UCHVA3	Cement technology
25UCHVA4	Soil and water managements
25UCHVA5	Sugar technology
25UCHVA6	Pesticide chemistry

Sem.	Course Code	Credits	Title of the Course	AC/CC/DE/ ES / GS / NME/ PF / PW / VAC/ VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25UCH1CC1	5	General Chemistry-I	CC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
Course Objectives: The purpose of learning this course is:											
1. To understand atomic structure, quantum principles, and electronic configurations.											
2. To analyze the modern periodic table and explain periodic trends.											
3. To explain ionic and covalent bonding, predict molecular shapes, and assess bond polarity.											
4. To compare valence bond and molecular orbital theories and describe coordinate and metallic bonding.											
5. To apply electronic effects to interpret basic organic reaction types and mechanisms.											
Course Outcomes:											
CO1: Describe fundamental concepts of atomic structure and quantum mechanics.											
CO2: Interpret the modern periodic table and periodic properties of elements.											
CO3: Explain ionic and covalent bonding and predict molecular shapes and bond polarity.											
CO4: Compare valence bond and molecular orbital theories and describe coordinate and metallic bonding.											
CO5: Apply electronic effects to understand the reactivity and mechanisms of basic organic reactions.											
Unit-I	Atomic structure and Periodic trends									15 Hrs.	
History of atom (J.J. Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic mass Black-Body Radiation and Planck's quantum theory - Bohr's model of atom; The Franck-Hertz Experiment; Interpretation of H- spectrum; Photoelectric effect, Compton effect; Dual nature of Matter- De- Broglie wavelength-Davisson and Germer experiment Heisenberg's Uncertainty Principle; Electronic Configuration of Atoms and ions- Hund's rule, Pauli' exclusion principle and Aufbau principle; Numerical problems involving the core concepts.											
Unit-II	Modern Periodic Table									15 Hrs.	
Cause of periodicity; role of electronic configuration; Features of the periodic table; long form and s, p, d, f block classification; classification of elements - metals, nonmetals, metalloids, noble gases, transition elements; Periodic trends for atomic size - Atomic radii, Ionic, crystal, van derWaals and Covalent radii; ionization energy, successive ionization energies; electron affinity, exceptions; electronegativity - electronegativity scales, Pauling and Mulliken scales; effects on bond polarity and strength; applications of electronegativity. Problems involving the core concepts - effective nuclear charge (Slater's rules); prediction of sizes and periodic trends; bond type and reactivity.											
Unit-III	Structure and bonding – I									15 Hrs.	
Ionic bond Lewis dot structure of ionic compounds; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies, Madelung constant; relative effect of lattice energy and solvation energy; Ion polarization.– polarising power and polarizability; Fajans' rules - effects of polarisation on properties of compounds; problems involving the core concepts.											
Covalent bond Shapes of orbitals, overlap of orbitals – σ and Π bonds; directed valency - hybridization; VSEPR theory - shapes of molecules of the type AB ₂ , AB ₃ , AB ₄ , AB ₅ , AB ₆ and AB ₇ Partial ionic character of covalent bond-dipole moment, application to molecules of the type A ₂ , AB, AB ₂ , AB ₃ , AB ₄ ; percentage ionic character- numerical problems based on calculation of percentage ionic character.											
Unit-IV	Structure and bonding – II									15 Hrs.	
VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – CO ₂ , NO ₂ , CO ₃ ²⁻ , NO ₃ ⁻ ; limitations of VBT; MO theory - bonding, antibonding and nonbonding orbitals, bond order; MO diagrams of , O ₂ , O ₂ ⁺ , O ₂ ⁻ , , NO, HF, CO; magnetic characteristics, comparison of VB and MO theories. Coordinate bond: Definition, Formation of BF ₃ , NH ₃ , NH ₄ ⁺ , H ₃ O ⁺ properties Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors.											

Unit-V	Basic concepts in Organic Chemistry and Electronic effects	15 Hrs.
<p>Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates; types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductomeric and electromeric effects.</p> <p>Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines. Hyperconjugation - stability of alkenes, bond length, orienting effect of methyl group, dipole moment of aldehydes and nitromethane. Types of organic reactions- addition, substitution, elimination and rearrangements (Basics Only).</p>		

Text Book(s):

1. Madan, R.D.; Sathya Prakash, *Modern Inorganic Chemistry*, 2nd ed., S. Chand and Company, New Delhi, 2003, ISBN 10: 8121900743, ISBN 13: 978-8121900744
2. Rao, C.N.R., *University General Chemistry*, Macmillan Publication, 2000, ISBN 10: 0333900138, ISBN 13: 978-0333900130
3. Puri, B.R.; Sharma, L.R., *Principles of Physical Chemistry*, 38th ed., Vishal Publishing Company, 2002, ISBN 10: 9382956786, ISBN 13: 978-9382956785
4. **Bruce, P.Y.; Prasad, K.J.R., *Essential Organic Chemistry*, Pearson Education, 2008, ISBN 13: 978-8131703731**
5. **Dash, U.N.; Dharmarha, O.P.; Soni, P.L., *Text Book of Physical Chemistry*, Sultan Chand & Sons, 2016, ISBN 13: 978-8195104321**

Reference Book(s):

1. **Madan, R.D.; Sathya Prakash, *Modern Inorganic Chemistry*, 2nd edition, S. Chand and Company, 2003, ISBN: 978-8121900744**
2. **Rao, C.N.R., *University General Chemistry*, Macmillan Publication, 2000, ISBN: 978-0333900130**
3. **Puri, B.R.; Sharma, L.R., *Principles of Physical Chemistry*, 38th edition, Vishal Publishing Company, 2002, ISBN: 978-9382956785**
4. **Bruce, P.Y.; Prasad, K.J.R., *Essential Organic Chemistry*, Pearson Education, 2008, ISBN: 978-8131703731**
5. **Dash, U.N.; Dharmarha, O.P.; Soni, P.L., *Text Book of Physical Chemistry*, Sultan Chand & Sons, 2016, ISBN: 978-8195104321**

Web Resources:

1. <https://onlinecourses.nptel.ac.in>
2. http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm
3. http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html
4. <https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding>
5. <https://www.chemtube3d.com/>

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1	1	1	1	3	2	1	1	1
CO2	3	2	2	1	1	1	1	1	3	2	1	1	1
CO3	3	3	2	2	1	1	2	1	3	3	2	2	1
CO4	3	3	3	2	1	1	2	1	3	3	2	2	1
CO5	2	3	3	2	2	2	3	2	2	3	3	2	2
Overall CO – PO Mapping index = 2.4									Overall CO – PSO Mapping index = 2.2				

1 – Low Correlation

2 – Medium Correlation

3 – High Correlation

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HoD

Sem.	Course Code	Credits	Title of the Course	AC/ AP / CC / CP / DE/ ES / GS / NME/ PW / VAC/ VE / SE / SS	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25UCH1CP1	3	Quantitative Inorganic Estimation Practical	CP	-	-	3	3 Hrs.	40	60	100
Pre-Requisite:											
Course Objectives: The purpose of learning this course is:											
1. To create awareness about chemical laboratory safety and risk management.											
2. To familiarize students with common laboratory apparatus and their correct use.											
3. To understand fundamental principles of volumetric quantitative estimation.											
4. To perform standard titrations in permanganometry, dichrometry, and iodometry.											
5. To apply complexometric and other estimation techniques for analyzing real samples.											
Course Outcomes:											
CO1: Demonstrate knowledge of laboratory safety practices, PPE usage, and emergency procedures.											
CO2: Identify and correctly handle common volumetric analysis apparatus.											
CO3: Explain concepts of mole, molarity, normality, and equivalent weight in quantitative analysis.											
CO4: Perform standard volumetric estimations using permanganometry, dichrometry, and iodometry methods.											
CO5: Apply complexometric and other titration techniques to estimate ions and compounds in practical samples.											
Unit-I											
Chemical Laboratory Safety in Academic Institutions											
Introduction - importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards; concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system; fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal.											
Common Apparatus Used in Quantitative Estimation (Volumetric)											
Description and use of burette, pipette, standard flask, measuring cylinder, conical flask, beaker, funnel, dropper, clamp, stand, wash bottle, watch glass, wire gauge and tripod stand.											
Principle of Quantitative Estimation (Volumetric)											
Equivalent weight of an acid, base, salt, reducing agent, oxidizing agent; concept of mole, molality, molarity, normality; primary and secondary standards, preparation of standard solutions; theories of acid-base, redox, complexometric, iodimetric and iodometric titrations; indicators – types, theory of acid-base, redox, metal ion and adsorption indicators, choice of indicators.											
Unit-II											
Quantitative Estimation(Volumetric): Preparation of standard solution, dilution from stock solution											
Permanganometry: Estimation of sodium oxalate using standard ferrous ammonium sulphate											
Dichrometry: Estimation of ferric alum using standard dichromate (external indicator) Estimation of ferric alum using standard dichromate (internal indicator)											
Iodometry: Estimation of copper in copper sulphate using standard dichromate											
Unit-III											
Complexometry: Estimation of hardness of water using EDTA											
Estimations: Estimation of iron in iron tablets Estimation of ascorbic acid.											
Text Book(s):											
1. Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R., <i>Basic Principles of Practical Chemistry</i> , 2nd ed., Sultan Chand & Sons, New Delhi, 1997, ISBN-10: 81-8054-776-8, ISBN-13: 978-8180547768											
2. Nad, A.K.; Mahapatra, B.; Ghoshal, A., <i>An Advanced Course in Practical Chemistry</i> , 3rd ed., New Central Book Agency, Kolkata, 2007, ISBN-10: 8173813027, ISBN-13: 978-8173813023											
Reference Book(s):											
1. Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.; Sivasankar, B., <i>Vogel's Textbook of Quantitative Chemical Analysis</i> , 6th ed., Pearson Education Ltd (Prentice Hall), 2000, ISBN-10: 0582226287, ISBN-13: 978-0582226289											

Web Resources:

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis>
2. <https://chemdictionary.org/titration-indicator/>

SCHEME OF VALUATION	
CRITERIA	MARKS
Record	5
Tabulation	10
Procedure writing	10
RESULTS	
< 1 %	35
1-2%	30
2-3%	25
3-4%	15
>4%	10

Relationship Matrix for COs, POs and PSOs

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1	1	1	1	3	2	1	1	1
CO2	3	2	2	1	1	1	1	1	3	2	1	1	1
CO3	3	3	2	2	1	1	2	1	3	3	2	2	1
CO4	3	3	3	2	1	1	2	1	3	3	2	2	1
CO5	2	3	3	2	2	2	3	2	2	3	3	2	2
Overall CO – PO Mapping index = 2.0									Overall CO – PSO Mapping index = 2.4				

1 – Low Correlation

2 – Medium Correlation

3 – High Correlation

Prepared by

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Sem.	Course Code	Credits	Title of the Course	AC/ AP / CC / CP / DE / ES / GS / NME / PW / VAC / VE / SE / SS	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25UCH2CC2	5	General Chemistry-II	CC	4	1	-	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. To understand acid-base equilibria, buffer systems, and solubility principles.
2. To study the chemistry of s-block elements and selected p-block groups with focus on structure and reactivity.
3. To explain the properties, compounds, and trends of p-block elements from Group 15–18, halogens, and noble gases.
4. To learn the preparation, reactions, and mechanisms of alkenes, alkadienes, and alkynes.
5. To explore aromatic hydrocarbons, their substitution reactions, and polynuclear aromatic compounds.

Course Outcomes:

CO1: Describe acid-base concepts, ionic equilibria, buffer action, and solve related numerical problems.

CO2: Explain the comparative chemistry of s-block elements and basic compounds of p-block elements

CO3: Discuss the general properties and important compounds of Groups 15–18, halogens, and noble gases.

CO4: Analyze preparation methods, reaction mechanisms, and polymerisation of alkenes, dienes, and alkynes.

CO5: Interpret the structure, aromaticity, and substitution reactions of benzene and polynuclear aromatic hydrocarbons.

Unit-I Acids, bases and Ionic equilibria 12 Hrs.

Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; dissociation of poly basic acids, ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators; Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis - salts of weak acids and strong bases, weak bases and strong acids, weak acids and weak bases - hydrolysis constant, degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis; Solubility product - determination and applications; numerical problems involving the core concepts.

Unit-II a. Chemistry of s - Block Elements 12 Hrs.

Hydrogen: Position of hydrogen in the periodic table. Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Preparation, properties and uses of NaOH, Na₂CO₃, KBr, KClO₃ alkaline earth metals. Anomalous behaviour of Be.

b. Chemistry of p- Block Elements (Group 13 & 14)

preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Alloys of Al comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses. Percarbonates, per monocarbonates and per dicarbonates.

Unit-III Chemistry of p- Block Elements (Group 15-18) 12 Hrs.

General characteristics of elements of Group 15; chemistry of H₂N-NH₂, NH₂OH, HN₃ and HNO₃. Chemistry of PH₃, PCl₃, PCl₅, POCl₃, P₂O₅ and oxy acids of phosphorous (H₃PO₃ and H₃PO₄). General properties of elements of group 16 - Structure and allotropy of elements - chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur (Caro's and Marshall's acids).

Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogen acids (HF, HCl, HBr and HI), oxides and oxy acids (HClO₄). Inter-halogen compounds (ICl, ClF₃, BrF₅ and IF₇), pseudo halogens [(CN)₂ and (SCN)₂] and basic nature of Iodine. Noble gases: Position in the periodic table. Preparation, properties and structure of XeF₂, XeF₄, XeF₆ and XeOF₄; uses of noble gases - clathrate compounds.

Unit-IV Hydrocarbon Chemistry-I 12 Hrs.

Petroproducts: Fractional distillation of petroleum; cracking, isomerisation, alkylation, reforming and uses
Alkenes-Nomenclature, general methods of preparation – Mechanism of β - elimination reactions – E1 and E2 mechanism - factors influencing – stereochemistry – orientation – Hofmann and Saytzeff rules.
 Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule.

Alkadienes

Nomenclature - classification – isolated, conjugated and cumulated dienes; stability of conjugated dienes; mechanism of electrophilic addition to conjugated dienes - 1, 2 and 1, 4 additions; free radical addition to conjugated dienes– Diels–Alder reactions – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanisation, polychloroprene.

Alkynes

Nomenclature; general methods of preparation, properties and reactions; acidic nature of terminal alkynes and acetylene, polymerisation and isomerisation.

Unit-V	Hydrocarbon Chemistry - II	12 Hrs.
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Benzene: Source, structure of benzene, stability of benzene ring, molecular orbital picture of benzene, aromaticity, Huckel's (4n+2) rule and its applications. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity.

Polynuclear Aromatic hydrocarbons: Naphthalene – nomenclature, Haworth synthesis; physical properties, reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & alkylation, preferential substitution at α - position – reduction, oxidation – uses.

Text Book(s):

1. Madan, R.D.; Sathya Prakash, Modern Inorganic Chemistry, 2nd ed., S. Chand and Company, New Delhi, 2003, ISBN-10: 8121900743, ISBN-13: 978-8121900744
2. **Sathya Prakash; Tuli, G.D.; Basu, S.K.; Madan, R.D., Advanced Inorganic Chemistry**, 17th ed., S. Chand and Company, New Delhi, 2003, **ISBN-10: 9355010990, ISBN-13: 978-9355010995**
3. **Bahl, B.S.; Bhal, A., Advanced Organic Chemistry**, 3rd ed., S. Chand and Company, New Delhi, 2003, **ISBN-10: 8121901163, ISBN-13: 978-8121901161**
4. **Tewari, K.S.; Mehrothra, S.N.; Vishnoi, N.K., Text Book of Organic Chemistry**, 2nd ed., Vikas Publishing House, New Delhi, 1998, **ISBN-10: 8125900572, ISBN-13: 978-8125900575**
5. **Puri, B.R.; Sharma, L.R., Principles of Physical Chemistry**, 38th ed., Vishal Publishing Company, Jalandhar, 2002, **ISBN-10: 9382956786, ISBN-13: 978-9382956785**

Reference Book(s):

1. **Maron, S.H.; Prutton, C.P., Principles of Physical Chemistry**, 4th ed., Collier Macmillan Ltd (Macmillan Co.), New York, 1972, **ISBN-10: 0023762306, ISBN-13: 978-0023762307**
2. **Barrow, G.M., Physical Chemistry**, 5th ed., Tata McGraw Hill, New Delhi, 1992, **ISBN-10: 0070051119, ISBN-13: 978-0070051119**
3. **Lee, J.D., Concise Inorganic Chemistry**, 4th ed., Chapman & Hall/ELBS William Heinemann, London, 1991, **ISBN-10: 0-412-40290-4, ISBN-13: 978-0-412-40290-4**
4. **Huheey, J.E., Inorganic Chemistry: Principles of Structure and Reactivity**, 4th ed., Addison Wesley (Dorling Kindersley India), India, 1993, **ISBN-10: 006042995X, ISBN-13: 978-0060429959**
5. **Agarwal, O.P., Reactions and Reagents in Organic Chemistry**, 8th ed., Goel Publishing House, Meerut, 1995, **ISBN-10: 8187224657, ISBN-13: 978-8187224655**

Web Resources:

1. <https://onlinecourses.nptel.ac.in>
2. http://cactus.dixie.edu/sblack/chem1010/lecture_notes/4B.html
3. <http://www.auburn.edu/~deruija/pdareson.pdf><https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding>
4. <http://nptel.ac.in/courses/104101090/>
5. <http://nptel.ac.in/courses/104101090>

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	1	1	1	1	1	3	3	1	1	1
CO2	3	2	2	1	1	1	1	1	3	3	1	1	1
CO3	3	2	3	1	1	1	1	1	3	3	2	1	1
CO4	3	3	3	2	2	1	2	1	3	3	3	2	2
CO5	3	3	3	2	2	2	3	1	3	3	3	2	2
Overall CO – PO Mapping index = 2.1									Overall CO – PSO Mapping index = 2.3				

1 – Low Correlation

2 – Medium Correlation

3 – High Correlation

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			m. Exam	Max. Marks		
					Theo. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25UCH2CP2	3	Qualitative Organic Analysis Practical	CC	-	-	3	3 Hrs.	40	60	100
Pre-Requisite:											
Course Objectives: The purpose of learning this course is:											
1. To understand basic safety rules, symbols, and first aid in a chemistry laboratory.											
2. To become familiar with the parts and operation of a Bunsen burner and laboratory glassware.											
3. To perform preliminary examinations and detect special elements in organic compounds.											
4. To distinguish between aromatic/aliphatic and saturated/unsaturated compounds.											
5. To identify and confirm various organic functional groups and prepare derivatives.											
Course Outcomes:											
CO1: Apply safety rules, recognize safety symbols, and respond with proper first aid in the laboratory.											
CO2: Operate a Bunsen burner correctly and handle common laboratory glassware appropriately.											
CO3: Perform tests to detect nitrogen, sulphur, and halogens in organic compounds.											
CO4: Differentiate aromatic/aliphatic compounds and test for saturation and unsaturation.											
CO5: Identify functional groups through solubility and confirmatory tests and prepare suitable derivatives.											
Unit-I											
Safety rules, symbols and first-aid in chemistry laboratory Basic ideas about Bunsen burner, its operation and parts of the flame. Chemistry laboratory glassware –basis information and uses.											
Unit-II											
Qualitative Organic Analysis Preliminary examination, detection of special elements - nitrogen, sulphur and halogens Aromatic and aliphatic nature, Test for saturation and unsaturation, identification of functional groups using solubility tests Confirmation of functional groups i. monocarboxylic acid, dicarboxylic acid ii. monohydric phenol, polyhydric phenol iii. aldehyde, ketone, ester iv. carbohydrate (reducing and non-reducing sugars) v. primary, secondary, tertiary amine vi. monoamide, diamide, thioamide vii. anilide, nitro compound viii. Preparation of derivatives for functional groups											
Text Book(s): 1. Vogel, A.I., <i>Practical Organic Chemistry</i> , 5th Edition, Pearson Education, ISBN: 9788131720780.											
Reference Book(s): 1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R. , <i>Basic Principles of Practical Chemistry</i> , 2nd ed., Sultan Chand & Sons, New Delhi, 2012 — ISBN-10: 8180547760, ISBN-13: 978-8180547768 2. Manna, A.K. , <i>Practical Organic Chemistry</i> , Books and Allied, India, 2018 — ISBN-13: 978-93-84294-12-0 3. Gurtu, J.N.; Kapoor, R. , <i>Advanced Experimental Chemistry (Organic)</i> , Sultan Chand, New Delhi, 1987 4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R., <i>Vogel's Textbook of Practical Organic Chemistry</i> , 5th ed., Pearson India, 2003 — ISBN-10: 8177589571, ISBN-13: 978-8177589573											
Web Resources: 1. https://www.vlab.co.in/broad-area-chemical-sciences											

Scheme of valuation			
Criteria	Marks		
Record	5		
Procedure writing	5		
Physical constant	5		
Organic preparation	10		
Organic analysis	{15}	Gravimetry{20}	
Aliphatic/aromatic	2	error	Marks
Saturated/unsaturated	2		
Element test	4	< 1 %	20
Functional group	4	1-2%	15
Derivative	3	2-3%	10
		>3%	5

1 – Low Correlation

2 – Medium Correlation

3 – High Correlation

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE SE / GS / EVS VE / VAC	Category			m. Exam	Max. Marks		
					Theo. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25UCH2NME1	2	Qualitative Organic Analysis Practical	SE	2	-	-	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. To understand the composition, physical properties, and factors affecting the quality of milk.
2. To learn the microbiology, processing methods, and preservation techniques for milk.
3. To gain knowledge of major milk products and their chemical properties, production, and quality control.
4. To study the characteristics and preparation methods of special milk varieties.
5. To explore the production and significance of fermented and other dairy products, including ice cream, milk powder, and whey products.

Course Outcomes:

CO1: Describe the general composition, physical properties, and quality factors of milk.

CO2: Explain the microbiological aspects, processing methods, and storage of milk.

CO3: Analyze the production processes, chemical aspects, and quality standards of major milk products like cream, butter, and ghee.

CO4: Discuss the types, processing, and nutritional aspects of special milk products.

CO5: Identify various fermented and other dairy products, their production methods, and applications.

Unit-I | Composition of Milk

6 Hrs.

Milk-definition-general composition of milk- constituents of milk - lipids, proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity - Factors affecting the composition of milk - adulterants, preservatives with neutralizer-examples and their detection- estimation of fat, acidity and total solids in milk - **role of enzymes in milk - casein micelle structure - milk spoilage and shelf life.**

Unit-II | Processing of Milk

6 Hrs.

Microbiology of milk - destruction of micro - organisms in milk, physico – chemical changes taking place in milk due to processing - boiling, pasteurization – types of pasteurization - Bottle, Batch and HTST (High Temperature Short Time) – Vacuum pasteurization – Ultra High Temperature Pasteurization - **membrane processing (ultrafiltration, reverse osmosis) - sterilization methods - packaging and storage of processed milk.**

Unit-III | Major Milk Products

6 Hrs.

Cream - definition - composition - chemistry of creaming process - gravitational and centrifugal methods of separation of cream - estimation of fat in cream. Butter - definition -composition - theory of churning – desi butter - salted butter, estimation of acidity and moisture content in butter. Ghee - major constituents - common adulterants added to ghee and their detection - rancidity - definition - prevention - antioxidants and synergists - natural and synthetic - **clarified butter - by-products from butter making - quality standards of ghee and butter.**

Unit-IV | Special Milk

6 Hrs.

Standardised milk - definition - merits - reconstituted milk - definition - flow diagram of manufacture - Homogenised milk - flavoured milk – vitaminised milk - toned milk - Incitation milk - Vegetable toned milk - humanized milk - condensed milk - definition, composition and nutritive value - **evaporated milk - dried whole milk - fortified milk - milk based beverages.**

Unit-V | Fermented and other Milk Products

6 Hrs.

Fermented milk products – fermentation of milk - definition, conditions, cultured milk - definition of culture - example, conditions - cultured cream, butter milk - Bulgarian milk - acidophilus milk – Yoheer Indigenous products- khoa and chhena definition - Ice cream - definition - percentage composition - types - ingredients - manufacture of ice-cream, stabilizers emulsifiers and their role - milk powder - definition - need for making milk powder - drying process - types of drying - **yogurt and probiotic milk - cheese varieties and processing - whey and its utilization - lactose free dairy products.**

Text Book(s):

1. Bagavathi Sundari, K., *Applied Chemistry*, 1st ed., MJP Publishers, New Delhi, 2006, ISBN 10: 818094025X, ISBN 13: 9788180940255
2. Rangappa, K.S.; Acharya, K.T., *Indian Dairy Products*, Asia Publishing House, New Delhi, 1974, ISBN: (not available online)
3. Mathur, M.P.; Datta Roy, D.; Dinakar, P., *Text Book of Dairy Chemistry*, 1st ed., ICAR, New Delhi, 2008, ISBN 13: 9788171640461
4. Singh, Saurav, *A Text Book of Dairy Chemistry*, 1st ed., Daya Publishing House, 2013, ISBN 10: 9350843056, ISBN 13: 9789350843055
5. Choudhary, P.L., *Text Book of Dairy Chemistry*, Bio-Green Book Publishers, 2021, ISBN 13: 9789390438990

Reference Book(s):

1. Jenness, Robert; Patton, S., *Principles of Dairy Chemistry*, Medtech (reprint of Wiley), New York, 2005, ISBN 10: 9385998854, ISBN 13: 9789385998850
2. Wong, N.P.; Marth, E.H.; Keeney, M.; Jenness, R., *Fundamentals of Dairy Chemistry*, 3rd edition, Springer, Singapore, 2006 (originally published 1988), ISBN 10: 0442204892, ISBN 13: 9780442204891
3. De, Sukumar, *Outlines of Dairy Technology*, Oxford University Press, New Delhi, 1980, ISBN 10: 0195611942, ISBN 13: 9780195611946
4. Fox, P.F.; McSweeney, P.L.H., *Dairy Chemistry and Biochemistry*, Springer, 2nd edition, 2016, ISBN 10: 3319374362, ISBN 13: 9783319374369
5. Fox, P.F.; Uniacke-Lowe, T.; McSweeney, P.L.H.; O'Mahony, J.A., *Dairy Chemistry and Biochemistry*, Springer, 2nd edition, 2015, ISBN 10: 3319148915, ISBN 13: 9783319148915

Web Resources:

1. <https://dairyprocessinghandbook.tetrapak.com/chapter/chemistry-milk>
2. <https://link.springer.com/book/10.1007/978-3-319-14892-2>

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	1	1	1	1	1	3	3	1	1	1
CO2	3	2	2	1	1	1	1	1	3	3	1	1	1
CO3	3	2	3	1	1	1	1	1	3	3	2	1	1
CO4	3	3	3	2	2	1	2	1	3	3	3	2	2
CO5	3	3	3	2	2	2	3	1	3	3	3	2	2
Overall CO – PO Mapping index = 1.85									Overall CO – PSO Mapping index = 2.16				

1 – Low Correlation

2 – Medium Correlation

3 – High Correlation

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