B.Sc. Chemistry

Programme Code - UCH

(Aided & SF)

Revised I year syllabi for

2023-2026 batch

Programme outcome-PO (Aligned with Graduate Attributes)-Bachelor of Science (B.Sc.,)

Scientific Knowledge and Critical Thinking

Apply the knowledge of Life Science, Physical and Chemical Science, Mathematics, statistics, Computer science and humanities for the attainment of solutions to the problems that come across in our day-to-day life/activities.

Problem Solving

Identify and analyze the problem and formulate solutions for problems using the principles of mathematics, natural sciences with appropriate consideration for the public health, safety and environmental considerations.

Communication and Computer Literacy

Communicate the fundamental and advanced concepts of their discipline in written and oral form. Able to make appropriate and effective use of information and information technology relevant to their discipline

Life-Long Learning

Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Ethical, Social and Professional Understanding

Commitment to principles, codes of conduct and social responsibility in order to behave consistently with personal respect. Acquire the responsibility to contribute for the personal development and for the development of the community. Respect the ethical values, social responsibilities and diversity.

Innovative, Leadership and Entrepreneur Skill Development

Function as an individual, and as a member or leader in diverse teams and in multidisciplinary settings. Become an entrepreneur by acquiring technical, communicative, problem solving and intellectual skills.

DEPARTMENT OF CHEMISTRY

Vision : To train our students as scientifically literate professionals with a sense of social responsibilities.

Mission: (i)To make our students to understand the advancement of chemistry in all of its branches through education and research.

(ii) To provide students with community need based research and outreach opportunities.

(iii) To strive for an ideal balance between creation and knowledge dissemination in the Chemical sciences.

(iv) To train our students to succeed in this competitive world.

BACHELOR OF CHEMISTRY
(PROGRAMMING CODE: UCH)

Program Educational Objectives (PEOs)

The objectives of the B.Sc Chemistry programme is to prepare-equip the students.

PEO1	To pursue further studies and succeed in academic and research careers.
PEO2	To develop productive employees in chemical, petrochemical and allied industries.
PEO3	As all rounded professionals in terms of effective communication, skillful execution, good leadership qualities and teamwork.
PEO4	To provide solutions for societal issues such as environmental protection, occupational health and safety, resource management and appropriate business skills.
PEO5	To develop life-long learning skills and abilities.

Program Specific Outcomes (PSOs)

On the successful completion of B.Sc Chemistry program students will be able

PSO1	To get a firm foundation in the fundamentals and applications of chemical and scientific theories including environmental and biological Chemistry.
PSO2	To carry out scientific experiments with the help of laboratory and analytical instruments, as well as accurately record and analyze the results of such experiments.
PSO3	To develop skills in problem solving, critical thinking and analytical reasoning as applied to chemistry related problems.
PSO4	To find the solution for the ethical, historic, philosophical, economical and environmental dimensions of problems and issues facing chemists.-
PSO5	To pursue post graduate program in higher educational institutions and also to get suitable employment opportunities in industries and academic institutions.

THIAGARAJAR COLLEGE, MADURAI – 9
(Re-Accredited with 'A^{++}' Grade by NAAC)
DEPARTMENT OF CHEMISTRY
Bachelor of Science (B.Sc.,) (w.e.f. 2023-2024 Batch onwards)
Programme Code-UCH

Programme Scheme

SEMESTER –I

Course		Code No	Subject	Hrs/ Week	Cred.	Total Hrs	Max Mark CA	Max Marks SE	Total
Part - I	Tamil	U23P1TA11B	*பொதுத்தமிழ் - I*	6	3	90	25	75	100
Part - II	English	U23P2EN11	General English - I	4	3	60	25	75	100
Part - III	Core theory-1	UCH23CT11	General chemistry-I	5	5	75	25	75	100
	Core lab -1	UCH23CL11	Quantitative Inorganic estimation (titrimetry) and Inorganic Preparations	4	3	60	25	75	100
	Generic elective theory phyics	UPH23GT11C	Ancillary Physics-I	3	2	45	25	75	100
	Generic elective lab physics	UPH23GL21C	Ancillary Physics practical –I	2	-	30	-	-	-
Part – IV	NME-1	UCH23NT11	Role of chemistry in daily life	2	2	30	25	75	100
	AECC-1	UEN23AT11	Introduction to Personality Development	2	2	30	25	75	100
	Foundation course	UCH23FT11	Foundation course in chemistry	2	2	30	25	75	100
			TOTAL	**30**	**22**	450			

Semester – II

Course		Code No	Subject	Hrs/ Week	Cred.	Total Hrs	Max Mark CA	Max Marks SE	Total
Part - I	Tamil	U23P1TA21B	*பொதுத்தமிழ் - II*	6	3	90	25	75	100
Part - II	English	U23P2EN21	General English - II	4	3	60	25	75	100
Part - III	Core theory - 2	UCH23CT21	General chemistry - II	5	5	75	25	75	100
	Core lab -2	UCH23CL21	Qualitative Organic Analysis and preparation of Organic Compounds	4	3	60	25	75	100
	Generic elective theory Physics	UPH23GT21C	Ancillary Physics – II	3	2	45	25	75	100
	Generic elective Lab Physics	UPH23GL21C	Ancillary physics practical-I	2	2	30	25	75	100
Part – IV	NME-2	UCH23NT21	Dairy chemistry	2	2	30	25	75	100
	SEC-1	UCH23ST21	Cosmetics and personal grooming	2	2	30	25	75	100
	AECC- 2	UEN23AT21	Employability Skills	2	2	30	25	75	100
TOTAL				**30**	**24**	450			
Extra credit U23NM21		**Naan Mudhalvan Scheme** Language Proficiency for Employability			**2**				

Generic electives in Chemistry

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part III Generic electives	UCH23GT11M/ UCH23GT31P	Chemistry for Physical Sciences - I (For Mathematics & Physics)	3	2	45	25	75	100
	UCH23GT21M/ UCH23GT41P	Chemistry for Physical Sciences - II (For Mathematics & Physics)	3	2	45	25	75	100
	UCH23GT11Z/ UCH23GT31B	Chemistry for biological sciences-I (For Zoology and Botany)	3	2	45	25	75	100
	UCH23GT21Z/ UCH23GT41B	Chemistry for biological sciences-II (for zoology and botany students)	3	2	45	25	75	100
Generic elective practical	UCH23GL21M / UCH23GL21Z / UCH23GL41B/ UCH23GL41P (non-semester)	Chemistry Practical for physical and biological sciences (for Mathematics andZoology 1 year/I semester; For Botany and Physics II year/ III semester)	2	-	30	-	-	-
		Chemistry Practical for physical and biological sciences (for Mathematics andZoology 1 year/II semester; For Botany and Physics II year/ IV semester)	2	2	30	25	75	100

A) CONSOLIDATION OF CONTACT HOURS AND CREDITS: UG

Semester	Contact hours	Credits
I	30	22
II	30	24
III	30	22
IV	30	25
V	30	26
VI	30	21
Total	**180**	**140**

B)CURRICULUM CREDITS: PART WISE

Part I	Tamil	4 x 3	= 12 credits
Part II	English	4 x 3	= 12 credits
Part III	Core theory	5+5+5+5+4+4+4+3+3+4	= 42 credits
	Core lab	3+3+3+3+4+2	=18 credits
	Core elective	3+3+3+3	=12 credits
	Generic elective (Theory & lab)	2+2+2+3+3	=12 credits
Part IV	SEC	2+2+2+1+2+2+2	= 13 credits
	AECC	2+2+2+2	= 8 credits
	Foundation course	2	= 2 credits
	EVS	2	= 2 credits
	Value education	2	= 2 credits
	Internship / Industrial Visit / Field Visit	2	= 2 credits
	Professional competency skill	2	= 2 credits
Part V	Extension activity	1	= 1 credit
	Total		**= 140 credits**

AECC: Ability Enhancement Compulsory Course
SEC : Skill Enhancement Course

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Course Code	Course Title	Category	L	T	P	Credit
UCH23CT11	General chemistry-I	Core theory-1	4	1	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
I	I	25	75	100

Preamble

The course aims at giving an overall view of the

- Various atomic models and atomic structure
- Wave particle duality of matter
- Periodic table, periodicity in properties and its application in explaining the chemical behaviour
- Nature of chemical bonding, and
- Fundamental concepts of organic chemistry

Course Outcomes

On completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Explain the atomic structure, wave particle duality of matter, periodic properties bonding, and properties of compounds.	85	80
CO2	Classify the elements in the periodic table, types of bonds, reaction intermediates electronic effects in organic compounds, types of reagents.	82	80
CO3	Apply the theories of atomic structure, bonding, to calculate energy of a spectral transition, Δx, Δp electronegativity, percentage ionic character and bond order.	80	80
CO4	Evaluate the relationship existing between electronic configuration, bonding, geometry of molecules and reactions; structure reactivity and electronic effects.	85	83
CO5	Construct MO diagrams, predict trends in periodic properties, assess the properties of elements, and explain hybridization in molecules, nature of H – bonding and organic reaction mechanisms.	85	82

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	S	S
CO2	M	S	S	S	M	S
CO3	S	S	S	M	S	S
CO4	S	S	S	S	S	S
CO5	S	M	S	S	S	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	S	S	M	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	M	S	S	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Syllabus: General chemistry-I

Unit I: Atomic structure and Periodic trends **15 hrs**

History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom;The Franck-Hertz Experiment; Interpretation of Hspectrum; 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: Introduction to Quantum mechanics **15 hrs**

Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wavefunctions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ^2.

Modern Periodic Table

Cause of periodicity; features of the periodic table; classification of elements - Periodic trends for atomic size- Atomic radii, Ionic, crystal and Covalent radii; ionization energy, electron affinity, electronegativity-electronegativity scales, applications of electronegativity.

Problems involving the core concepts.

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 polarisation – 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 H_2, C_2, O_2, O_2^+, O^{2-}, O_2^{2-}, N_2, NO, HF, CO; magnetic characteristics, comparison of VB and MO theories.

Coordinate bond: Definition, Formation of BF_3, NH_3, NH_4^+, H_3O^+ properties.

Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors.

Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, special properties of water, ice, stability of DNA; Effects of chemical force, melting and boiling points.

Unit V: Basic concepts in Organic Chemistry and Electronic effects 15 hrs

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, carbenes, arynes and nitrynes.

Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductomeric and electromeric effects.

Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, bond lengths; steric inhibition to resonance.

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.

Text Books:

1. Madan, R. D. and Sathya Prakash, Modern Inorganic Chemistry, 2nd ed.; S. Chand and Company: New Delhi, 2003.
2. Rao, C.N. R. University General Chemistry, Macmillan Publication: New Delhi, 2000.
3. Puri, B. R. and Sharma, L. R. Principles of Physical Chemistry, 38th ed.; Vishal Publishing Company: Jalandhar, 2002.
4. Bruce, P. Y. and PrasadK. J. R. Essential Organic Chemistry, Pearson Education: New Delhi, 2008.
5. Dash UN, Dharmarha OP, Soni P.L. Textbook of Physical Chemistry, Sultan Chand & Sons: New Delhi, 2016.

References:

1. Maron, S. H. and Prutton C. P. Principles of Physical Chemistry, 4th ed.; The Macmillan Company: Newyork, 1972.
2. Lee, J. D. Concise Inorganic Chemistry, 4th ed.; ELBS William Heinemann: London, 1991.
3. Gurudeep Raj, Advanced Inorganic Chemistry, 26th ed.; Goel Publishing House: Meerut, 2001.
4. Atkins, P.W. & Paula, J. Physical Chemistry, 10th ed.; Oxford University Press: New York, 2014.
5. Huheey, J. E. Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed.; Addison, Wesley Publishing Company: India, 1993.

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 Designers:

Dr.A. Elangovan
Dr.D.S.Bhuvaneshwari
Dr.K.Selvakumar
Dr.S. Pitchaimuthu
Dr.N.Sudhan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
I	**Atomic structure and Periodic trends**	
1.1	History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom;The Franck-Hertz Experiment	4
1.2	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	4
1.3	Numerical problems involving the core concepts of Atomic structure and Periodic trends.	4
	Tutorial	3
2	**Introduction to Quantum mechanics**	
2.1	Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wavefunctions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and	5

	Ψ^2.	
2.2	**Modern Periodic Table** Cause of periodicity; Features of the periodic table; classification of elements - Periodic trends for atomic size- Atomic radii, Ionic, crystal and Covalent radii; ionization energy, electron affinity, electronegativity-electronegativity scales, applications of electronegativity.	5
2.3	Problems involving the core concepts of Quantum mechanics and periodicity.	2
	Tutorial	3
3	**Structure and bonding - I**	
3.1	**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 polarisation – polarising power and polarizability; Fajans' rules - effects of polarisation on properties of compounds;	5
3.2	**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	5
3.3	Problems involving the core concepts ionic and covalent bond. Numerical problems based on calculation of percentage ionic character.	2
	Tutorial	3
4	**Structure and bonding - II**	
4.1	VB theory – application to hydrogen molecule; concept of resonance -	4

	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 H_2, C_2, O_2, O_2^+, O^{2-}, O_2^{2-}, N_2, NO, HF, CO; magnetic characteristics, comparison of VB and MO theories.	
4.2	Coordinate bond: Definition, Formation of BF_3, NH_3, NH_4^+, H_3O^+ properties. Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors.	4
4.3	Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, special properties of water, ice, stability of DNA; Effects of chemical force, melting and boiling points.	4
	Tutorial	3
5	**Basic concepts in Organic Chemistry and Electronic effects**	
5.1	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, carbenes, arynes and nitrynes. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductomeric and electromeric effects.	4
5.2	Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, bond lengths; steric inhibition to resonance.	4
5.3	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.	4

	Tutorial	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Atomic structure and Periodic trends	15	BB/PPT
2	Introduction to Quantum mechanics Modern Periodic Table	15	BB/PPT
3	Structure and bonding - I	15	Chem Models/PPT
4	Structure and bonding - II	15	Chem Models/PPT
5	Basic concepts in Organic Chemistry and Electronic effects	15	BB/PPT
	Total	**75**	

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Course Code	Course Title	Category	L	T	P	Credit
UCH23CL11	Quantitative Inorganic Estimation (titrimetry) and Inorganic Preparations	Core lab 1	-	-	4	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	I	**25**	**75**	**100**

Preamble

The course aims at giving an overall view of the

- various atomic models and atomic structure
- wave particle duality of matter
- periodic table, periodicity in properties and its application in explaining the
- chemical behaviour nature of chemical bonding, and
- fundamental concepts of organic chemistry

Course Outcomes

On completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Explain the basic principles involved in titrimetric analysis and inorganic preparations.	85	80
CO2	Idendify the common apparatus used in volumetric analysis	90	90
CO3	Compare the methodologies of different titrimetric analysis.	80	78
CO4	Calculate the concentrations of unknown solutions in different ways and develop the skill and to estimate the amount of a substance present in a given solution.	80	75
CO5	Assess the yield of different inorganic preparations and identify the end point of various titrations.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	S	S
CO2	S	S	S	S	M	M
CO3	M	S	S	S	M	S

CO4	S	S	S	M	S	S
CO5	S	S	S	S	M	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S
CO4	S	S	M	S	S
CO5	S	S	S	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course title: Quantitative Inorganic Estimation (titrimetry) and Inorganic Preparations

Unit I: Chemical Laboratory Safety in Academic Institutions **12 hrs**

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.

Unit II: Principle of Quantitative Estimation (Volumetric) **12 hrs**

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 III: Quantitative Estimation (Volumetric) **12 hrs**

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

Argentimetry

Estimation of chloride in barium chloride using standard sodium chloride/

Estimation of chloride in sodium chloride (Volhard's method)

Unit IV **12 hrs**

Complexometry

Estimation of hardness of water using EDTA.

Estimations

Estimation of iron in iron tablets.

Estimation of ascorbic acid.

Unit V: Preparation of Inorganic compounds **12 hrs**

Potash alum

Tetraammine copper (II) sulphate

Hexamminecobalt (III) chloride

Mohr's Salt

Text Books:

1. Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R. Basic Principles of Practical Chemistry, 2nd ed.; Sultan Chand &Sons: New Delhi, 1997.

2. Nad, A. K.; Mahapatra, B.; Ghoshal, A.; An advanced course in Practical Chemistry, 3rd ed.; New Central Book Agency: Kolkata, 2007.

References:

1. Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; Vogel's Textbook of Quantitative Chemical Analysis, 6th ed.; Pearson Education Ltd: New Delhi, 2000.

Web Resources:

1. http://www.federica.unina.it/agraria/analytical-chemistry/volumetricanalysis
2. https://chemdictionary.org/titration-indicator/

Course Designers:

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Dr.D.S. Bhuvaneshwari
Dr.K. Selvakumar
Dr.S. Pitchaimuthu
Dr.N. Sudhan

Course Contents and lecture Schedule

Unit	Topic	Lecture/ Practical hrs.
1	**Chemical Laboratory Safety in Academic Institutions Introduction**	
1.1	Importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards	4
1.2	Concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system	3
1.3	Fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal.	3
1.4	**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.	2
2	**Principle of Quantitative Estimation (Volumetric)**	
2.1	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;	4
2.2	Theories of acid-base, redox, complexometric, iodimetric and iodometric titrations;	4

2.3	Indicators – types, theory of acid–base, redox, metal ion and adsorption indicators, choice of indicators.	4
3	**Quantitative Estimation(Volumetric)**	
3.1	Preparation of standard solution, dilution from stock solution	1
3.2	**Permanganometry** Estimation of sodium oxalate using standard ferrous ammonium sulphate	2
3.3	**Dichrometry (Any one)** Estimation of ferric alum using standard dichromate (external indicator) Estimation of ferric alum using standard dichromate (internal indicator)	4
3.4	**Iodometry (Any Two)** Estimation of copper in copper sulphate using standard dichromate	3
3.5	**Argentimetry** Estimation of chloride in barium chloride using standard sodium chloride/ Estimation of chloride in sodium chloride (Volhard's method)	3
4	**Complexometry and estimations**	
4.1	**Complexometry** Estimation of hardness of water using EDTA.	4
4.2	**Estimations (Any One)** Estimation of iron in iron tablets. Estimation of ascorbic acid.	6
5	**Preparation of Inorganic compounds (Any Two)**	
5.1	Potash alum Tetraammine copper (II) sulphate Hexamminecobalt (III) chloride Mohr's Salt	6
	Model Lab	4
	Viva	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Chemical Laboratory Safety in Academic Institutions	12	Demo
2	Principle of Quantitative Estimation (Volumetric)	12	BB, PPT

3	Quantitative Estimation(Volumetric)	13	Practical
4	Complexometry and estimations	10	Practical
5	Preparation of Inorganic compounds	6	Practical
	Model lab and viva-voce	7	
	Total	**60**	

Thiagarajar College (Autonomous), Madurai – 625 009

(Re-Accredited with A^{++} Grade by NAAC)

Department of Chemistry

(For those joined B.Sc., Chemistry on or after June 2023)

Programming Code: UCH

Course Code	Course title	Category	L	T	P	Credit
UCH23NT11	Role of chemistry in daily life	NME-1	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	I	25	75	100

Preamble

This course aims at providing an overall view of the

- Importance of Chemistry in everyday life
- Chemistry of building materials and food
- Chemistry of Drugs and pharmaceuticals

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Learn about the chemicals used in everyday life as well as air pollution and water pollution.	85	85
CO2	Get knowledge on building materials cement, ceramics, glass and plastics, polythene, PVC, bakelite, polyesters	85	80
CO3	Acquire information about Food and Nutrition. Carbohydrates, Proteins, Fats Also have an awareness about Cosmetics Tooth pastes, face powder, soaps and detergents	85	78
CO4	Discuss about the fertilizers like urea, NPK fertilizers and super phosphate. Fuel: classification solid, liquid and gaseous; nuclear fuel - examples and uses	90	85
CO5	Have an idea about the pharmaceutical drugs analgesics and antipyretics like paracetamol and aspirin and also about pigments and dyes and its applications.	85	80

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**

CO3	S	S	M	S	S
CO4	S	S	S	M	S
CO5	S	S	S	M	S

S-Strong; M-Medium; L-Low

Mapping of COs with POs (B.Sc)

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	M	S
CO2	S	S	S	S	M	S
CO3	S	S	S	M	M	S
CO4	S	S	S	S	M	S
CO5	S	M	S	S	M	S

Mapping of COs with POs (B.A)

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	S	S	S
CO2	S	S	M	S	S	S
CO3	S	S	M	M	S	S
CO4	S	S	M	M	S	S
CO5	S	S	M	M	S	S

Mapping of COs with POs (B.B.A)

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	M	M	S
CO2	S	S	S	M	M	S
CO3	S	S	S	M	M	S
CO4	S	S	S	M	M	S
CO5	S	S	S	M	M	S

Mapping of COs with POs (B.Com)

#	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	M	S	M	S
CO3	S	M	S	M	S
CO4	S	M	S	M	S

CO5	**S**	**M**	**S**	**M**	**S**

S – Strong, M – Medium, L – Low

Bloom's Taxonomy and assessment pattern

Bloom's Taxonomy	CA		End of Semester (%)
	First (%)	Second (%)	
Knowledge	40	40	40
Understand	40	40	40
Apply	20	20	20

Course title: Role of Chemistry in Daily Life

UNIT – I **6 hrs**

General survey of chemicals used in everyday life. Air - components and their importance; photosynthetic reaction, air pollution, green - house effect and the impact on our life style. Water - Sources of water, qualities of potable water, soft and hard water, methods of removal of hardness-water pollution.

UNIT – II **6 hrs**

Building materials - cement, ceramics, glass and refractories - definition, composition and application only. Plastics - polythene, PVC, bakelite, polyesters, melamine-formaldehyde resins - preparation and uses only.

UNIT – III **6 hrs**

Food and Nutrition - Carbohydrates, Proteins, Fats - definition and their importance as food constituents – balanced diet – Calories minerals and vitamins (sources and their physiological importance). Cosmetics – tooth paste, face powder, soaps and detergents, shampoos, nail polish, perfumes - general formulation and preparations - possible hazards of cosmetic use.

UNIT – IV **6 hrs**

Chemicals in food production – fertilizers - need, natural sources; urea, NPK fertilizers and super phosphate. Fuel – classification - solid, liquid and gaseous; nuclear fuel examples and uses.

UNIT – V **6 hrs**

Pharmaceutical drugs - analgesics and antipyretics - paracetamol and aspirin. Colour chemicals - pigments and dyes - examples and applications. Explosives - classification and examples.

Text Books

1. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010.
2. A textbook of pharmaceutical chemistry by Jayashree Ghosh, S Chand publishing, 2012.
3. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
4. B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, Sixteenth edition, 2014.
5. Introduction to forensic chemistry, Kelly M. Elkins, CRC Press Taylor & Francis Group, 2019.

6. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co.Publishers, second edition, 2006.

Reference Books

1. Randolph. Norris Shreve, Chemical Process Industries, McGraw-Hill, Texas, fourthedition, 1977.
2. W.A.Poucher, JosephA. Brink, Jr. Perfumes, Cosmetics and Soaps, Springer, 2000.
3. A.K.De, EnvironmentalChemistry, New Age International Public Co., 1990.

E-Resources

https://onlinecourses.swayam2.ac.in/cec20_ag10/preview
https://onlinecourses.nptel.ac.in/noc23_ag19/preview
http://chemistry-journal.org/dnload/Sunita-Bhargava/CHEMISTRY-JOURNAL-CHJV06I02P0192.pdf

Course Designers

1. Dr. D.S. Bhuvaneshwari
2. Dr. Selvakumar
3. Dr. M. Sathiya

Course contents and lecture schedule

Unit	TOPIC	No. of lecture hrs
	UNIT – I	
1.1	General survey of chemicals used in everyday life.	1
1.2	Air - components and their importance; photosynthetic reaction	1
1.3	Air pollution, green - house effect and the impact on our life style.	1
1.4	Water - Sources of water	1
1.5	Qualities of potable water, soft and hard water,	1
1.6	Methods of removal of hardness-water pollution.	1
	UNIT – II	
2.1	Building materials	1
2.2	Cement, ceramics, glass and refractories - definition, composition and application only.	2
2.3	Plastics - polythene, PVC, bakelite, polyesters, melamine-formaldehyde resins -preparation and uses only.	3
	UNIT – III	
3.1	Food and Nutrition	1
3.2	Carbohydrates, Proteins, Fats - definition and their importance as food constituents	1

3.3	Balanced diet - Calories minerals and vitamins (sources and their physiological importance).	1
3.4	Cosmetics – tooth paste, face powder, soaps and detergents, shampoos, nail polish, perfumes	1
3.5	General formulation and preparations	1
3.6	Possible hazards of cosmetic use.	1
	UNIT – IV	
4.1	Chemicals in food production	1
4.2	Fertilizers - need, natural sources; urea, NPK fertilizers and super phosphate.	2
4.3	Fuel – classification - solid, liquid and gaseous; nuclear fuel examples and uses.	3
	UNIT –V	
5.1	Pharmaceutical drugs	1
5.2	Analgesics and antipyretics - paracetamol and aspirin.	2
5.3	Colour chemicals - pigments and dyes - examples and applications.	2
5.4	Explosives - classification and examples	1

Thiagarajar College(Autonomous), Madurai – 625 009

(Re-Accredited with A^{++} Grade by NAAC)

Department of Chemistry

(For those joined B.Sc., Chemistry on or after June 2023)

Programming Code: UCH

Course Code	Course title	Category	L	T	P	Credit
UCH23FT11	Foundation course in Chemistry	Foundation Course	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	I	25	75	100

Preamble

This course aims at filling the gaps and enhances the foundation in chemistry subjects

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Learn Mathematical foundation for chemistry- error analysis and significant figures- graphs	85%	80%
CO2	Get updated in Mole concept and Stoichiometry	78%	75%
CO3	Know and solve problems in gas laws in gaseous state	80%	75%
CO4	Know the fundamental of organic chemistry -IUPAC naming, Isomerism and Hybridization	75%	72%
CO5	Know the fundamentals of Isomerism and Hybridization in organic compounds	78%	74%

Mapping of COs and POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**	**S**

Mapping of COs and PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Bloom's Taxonomy and assessment pattern

Bloom's Taxonomy	**CA**		**End of Semester (%)**
	First (%)	**Second (%)**	
Knowledge	40	40	40
Understand	40	40	40
Apply	20	20	20

Course title:Foundation Course in Chemistry

UNIT – I: Mathematical foundation for chemistry **6 hrs**

Identifying the types of functions used in chemistry equations and laws. Usage of Matrices, vector algebra, differential equations, integral equations in chemistry. Error analysis and Significant figures. Types of graphs.

UNIT – II: Mole Concept and Stoichiometry **6 hrs**

Classification of Matter – Laws of chemical combinations, Atoms, Molecules, Atomic Mass, Molecular mass, Equivalent Mass (Acids, bases and Salts)-Mole concept -Molecular Formula -Empirical formula -Various concentrations terms-simple problems

UNIT – III: Gas laws **6 hrs**

Equation of state, macroscopic variables used in Gaseous state and its various units (P, V, T) Inter conversion of various units of pressure and temperature. Boyles law, Charles law, Gay-Lussac Law, Avogadro law, Ideal gas equation, Daltons law of partial pressure and total pressure, Grahams law, Kinetic gas theory equation and simple problems related to all gas laws.

UNIT – IV: Foundation in Organic Chemistry **6 hrs**

Carbon-Anomalous behaviour of Carbon- Catenation-Classification of organic compounds-Homologous series- list of different Functional groups - IUPAC rules and IUPAC naming of various organic compounds.

UNIT – V: Isomerism and Hybridization in Organic Compounds **6 hrs**

Isomerism – Structural isomerism -Stereo isomerism. Writing the organic molecules in various projections- R/S notation. D/L and d/l Notation. Hybridization - Hybridization in Methane, Ethane, Ethene, Ethyne and Benzene.

Text Books

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Pathania ; Publisher, Vishal publishing Company, 2008
2. A Textbook of Organic Chemistry, 22e. Arun Bahl & B S Bahl. S. Chand Publishing, 2019.
3. Chemistry for JEE Main, Seema Saini, K.S. Saini, Cengage publishers, 2020.

Reference Books

1. The Pearson Guide to Physical chemistry, Atul Singh, Pearson Publisher, 2010.
2. Organic Chemistry, J. Clayden, N. Geeves, S. Warren, Oxford University Press, 2012.

E-Resources

1. **https://www.coursera.org/learn/intro-chemistry#about**

*2.**https://www.youtube.com/watch?v=AUIWJpfZdTc&list=PL18DF0AEFCD1784E9&index=3&pp=iAQB***

3. https://www.youtube.com/watch?v=Zrvfgfi0Zs&list=PL18DF0AEFCD1784E9&index=4

4. https://www.youtube.com/watch?v=u8UDvc0DcIw

Course Designers

1. Dr. M. Sathiya

Course contents and lecture schedule

Unit	Topic	No. of lecture hrs
1	**Mathematical foundation for chemistry**	
1.1	Identifying the types of functions used in chemistry equations and laws. and.	1
1.2	Usage of Matrices, vector algebra, differential equations, integral equations in chemistry.	2

1.3	Error analysis	1
1.4	Significant figures	1
1.5	Types of graphs.	1
2	**Mole Concept and Stoichiometry**	
2.1	Classification of Matter	1
2.2	Laws of chemical combinations	1
2.3	Atoms, Molecules, Atomic Mass, Molecular mass, Equivalent Mass (Acids, bases and Salts)	2
2.4	Mole concept -Molecular Formula -Empirical formula	1
2.5	Various concentrations terms -simple problems	1
3	**Gas laws**	
3.1	Equation of state, Macroscopic variables used in Gaseous state and its various units (P, V, T)	1
3.2	Inter conversion of various units of pressure and temperature.	1
3.3	Boyles law, Charles law, Gay-Lussac Law, Avogadro law, Ideal gas Equation	1
3.4	Daltons law of partial pressure and total pressure, Grahams law, Kinetic gas theory equation	2
3.5	simple problems related to all gas laws.	1
4	**Foundation in Organic Chemistry**	
4.1	Carbon-Anomalous behaviour of Carbon	1
4.2	Catenation-Classification of organic compounds	1
4.3	Homologous series- list of different Functional groups	1
4.4	IUPAC rules and IUPAC naming of various organic compounds.	3
5	**Isomerism and Hybridization in Organic Compounds**	
5.1	Isomerism – Structural isomerism	1
5.2	Stereo isomerism	1
5.3	Writing the organic molecules in various projections	1
5.4	R/S notation. D/L and d/l Notation.	1
5.5	Hybridization-Hybridization in Methane, Ethane, Ethene, Ethyne and Benzene	2

Teaching methods

Unit	Topic	No. of lecture hrs	Teaching Method
I	Mathematical foundation for chemistry	6	
II	Mole Concept and Stoichiometry	6	BB, PPT
III	Gas laws	6	BB, PPT
IV	Foundation in Organic Chemistry	6	BB, PPT
V	Isomerism and Hybridization in Organic Compounds	6	BB, Models, PPT
	Total	**30**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined B.Sc. Chemistry on or after June 2023)
Programme Code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23CT21	General chemistry – II	Core theory 2	4	1	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims at providing an overall view of the

- Chemistry of acids, bases and ionic equilibrium
- Properties of s-and p-block elements
- Chemistry of hydrocarbons
- Ppplications of acids and bases
- Compounds of main block elements and hydrocarbons

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Explain the concept of acids, bases and ionic equilibria; periodic properties of s and p block elements, preparation and properties of aliphatic and aromatic hydrocarbons	80	75
CO2	Discuss the periodic properties of sand p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids	85	83
CO3	Classify hydrocarbons, types of reactions, acids and bases, examine the properties and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons	80	75
CO4	Explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements	80	75
CO5	Assess the application of hard and soft acids indicators, buffers, compounds of s and p-block elements and hydrocarbons	80	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	S	S
CO2	M	S	S	S	M	S
CO3	S	S	S	M	S	S
CO4	S	S	S	S	S	S
CO5	S	M	S	S	S	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course title: General chemistry-II

Unit I: Acids, bases and Ionic equilibria **15 hrs**

Concepts of Acid sand Bases – Arrhenius concept, Bronsted-Lowry concept, Lewisconcept; 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 methylorange, titration curves – use of acid base indicators; Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hassel balch 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: Chemistry of s-Block Elements **15 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, Na_2CO_3, KBr, $KClO_3$, alkaline earth metals. Anomalous behavior of Be.

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. Per carbonates, per mono carbonates and per di carbonates.

Unit III:Chemistry of p-Block Elements (Group15-18) 15 hrs

General characteristics of elements of Group 15; chemistry of $H_2N\text{-}NH_2$, NH_2OH, HN_3 and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxy acids of phosphorous (H_3PO_3 and H_3PO_4).

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 –Oxyacids of sulphur (Caro's and Marshall's acids).

Chemistry of Halogens: General characteristics of halogen with reference to electronegativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogenacids (HF, HCl, HBr and HI), oxides and oxy acids ($HClO_4$). Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudohalogens [$(CN)_2$ and $(SCN)_2$] and basic nature of Iodine.

Noble gases: Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases – clathrate compounds.

Unit IV: Hydrocarbon Chemistry-I 15 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, Kharasch effect, oxidation reactions – hydroxylation, oxidative degradation, epoxidation, ozonolysis; polymerization.

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, polymerization and isomerisation.

Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations. Conformational analysis of cyclohexane, mono and disubstituted cyclohexanes. Geometrical isomerism in cyclohexanes.

Unit V: Hydrocarbon Chemistry-II **15 hrs**

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 o-position –reduction, oxidation – uses.

Anthracene – synthesis by Elbs reaction, Diels – Alder reaction and Haworth synthesis; physical properties; reactions - Diels-Alder reaction, preferential substitution at C-9 and C-10; uses.

Text Books:

1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd edn, S.Chand and Company, New Delhi.
2. Sathya Prakash, Tuli G D, Basu S K and Madan R D, (2003), Advanced Inorganic Chemistry, 17th ed., S.Chand and Company, New Delhi.
3. Bahl B S, Arul Bhal, (2003), Advanced Organic Chemistry, 3rd ed., S.Chand and Company, New Delhi.
4. Tewari K S, Mehrothra S N and Vishnoi N K, (1998), Text book of Organic Chemistry, 2nd ed., Vikas Publishing House, New Delhi.
5. Puri B R, Sharma L R, (2002), Principles of Physical Chemistry, 38th ed., Vishal Publishing Company, Jalandhar.

References:

1. Maron S H and Prutton C P, (1972), Principles of Physical Chemistry, 4th edn., The Macmillan Company, New york.
2. Barrow G M, (1992), Physical Chemistry, 5th edn., Tata McGraw Hill, New Delhi.
3. Lee J D, (1991), Concise Inorganic Chemistry, 4th ed., ELBS William Heinemann, London.
4. Huheey J E, (1993), Inorganic Chemistry: Principles of Structure and Reactivity, 4th edn. Addison Wesley Publishing Company, India.
5. Gurudeep Raj, (2001), Advanced Inorganic Chemistry Vol – I, 26th ed., Goel Publishing House, Meerut.
6. Agarwal O P, (1995), Reactions and Reagents in Organic Chemistry, 8th ed., Goel Publishing House,Meerut.

Web Resources:

1. https://onlinecourses.nptel.ac.inhttp://cactus.dixie.edu/smblack/chem1010/lecture_notes/4B.html
2. http://www.auburn.edu/~deruija/pdareson.pdfhttps://swayam.gov.in/course/64-atomic-structure-and-chemical-bondingMOOC components
3. http://nptel.ac.in/courses/104101090/Lecture 1: Classification of elements and periodic

properties
4. http://nptel.ac.in/courses/104101090/

Course Designers:

1. Dr. P. Prakash
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Dr. K. Venkatesh

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Acids, bases and Ionic equilibria**	
1.1	Concepts of Acid sand Bases – Arrhenius concept, Bronsted-Lowry concept, Lewisconcept; 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;	4
1.2	Acid base indicators, theory of acid base indicators – action of phenolphthalein and methylorange, titration curves – use of acid base indicators; Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hassel balch equation	4
1.3	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	4
	Tutorial	3
2	**Chemistry of s-Block Elements**	
2.1	**Chemistry of s-Block Elements** 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, Na_2CO_3, KBr, $KClO_3$, alkaline earth metals. Anomalous behavior of Be.	6
2.2	**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.	3

2.3	Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses. Per carbonates, per mono carbonates and per di carbonates.	3
	Tutorial	3
3	**Chemistry of p-Block Elements (Group15-18)**	
3.1	General characteristics of elements of Group 15; chemistry of H_2N-NH_2, NH_2OH, HN_3 and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxy acids of phosphorous (H_3PO_3 and H_3PO_4).	4
3.2	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 –Oxyacids of sulphur (Caro's and Marshall's acids).	3
3.3	Chemistry of Halogens: General characteristics of halogen with reference to electronegativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogenacids (HF, HCl, HBr and HI), oxides and oxy acids ($HClO_4$). Inter-halogen compounds (Icl, ClF_3, BrF_5 and IF_7), pseudohalogens [$(CN)_2$ and $(SCN)_2$] and basic nature of Iodine.	3
3.4	Noble gases: Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases – clathrate compounds.	2
	Tutorial	3
4	**Hydrocarbon Chemistry-I**	
4.1	**Hydrocarbon Chemistry-I** 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, Kharasch effect, oxidation reactions – hydroxylation, oxidative degradation, epoxidation, ozonolysis; polymerization.	4
4.2	**Alkadienes** Nomenclature – classification –isolated, conjugated and cumulated dienes; stability of conjugated dienes; mechanism of electrophilic	3

	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.	
4.3	**Alkynes** Nomenclature; general methods of preparation, properties and reactions; acidic nature of terminal alkynes and acetylene, polymerization and isomerisation.	2
4.4	**Cycloalkanes**: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations. Conformational analysis of cyclohexane, mono and disubstituted cyclohexanes. Geometrical isomerism in cyclohexanes.	3
	Tutorial	3
5	**Hydrocarbon Chemistry-II**	
5.1	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.	5
5.2	Polynuclear Aromatic hydrocarbons: Naphthalene – nomenclature, Haworth synthesis; physical properties, reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & alkylation, preferential substitution at o-position – reduction, oxidation – uses.	4
5.3	Anthracene – synthesis by Elbs reaction, Diels – Alder reaction and Haworth synthesis; physical properties; reactions - Diels-Alder reaction, preferential substitution at C-9 and C-10; uses.	3
	Turorial	3

Teaching methods

Unit	Topic	No. of lecture hrs	Teaching Method
I	Acids, bases and Ionic equilibria	15	BB, PPT
II	Chemistry of s-Block Elements	15	BB, PPT

III	Chemistry of p-Block Elements (Group15-18)	15	BB, PPT
IV	Hydrocarbon Chemistry-I	15	BB, PPT
V	Hydrocarbon Chemistry-II	15	BB, Models, PPT
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined B.Sc. Chemistry on or after June 2023)
Programme code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23CL21	Qualitative organic analysis and preparation of organic compounds	Core lab-2	-	-	4	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims at providing knowledge on

- Laboratory safety
- Handling glass wares
- Analysis of organic compounds
- Preparation of organic compounds

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Observe the physical state, odour, colour and solubility of the given organic compound.	85	85
CO2	Identify the presence of special elements and functional group in an unknown organic compound performing a systematic analysis.	85	83
CO3	Compare mono and dicarboxylic acids, primary, secondary and tertiary amines, mono and diamides, mono and polyhydric phenols, aldehyde and ketone, reducing and nonreducing sugars and explain the reactions behind it.	80	75
CO4	Exhibit a solid derivative with respect to the identified functional group.	80	75
CO5	Identify the suitable separation techniques for the organic compounds	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	S	S

CO2	M	S	S	S	S	M
CO3	S	S	S	M	S	S
CO4	S	S	S	S	S	S
CO5	S	S	S	S	S	S

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Syllabus: Qualitative organic analysis and preparation of organic compounds

Unit I: **12 hrs**

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 **12 hrs**

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

- monocarboxylic acid, dicarboxylic acid
- monohydric phenol, polyhydric phenol
- aldehyde, ketone, ester
- carbohydrate (reducing and non-reducing sugars)
- primary, secondary, tertiary amine
- monoamide, diamide, thioamide
- anilide, nitro compound
- Preparation of derivatives for functional groups

Unit III: Preparation of Organic Compounds **12 hrs**

i. Nitration - picric acid from Phenol
ii. Halogenation - p-bromo acetanilide from acetanilide
iii. Oxidation - benzoic acid from Benzaldehyde
iv. Microwave assisted reactions in water:
v. Methyl benzoate to Benzoic acid
vi. Salicylic acid from Methyl Salicylate
vii. Rearrangement - Benzil to Benzilic Acid
viii. Hydrolysis of benzamide to Benzoic Acid

Unit IV: Separation and Purification Techniques (Not for Examination) 12 hrs

1. Purificationof organic compounds by crystallization (from water / alcohol) and distillation
2. Determination of melting and boiling points of organic compounds.
3. Steam distillation - Extraction of essential oil from citrus fruits/eucalyptus leaves.

Unit V: 12 hrs

4. Chromatography (any one) (Group experiment)
   (i) Separation of amino acids by Paper Chromatography
   (ii)Thin Layer Chromatography - mixture of sugars / plant pigments/permanganate dichromate.
   (iii) Column Chromatography - extraction of carotene, chlorophyll and xanthophyll from leaves / separation of anthracene - anthracene picrate.
5. Electrophoresis – Separation of amino acids and proteins. (Demonstration)

6. Isolation of casein from milk/Determination of saponification value of oil or fat/Estimation of acetic acid from commercial vinegar. (Any one Group experiment) **(4,5 & 6–not for ESE)**

References:

1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R. Basic Principles of Practical Chemistry, 2nd ed.; Sultan Chand: New Delhi, 2012.
2. Manna, A.K. Practical Organic Chemistry, Books and Allied: India, 2018.
3. Gurtu, J. N; Kapoor, R. Advanced Experimental Chemistry (Organic), Sultan Chand: New Delhi, 1987.
4. Furniss,B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, 5th ed.; Pearson: India,1989.

Web Resources:

https://www.vlab.co.in/broad-area-chemical-sciences

Course Designers:

1. Dr. P. Prakash
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Dr. J. Thirupathy
5. Dr. K. Venkatesh

Unit	Topic	Lecture hrs.
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	**7**
II	Qualitative Organic Analysis	12
	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 • monocarboxylic acid, dicarboxylic acid • monohydric phenol, polyhydric phenol • aldehyde, ketone, ester • carbohydrate (reducing and non-reducing sugars) • primary, secondary, tertiary amine • monoamide, diamide, thioamide • anilide, nitro compound • Preparation of derivatives for functional groups	
III	Preparation of Organic Compounds	12
	i. Nitration - picric acid from Phenol ii. Halogenation - p-bromo acetanilide from acetanilide iii. Oxidation - benzoic acid from Benzaldehyde iv. Microwave assisted reactions in water: v. Methyl benzoate to Benzoic acid vi. Salicylic acid from Methyl Salicylate vii. Rearrangement - Benzil to Benzilic Acid viii. Hydrolysis of benzamide to Benzoic Acid	
IV	**Separation and Purification Techniques (Not for Examination)** 1. Purificationof organic compounds by crystallization (from water / alcohol) and distillation 2. Determination of melting and boiling points of organic compounds. 3. Steam distillation - Extraction of essential oil from citrus fruits/eucalyptus leaves.	12
V	4. Chromatography (any one) (Group experiment) (i) Separation of amino acids by Paper Chromatography (ii)Thin Layer Chromatography - mixture of sugars / plant	12

	pigments/permanganate dichromate. (iii) Column Chromatography - extraction of carotene, chlorophyll and xanthophyll from leaves / separation of anthracene - anthracene picrate. 5. Electrophoresis – Separation of amino acids and proteins. (Demonstration) **6.** Isolation of casein from milk/Determination of saponification value of oil or fat/Estimation of acetic acid from commercial vinegar. (Any one Group experiment) **(4,5 & 6–not for ESE)**	
	Model practical & viva voce	5

Thiagarajar College(Autonomous), Madurai – 625 009

(Re-Accredited with A^{++} Grade by NAAC)

Department of Chemistry

(For those joined B.Sc., Chemistry on or after June 2023)

Programming Code: UCH

Course Code	Course title	Category	L	T	P	Credit
UCH23NT21	Dairy chemistry	NME- 2	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	II	25	75	100

Preamble

This course aims at giving an overall view of chemistry of milk and milk products, processing of milk and preservation and formation of milk products.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Understand about general composition of milk – constituents and its physical properties.	85%	80%
CO2	Acquire knowledge about pasteurization of Milk and various types of pasteurization - Bottle, Batch and HTST Ultra High Temperature Pasteurization.	78%	75%
CO3	Learn about Cream and Butter their composition and how to estimate fat in cream and Ghee	80%	75%
CO4	Explain about Homogenized milk, flavoured milk, vitaminised milk and toned milk.	75%	72%
CO5	Get an idea about how to make milk powder and its drying process - types of drying process	78%	74%

Mapping of COs and PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**

CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Mapping of COs with POs (B.Sc)

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**	**S**

Mapping of COs with POs (B.A)

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**M**	**S**	**S**
CO2	**S**	**S**	**M**	**M**	**S**	**S**
CO3	**S**	**S**	**M**	**M**	**S**	**S**
CO4	**S**	**S**	**M**	**M**	**S**	**S**
CO5	**S**	**S**	**M**	**M**	**S**	**S**

Mapping of COs with POs (B.B.A)

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**S**	**M**	**S**
CO2	**S**	**S**	**M**	**S**	**M**	**S**
CO3	**S**	**S**	**M**	**S**	**M**	**S**

CO4	**S**	**S**	**M**	**S**	**M**	**S**
CO5	**S**	**S**	**M**	**S**	**M**	**S**

Mapping of COs with POs (B.Com)

#	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**

S – Strong, M – Medium, L – Low

Bloom's Taxonomy and assessment pattern

Bloom's Taxonomy	CA		End of Semester (%)
	First (%)	Second (%)	
Knowledge	40	40	40
Understand	40	40	40
Apply	20	20	20

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.

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.

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.

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**.**

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 - Bulgarious milk - acidophilous milk – Yoheer Indigeneous 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.

Text Books

1. K. Bagavathi Sundari, Applied Chemistry, MJP Publishers, first edition, 2006.
2. K. S. Rangappa and K.T. Acharya, Indian Dairy Products, Asia Publishing House New Delhi, 1974.
3. Text book of dairy chemistry, M.P. Mathur, D. Datta Roy, P. Dinakar, Indian Council of Agricultural Research, 1 st edition, 2008.
4. A Text book of dairy chemistry, Saurav Singh, Daya Publishing house, 1st edition, 2013.
5. Text book of dairy chemistry, P. L. Choudhary, Bio-Green book publishers, 2021.

Reference Books

1. Robert Jenness and S. Patom, Principles of Dairy Chemistry, S.Wiley, New York, 2005.
2. F.P.Wond, Fundamentals of Dairy Chemistry, Springer, Singapore, 2006.
3. Sukumar De, Outlines of Dairy Technology, Oxford University Press, New Delhi, 1980.
4. P.F.Fox and P.L.H. Mcsweeney, Dairy Chemistry and Biochemistry, Springer, Second edition, 2016.
5. Dairy chemistry and biochemistry, P. F. Fox, T. Uniacke-Lowe, P.L.H. McSweeney, J.A. O Mahony, Springer, Second edition, 2015.

Course Designers

1. Dr. M. Sathiya

Course contents and lecture schedule

	TOPIC	No. OF LECTURE Hrs
	UNIT – I **Composition of Milk**	
1.1	Milk- definition-general composition of milk.	1
1.2	Constituents of milk -lipids, proteins, carbohydrates, vitamins and minerals	1
1.3	Physical properties of milk -colour, odour, acidity, specific gravity, viscosity and conductivity	1
1.4	Factors affecting the composition of milk	1
1.5	Adulterants, preservatives with neutralizer examples and their detection	1
1.6	Estimation of fat, acidity and total solids in milk.	1
	UNIT – II **Processing of Milk**	
2.1	Microbiology of milk - destruction of microorganisms in milk	1
2.2	Physico-chemical changes taking place in milk due to processing	1
2.3	boiling, pasteurization	1
2.4	Types of pasteurization - Bottle, Batch and HTST (High Temperature Short Time)	2
2.5	Vacuum pasteurization – Ultra High Temperature Pasteurization.	1
	UNIT – III **Major Milk Products**	
3.1	Cream - definition - composition	1
3.2	Chemistry of creaming process -gravitational and centrifugal methods of separation of cream	1
3.3	Estimation of fat in cream	1
3.4	Butter - definition -composition - theory of churning – desi butter -salted butter, estimation of acidity and moisture content in butter.	1
3.5	Ghee – major constituents - common adulterants added to ghee and their detection	1
3.6	Rancidity - definition - prevention - antioxidants and synergists - natural and synthetic.	1
	UNIT – IV **Special Milk**	
4.1	Standardised milk - definition - merits	1
4.2	Reconstituted milk definition – flow diagram of manufacture	2
4.3	Homogenised milk - flavoured milk – vitaminised milk - toned milk - Incitation milk - Vegetable toned milk - humanized milk -condensed milk - definition, composition and nutritive value**.**	3

	UNIT –V Fermented and other Milk Products	
5.1	Fermented milk products – fermentation of milk - definition, conditions	1
5.2	Cultured milk - definition of culture - example, conditions - cultured cream, butter milk - Bulgarious milk -acidophilous milk	2
5.3	Yoheer Indigeneous products- khoa and chhena definition	1
5.4	Ice cream- definition-percentage, composition- types- ingredients- manufacture of ice–cream, stabilizers -Emulsifiers and their role	1
5.5	Milk powder-definition-need for making milk powder drying process- types of drying	1

Thiagarajar College (Autonomous), Madurai – 625 009

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Department of Chemistry

(For those joined B.Sc., Chemistry on or after June 2023)

Programming Code: UCH

Course Code	Course title	Category	L	T	P	Credit
UCH23ST21	Cosmetics and Personal Grooming	SEC- 1	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	II	25	75	100

Preamble

This course aims at familiarizing the students with formulations of various types of cosmetics and their significance, hair, skin and dental care, makeup preparations and personal grooming

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Know about the composition of various cosmetic products	75%	75%
CO2	Understand chemical aspects and applications of hair care and dental care and skin care products.	75%	75%
CO3	Understand chemical aspects and applications of perfumes and skin care products.	75%	75%
CO4	Understand the methods of beauty treatments their advantages and disadvantage	75%	75%
CO5	Understand the hazards of cosmetic products.	75%	75%

Mapping of COs and POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**	**S**

CO5	**S**	**S**	**M**	**S**	**S**	**S**

S-Strong; M-Medium; L-Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Bloom's Taxonomy and assessment pattern

Bloom's Taxonomy	CA		End of Semester (%)
	First (%)	Second (%)	
Knowledge	40	40	40
Understand	40	40	40
Apply	20	20	20

UNIT – I: Skin care **6 hrs**

Nutrition of the skin, skin care and cleansing of the skin; face powder – ingredients; creams and lotions – cleansing, moisturizing all purpose, shaving and sunscreen (formulation only); Gels – formulation and advantages; astringent and skin tonics – key ingredients, skin lightness, depilatories.

UNIT – II : Hair care **6 hrs**

Shampoos – types – powder, cream, liquid, gel – ingredients; conditioner –types – ingredients

Dental care

Tooth pastes – ingredients – mouth wash

UNIT – III:Make up **6 hrs**

Base – foundation – types – ingredients; lipstick, eyeliner, mascara, eye shadow, concealers, rouge.

UNIT – IV: Perfumes **6 hrs**

Classification - Natural – plant origin – parts of the plant used, chief constituents; animal origin – amber gries from whale, civetone from civet cat, musk from musk deer; synthetic – classification emphasizing characteristics –esters – alcohols – aldehydes – ketones

UNIT – V: Beauty treatments **6 hrs**

Facials - types – advantages – disadvantages; face masks – types; bleach - types – advantages– disadvantages; shaping the brows; eyelash tinting; perming– types; hair colouring and dyeing permanent waving – hair straightening; wax– types – waxing; pedicure, manicure - advantages – disadvantages.

Text Books

1. Thankamma Jacob, (1997) Foods, drugs and cometics – A consumer guide, Macmillan publication, London.

Reference Books

1. W.A.Poucher, Joseph A. Brink,Jr. Perfumes, Cosmetics and Soaps, Springer,2000.
2. Wilkinson J B E and Moore R J, (1997) Harry's cosmeticology, 7th ed., Chemical Publishers, London.
3. George Howard, (1987) Principles and practice of perfumes and cosmetics Stanley Therones, Chettenham

E-Resources

1. http://www.khake.com/page75.html
2. Net.foxsm/list/284

Course Designers

1. Dr. M. Sathiya

Course contents and lecture schedule

Unit	TOPIC	No. of lecturehrs
	Skin care	
1.1	Nutrition of the skin,	1
1.2	Skin care and cleansing of the skin	1
1.3	Face powder – ingredients	1
1.4	Creams and lotions – cleansing, moisturizing all purpose, shaving and sunscreen (formulation only);	1
1.5	Gels – formulation and advantages;	1
1.6	Astringent and skin tonics – key ingredients, skin lightness, depilatories.	1
	UNIT – II	
2.1	**Hair care :** Shampoos – types – powder, cream, liquid, gel –ingredients;	2
2.2	Hair conditioner –types – ingredients	2
2.3	**Dental care :**Tooth pastes – ingredients – mouth wash	2
	UNIT – III **Make up**	
3.1	Base – foundation – types – ingredients	3

3.2	Lipstick, eyeliner, mascara, eye shadow, concealers, rouge.	3
	UNIT – IV **Perfumes**	
4.1	Classification	1
4.2	Natural – plant origin – parts of the plant used, chief constituents;	1
4.3	Animal origin –amber gries from whale, civetone from civet cat, musk from musk deer;	2
4.4	Synthetic – classification emphasizing characteristics –esters – alcohols – aldehydes – ketones	2
	UNIT –V **Beauty treatments**	
5.1	Facials - types	1
5.2	Face masks – types; bleach - types – advantages– disadvantages;	1
5.3	Shaping the brows; eyelash tinting; perming– types	1
5.4	Advantages – disadvantages hair colouring and dyeing, –permanent waving – hair straightening;	1
5.5	Wax– types – waxing; pedicure, manicure - advantages – disadvantages.	2

GENERIC ELECTIVES

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Chemistry
(For those joined B.Sc. Mathematics/Physics with effect from 2023-2024 Batches onwards)
Programme Code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23GT11M/ UCH23GT31P	Chemistry for Physical Sciences - I (For Mathematics & Physics)	Elective-1 (Generic)	3	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I/II	I/III	25	75	100

Preamble

This course aims to provide knowledge on the

- Basics of atomic orbitals, chemical bonds, hybridization
- Concepts of thermodynamics and its applications.
- Concepts of nuclear chemistry
- Importance of chemical industries
- Qualitative and analytical methods.

Course Outcomes

On completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Gain in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications.	85	80
CO2	Evaluate the efficiencies and uses of various fuels and Fertilizers	90	85
CO3	Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions	85	80
CO4	Apply various thermodynamic principles, systems and phase rule	80	75
CO5	Explain various methods to identify an appropriate method for the separation of chemical components	80	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	L	**S**	L
CO2	**S**	S	M	S	**S**	S
CO3	**S**	**S**	M	S	S	L

CO4	**S**	**S**	M	L	M	S
CO5	**S**	**S**	M	S	M	S

S-Strong; M-Medium; L-Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	S	M	M	S	S
CO3	S	M	S	M	S
CO4	S	M	M	M	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

Blooms taxonomy: Assessment Pattern

Bloom's Taxonomy	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course title: Chemistry for Physical Sciences - I

Unit I: Chemical Bonding and Nuclear Chemistry 9 hrs

Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.

Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes – carbon dating, rock dating and medicinal applications.

Unit II: Industrial Chemistry 9 hrs

Fuels: Fuel gases- Natural gas, water gas, semi water gas, carbureted
water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required).
Silicones: Synthesis, properties and uses of silicones.
Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate

Unit III: Fundamental Concepts in Organic Chemistry 9 hrs

Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Electronic effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric-examples. Reaction mechanisms: Types of reactions–aromaticity (Huckel's rule)–aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation.
Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.

Unit IV: Thermodynamics and Phase Equilibria Thermodynamics 9 hrs

Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no derivation). Conditions for spontaneity in terms of entropy and Gibbs free energy. Relationship between Gibbs free energy and entropy.

Phase Equilibria: Phase rule - definition of terms in it. Applications of phase rule to water system. Two component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag).

Unit V: Analytical Chemistry 9 hrs

Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques – extraction, distillation and crystallization.

Chromatography: Principle and application of column, paper and thin layer chromatography.

Text Books:

1. V. Veeraiyan, Text book of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.
2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. S. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S. Chand and Company, New Delhi, twenty third editions, 2012.
4. P.L.Soni, H. M. Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007

References:

5. P. L. Soni, Mohan Katyal, Textbook of Inorganicchemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
6.B. R. Puri, L.R.Sharma, M.S.Pathania, Textbook Physical Chemistry; Vishal Publishing Co., New Delhi, forty forty seventh edition, 2018.
7. B.K. Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.

Web Resources:

1. https://chem.libretexts.org/Courses/Oregon_Institute_of_Technology/OIT%3A_CHE_201_-_General_Chemistry_I_(Anthony_and_Clark)/Unit_3%3A_Nuclei_Ions_and_Molecules/3.1%3A_Nuclear_Chemistry_and_Radioactive_Decay
2.https://chem.libretexts.org/Courses/University_of_Georgia/CHEM_3212/09%3A_Phase_Equilibria
3. https://www.youtube.com/watch?v=ikPPLiN4AAQ

Course Designers:

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Dr. R. Mahalakshmy
Dr. A. R. Ramesh
Dr. D.S.Bhuvaneshwari
Dr. K. Selvakumar
Dr.M. Sathiya

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Chemical Bonding and Nuclear Chemistry**	
1.1	Chemical Bonding: Molecular Orbital Theory	2
1.2	Bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.	2
1.3	Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers	1
1.4	Differences between chemical reactions and nuclear reactions - group displacement law.	1
1.5	Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy.	1
1.6	Applications of radioisotopes – carbon dating, rock dating and medicinal applications	2
2	**Industrial Chemistry**	
2.1	Fuels: Fuel gases- Natural gas, water gas, semi water gas, carbureted water gas,	2
2.2	Producer gas, CNG, LPG and oil gas (manufacturing details not required).	2
2.3	Silicones: Synthesis, properties and uses of silicones.	2
2.4	Fertilizers: Urea, ammonium sulphate	3
3	**Fundamental Concepts in Organic Chemistry**	

3.1	potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate	2
3.2	Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6.	1
3.3	Electronic effects: Inductive effect Consequences on Ka and Kb of organic acids and bases,	1
3.4	Electromeric, mesomeric, hyper conjugation and steric- examples.	2
3.5	Reaction mechanisms: Types of reactions–aromaticity (Huckel's rule)	1
3.6	aromatic electrophilic substitution; nitration, halogenation, Friedel- Craft's alkylation and acylation.	1
3.7	Heterocyclic compounds: Preparation, properties of pyrrole and Pyridine	1
4	**Thermodynamics and Phase Equilibria Thermodynamics**	
4.1	Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes.	2
4.2	Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine.	1
4.3	Entropy and its significance. Free energy change and its importance (no derivation).	1
4.3	Conditions for spontaneity in terms of entropy and Gibbs free energy. Relationship between Gibbs free energy and entropy.	1
4.4	Phase rule - definition of terms in it. Applications of phase rule to water system. Two component system	2
4.5	Reduced phase rule and its application to a simple eutectic system (Pb-Ag).	2
5	**Analytical Chemistry**	
5.1	Introduction to qualitative and quantitative analysis. Principles of volumetric analysis.	3
5.2	Separation and purification techniques – extraction, distillation and crystallization.	3
5.3	Chromatography: Principle and application of column, paper and thin layer chromatography.	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Chemical Bonding and Nuclear Chemistry	9	BP/PPT
2	Industrial Chemistry	9	BP/PPT
3	Fundamental Concepts in Organic Chemistry	9	BP/PPT

	Hybridization		
4	Thermodynamics and Phase Equilibria Thermodynamics	9	BP/PPT
5	Analytical Chemistry	9	BP/PPT
	Total	**45**	

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Chemistry
(For those joined B.Sc. Mathematics/Physics with effect from 2023-2024 batches onwards)
Programme Code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23GT21M / UCH23GT41P	Chemistry for Physical Sciences - II (For Mathematics & Physics)	Elective-2 (Generic)	3	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I/II	II/IV	25	75	100

Preamble

This course aims at providing knowledge on the

- Co-ordination Chemistry and Water Technology
- Carbohydrates and Amino acids
- Basics and applications of electrochemistry
- Basics and applications of kinetics and catalysis
- Various photochemical phenomenons

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water Technology	80	75
CO2	Explain the preparation and property of carbohydrate, amino acids and nucleic acids.	85	80
CO3	Explain the preparation and property of carbohydrate, amino acids and nucleic acids.	80	78
CO4	Identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.	80	75
CO5	Outline the various type of photochemical process.	80	78

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	**S**	L
CO2	**S**	S	M	S	**S**	S
CO3	**S**	**S**	M	S	S	M
CO4	**S**	**S**	M	S	M	S
CO5	**S**	**S**	M	S	M	S

S-Strong; M-Medium; L-Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	S	S	M	S	S
CO3	S	M	S	M	S
CO4	S	M	M	S	S
CO5	S	S	M	S	S

S-Strong; M-Medium; L-Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course title: Chemistry for Physical sciences - II

Unit I: Co-ordination Chemistry and Water Technology Co-ordination Chemistry 9 hrs

Definition of terms-IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[Co(CN)_6]^{3-}$ Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis.

Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques - BOD, COD.

Unit II:Carbohydrates and Amino acids Carbohydrates 9 hrs

Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose –fructose interconversion. Properties of starch and cellulose.

Amino acids: Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).

Unit-III: Electrochemistry 9 hrs

Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials - electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its

biological applications - electroplating - Nickel and chrome plating – Types of cells - fuel cells - corrosion and its prevention.

Unit IV: Kinetics and Catalysis **9 hrs**

Order and molecularity. Integrated rate expression for I and II (2A ⟨Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.

Unit V: **Photochemistry 9 hrs**

Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).

Text Books:

1. V. Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.
2. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. Arun Bahl, B.S. Bahl, Advanced Organic Chemistry; S. Chand and Company, New Delhi, twenty third edition, 2012.
4. P.L. Soni, H.M. Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.

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2. R. Puri, L.R. Sharma, M.S. Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018. 67
3. B.K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.

Web Resources:

1. https://byjus.com/jee/coordination-compounds/
2. https://www.khanacademy.org/science/ap-biology/chemistry-of-life/properties-structure-and-function-of-biological-macromolecules/v/introduction-to-amino-acids
3. https://www.youtube.com/watch?v=DC4J0t1z3e8

Course Designers:

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Dr. A. R. Ramesh
Dr. D.S.Bhuvaneshwari

Dr. K. Selvakumar
Dr.M. Sathiya

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Co-ordination Chemistry and Water Technology Co-ordination Chemistry**	
1.1	Definition of terms-IUPAC Nomenclature - Werner's theory - EAN Rule	2
1.2	Pauling's theory – Postulates - Applications to $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[Co(CN)_6]^{3-}$ Chelation	1
1.3	Biological role of Haemoglobin and Chlorophyll (elementary idea)	2
1.4	Applications in qualitative and quantitative analysis.	1
1.5	Water Technology: Hardness of water, determination of hardness of water using EDTA method	2
1.6	Zeolite method-Purification techniques- BOD, COD.	1
2	**Carbohydrates and Amino acids Carbohydrates**	
2.1	Classification, preparation and properties of glucose, fructose and sucrose.	2
2.2	Discussion of open chain ring structures of glucose and fructose. Glucose –fructose interconversion.	1
2.3	Properties of starch and cellulose. Amino acids: Classification	3
2.4	Preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).	3
3	**Electrochemistry**	
3.1	Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials -	2
3.2	Electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations	2
3.3	pH determination by colorimetric method- Buffer solutions and its biological applications	2
3.4	Electroplating - Nickel and chrome plating	1
3.5	Types of cells -fuel cells-corrosion and its prevention.	2
4	**Kinetics and Catalysis**	
4.1	Order and molecularity. Integrated rate expression for I and II (2A □ Products) order reactions.	2

4.2	Pseudo first order reaction, methods of determining order of a reaction – Half-life period	2
4.3	Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes.	2
4.4	Concept of energy of activation and Arrhenius equation.	3
5	**Photochemistry**	
5.1	Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield	3
5.2	Hydrogen-chloride reaction. Phosphorescence, fluorescence, Chemiluminescence	3
5.3	Photosensitization and photosynthesis (definition with examples).	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Co-ordination Chemistry and Water Technology Co-ordination Chemistry	9	BP/PPT
2	Carbohydrates and Amino acids Carbohydrates	9	BP/PPT
3	Electrochemistry	9	BP/PPT
4	Kinetic and catalysis	9	BP/PPT
5	Photochemistry	9	BP/PPT
Total		**45**	

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Department of Chemistry
(For those joined B.Sc. Zoology/Botany with effect from 2023-2024 batches onwards)
Programme Code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23GT11Z /UCH23GT31B	Chemistry for biological sciences-I (For Zoology and Botany)	Elective-1 (Generic)	3	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I/II	I/III	25	75	100

Preamble

This course aims at providing knowledge on

- Basics of atomic orbitals, chemical bonds, hybridization and fundamentals of organic chemistry
- Nuclear chemistry and industrial chemistry
- Importance of speciality drugs and
- Separation and purification

Course Outcomes

On completion of the course the students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	State the theories of chemical bonding, nuclear reactions and its applications.	80	75
CO2	Evaluate the efficiencies and uses of various fuels and fertilizers.	85	80
CO3	Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions	80	78
CO4	Demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.	80	75
CO5	Analyse various methods to identify an appropriate method for the separation of chemical components.	75	73

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**M**	**M**	**L**	**S**	**L**
CO2	**S**	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**L**	**S**	**S**	**L**

CO4	**S**	**S**	**M**	**L**	**M**	**S**
CO5	**S**	**S**	**M**	**S**	**M**	**S**

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**M**	**M**	**S**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**M**	**S**	**M**	**S**
CO4	**S**	**M**	**M**	**M**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Course title: Chemistry for biological sciences -I

Unit I:Chemical Bonding and Nuclear Chemistry 9 hrs

Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.

Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers- Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes – carbon dating, rock dating and medicinal applications.

Unit II:Industrial Chemistry 9 hrs

Fuels: Fuel gases- Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required).

Silicones: Synthesis, properties and uses of silicones.

Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate

Unit III:Fundamental Concepts in Organic Chemistry Hybridization: 9 hrs

Orbital overlap hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Polar effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric-examples and explanation.

Reaction mechanisms: Types of reactions- aromaticity-aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation.

Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.

Unit IV:Drugs and specialty Chemicals 9 hrs

Definition, structure and uses: Antibiotics viz., Penicillin, Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin, Aspartame and cyclamate; Organic Halogen compounds viz., Freon, Teflon.

Unit V:Analytical Chemistry 9 hrs

Introduction qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques: extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.

Text Books:

1. V. Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.
2. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. Arun Bahl, B.S. Bahl, Advanced Organic Chemistry; S. Chand and Company, New Delhi, twenty third edition, 2012.
4. P.L. Soni, H.M. Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.

References:

1. P.L. Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
2. R. Puri, L.R. Sharma, M.S. Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018. 67
3. Jayashree gosh, Fundamental Concepts of Applied Chemistry; Sultan & Chand, Edition 2006.

Web Resources:

1. https://chem.libretexts.org/Courses/Oregon_Institute_of_Technology/OIT%3A_CHE_201_-_General_Chemistry_I_(Anthony_and_Clark)/Unit_3%3A_Nuclei_Ions_and_Molecules/3.1%3A_Nuclear_Chemistry_and_Radioactive_Decay
2. https://chem.libretexts.org/Courses/University_of_Georgia/CHEM_3212/09%3A_Phase_Equilibria
3. https://www.youtube.com/watch?v=ikPPLiN4AAQ

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Dr. D.S.Bhuvaneshwari
Dr. K. Selvakumar
Dr.M. Sathiya

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Chemical Bonding and Nuclear Chemistry**	
1.1	Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals.	2
1.2	Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.	1
1.3	Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions	1
1.4	Group displacement law. Nuclear binding energy - mass defect - calculations.	1
1.5	Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes	2
1.6	Carbon dating, rock dating and medicinal applications.	2
2	**Industrial Chemistry**	
2.1	Fuels: Fuel gases- Natural gas, water gas, semi water gas,	2
2.2	Carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required).	2
2.3	Silicones: Synthesis, properties and uses of silicones.	1
2.4	Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK	2
2.5	Fertilizer, superphosphate, triple superphosphate	2
3	**Fundamental Concepts in Organic Chemistry**	
3.1	Orbital overlap hybridization and geometry of CH4, C2H4, C2H2 and C6H6.	2
3.2	Polar effects: Inductive effect -Consequences on Ka and Kb of organic acids and bases.	2
3.3	Electromeric, mesomeric, hyper conjugation- Steric effect-examples	1

	and explanation	
3.4	Types of reactions- aromaticity-aromatic electrophilic substitution;	2
3.5	Nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds	1
3.6	Preparation, properties of pyrrole and pyridine	1
4	**Drugs and Speciality Chemicals**	
4.1	Definition, structure and uses: Antibiotics viz., Penicillin	2
4.2	Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform and Ether	2
4.3	Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin, Aspartame and cyclamate	2
4.4	Organic Halogen compounds viz., Freon, Teflon.	3
5	**Analytical Chemistry**	
5.1	Introduction qualitative and quantitative analysis. Principles of volumetric analysis.	3
5.2	Separation and purification techniques: extraction, distillation and crystallization.	3
5.3	Chromatography: principle and application of column, paper and thin layer chromatography	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Chemical Bonding and Nuclear Chemistry	9	BP/PPT
2	Industrial Chemistry	9	BP/PPT
3	Fundamental Concepts in Organic Chemistry Hybridization	9	BP/PPT
4	Drugs and Speciality Chemicals	9	BP/PPT
5	Photochemistry	9	BP/PPT
Total		**45**	

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Programme Code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23GT21Z/ UCH23GT41B	Chemistry for biological sciences-II (for botany and zoology students)	Elective-2 (Generic)	3	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I/II	II/IV	25	75	100

Preamble

This course aims to provide knowledge on

- Nomenclature of coordination compounds and carbohydrates
- Amino Acids and Essential elements of biosystem
- Understand the concepts of kinetics and catalysis
- Provide fundamentals of electrochemistry and photochemistry

Course Outcomes

On completion of the course the students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology.	80	75
CO2	Explain the preparation and property of carbohydrate.	85	83
CO3	Enlighten the biological role of transition metals, amino acids and nucleic acids.	80	78
CO4	Apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.	75	73
CO5	Outline the various type of photochemical process	75	73

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	**S**	L
CO2	**S**	S	M	S	**S**	S

CO3	**S**	**S**	M	S	S	M
CO4	**S**	**S**	M	S	M	S
CO5	**S**	**S**	M	S	M	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	S	S	M	S	S
CO3	S	M	S	M	S
CO4	S	M	M	S	S
CO5	S	S	M	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course title: Chemistry for biological sciences - II

Unit I:**Co-ordination Chemistry and Water Technology: 9 hrs**

Definition of terms-IUPAC Nomenclature - Werner'stheory - EAN rule - Pauling's theory – Postulates - Applications to $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$,$[Co(CN)_6]^{3-}$ Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis.

Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques-BOD, COD.

Unit II:Carbohydrates 9 hrs

Classification, preparation and properties of glucose and fructose. Discussion of open chain ring

structures of glucose and fructose. Glucose-fructose interconversion. Preparation and properties of sucrose, starch and cellulose.

Unit III:Amino Acids **9 hrs**

Amino Acids and Essential elements of biosystem, Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method - Proteins- classification – structure - Colour reactions – Biological functions –nucleosides -nucleotides – RNA and DNA – structure. Essentials of trace metals in biological system-Na, Cu, K, Zn, Fe, Mg.

Unit IV:Electrochemistry **9 hrs**

Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials - electrochemical series. Strong and weak electrolytes - ionic product of water-pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells -fuel cells- corrosion and its prevention.

Unit V:Photochemistry9 hrs

Grothus - Drapper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen -chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).

Text Books:

1. V. Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.
2. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
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5. B. K.Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.

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3. https://www.youtube.com/watch?v=DC4J0t1z3e8
4. https://www.youtube.com/watch?v=NClagKbLUMM

Course Designers:

Dr. R. Sayeekannan
Dr. R. Mahalakshmy
Dr. A. R. Ramesh
Dr. D.S.Bhuvaneshwari
Dr. K. Selvakumar
Dr.M. Sathiya

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Co-ordination Chemistry and Water Technology**	
1.1	Definition of terms-IUPAC Nomenclature - Werner's theory	2
1.2	EAN rule - Pauling's theory – Postulates - Applications to [Ni(CO)4], $[Ni(CN)_4]^{2-}$, $[Co(CN)_6]^{3-}$ Chelation	2
1.3	Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis.	1
1.4	Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method	2
1.5	Purification techniques- BOD, COD.	2
2	**Carbohydrates**	
2.1	Classification, preparation and properties of glucose and fructose.	3
2.2	Discussion of open chain ring structures of glucose and fructose. Glucose-fructose interconversion.	3
2.3	Preparation and properties of sucrose, starch and cellulose.	3
3	**Amino acids**	
3.1	Amino Acids and Essential elements of biosystem Classification - preparation and properties of alanine,	3
3.2	Preparation of dipeptides using Bergmann method - Proteins-classification – structure - Colour reactions – Biological functions –	3

	nucleosides –nucleotides	
3.3	RNA and DNA – structure. Essentials of trace metals in biological system-Na, Cu, K, Zn, Fe, Mg.	3
4	**Electrochemistry**	
4.1	Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials	3
4.2	Electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method	3
4.3	Buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells -fuel cells-corrosion and its prevention.	3
5	**Photochemistry**	
5.1	Grothus - Drapper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield	3
5.2	Hydrogen - chloride reaction. Phosphorescence, fluorescence, Chemiluminescence	3
5.3	Photosensitization and photosynthesis (definition with examples).	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Co-ordination Chemistry and Water Technology	9	BP/PPT
2	Carbohydrates	9	BP/PPT
3	Amino acids	9	BP/PPT
4	Electrochemistry	9	BP/PPT
5	Photochemistry	9	BP/PPT
	Total	**45**	

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Chemistry
(For those joined B.Sc. Maths/Zoology/Botany/physics with effect from 2023-2024 batches onwards)
Programme Code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23GL11M / UCH23GL11Z / UCH23GL31B/ UCH23GL31P	Chemistry Practical for physical and biological sciences (for Mathematics and Zoology – I Year/I Semester; for Botany and physics II Year/III Semester)	Generic Elective lab	-	-	2	-

Year	Semester	Int. Marks	Ext. Marks	Total
I/II	I/III	25	75	100

Preamble

This course aims to provide knowledge on the

- Basics of preparation of solutions.
- Principles and practical experience of volumetric analysis

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Gain an understanding of the use of laboratory glasswares	90	85
CO2	Estimate the amount of inorganic compounds.	85	80
CO3	Design, carry out, record and interpret the results of volumetric titration.	85	85
CO4	Apply their skill in the analysis of water/hardness.	80	75
CO5	Analyze the chemical constituents in allied chemical products	78	75

S – Strong, M – Medium, L – Low

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	**M**	**M**

CO2	**S**	S	M	S	**S**	**M**
CO3	**S**	**S**	M	S	S	S
CO4	**S**	**S**	M	S	M	S
CO5	**S**	**S**	M	S	M	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	S	S	M	S	S
CO3	S	M	S	M	S
CO4	S	M	M	S	S
CO5	S	S	M	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course title: Chemistry practical for physical and biological sciences **30 hrs**

Volumetric analysis

1. Estimation of sodium hydroxide using standard sodium carbonate.

2. Estimation of hydrochloric acid using standard oxalic acid.

3. Estimation of ferrous sulphate using standard Mohr's salt.

4. Estimation of oxalic acid using standard ferrous sulphate.

5. Estimation of potassium permanganate using standard sodium hydroxide.

6. Estimation of magnesium using EDTA.

7. Estimation of ferrous ion using diphenyl amine as indicator.

Text Books:

1. V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles of Practical Chemistry; Sultan Chand & sons, Second edition, 1997.

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Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Chemistry
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Programme Code: UCH

Course Code	Course Title	Category	L	T	P	Credit
UCH23GL21M / UCH23GL21Z / UCH23GL41B/ UCH23GL41P	Chemistry practical for physical and biological sciences (for Mathematics and Zoology – I Year/II Semester; for Botany and Physics -II Year/IV Semester)	Generic Elective lab	-	-	2	2

Year	Semester	Int. Marks	Ext. Marks	Total
I/II	II/IV	25	75	100

Preamble

This course aims to provide knowledge on

- Identification of organic functional groups
- Different types of organic compounds with respect to their properties.
- Determination of elements in organic compounds

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Gain an understanding of the use of laboratory glasswares	80	75
CO2	Identify the functional group present in the given compound	85	80
CO3	Detect the special elements (N, S, Halogens etc.,)	80	78
CO4	Distinguish between aliphatic and aromatic compounds.	80	75
CO5	Distinguish saturated and unsaturated compounds by qualitative analysis	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	**S**	**S**
CO2	**S**	S	M	S	**S**	**S**

CO3	**S**	**S**	M	S	S	S
CO4	**S**	**S**	M	S	M	S
CO5	**S**	**S**	M	S	M	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	S	S	M	S	S
CO3	S	M	S	M	S
CO4	S	M	M	S	S
CO5	S	S	M	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Bloom's category	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course title: Chemistry practical for physical and biological sciences

SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS

The analysis must be carried out as follows

(a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose].
(b) Detection of elements (N, S, Halogens).
(c) To distinguish between aliphatic and aromatic compounds.
(d) To distinguish – Saturated and unsaturated compounds.

Text Books:

1. V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles of Practical Chemistry; Sultan Chand & sons, Second edition, 1997.

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M.Sc. Chemistry

Programme Code - PCH

(Aided & SF)

Programme outcome-PO (Aligned with Graduate Attributes)-Master of Science (M.Sc.,)

Knowledge

Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

Complementary skills

Students will be able to engage in critical investigation through principle approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies;

Applied learning

Students will be able to apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate;

Communication

Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentations by oral and/or written form.

Problem solving

Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

Environment and sustainability

Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

Teamwork, collaborative and management skills

Recognise the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issue.

Department of Chemistry

Vision: To train our students as scientifically literate professionals with a sense of social responsibilities.

Mission: (i) To train our students to succeed in competitive examinations.
(ii) To encourage the advancement of chemistry in all of its branches through education, research and service opportunities.
(iii) To provide students with community need based research and outreach opportunities.
(iv) To strive for an ideal balance between creation and knowledge dissemination in the chemical sciences.

Program Educational Objectives (PEOs)
The objectives of the M.Sc Chemistry programme is to prepare/equip the students-

PEO1	To pursue Ph.D programme at national /global level research institute with CSIR-NET/ TOEFL/GRE qualification.
PEO2	To have successful professional careers in chemical industry, government, academia and national/international research institute as innovative scientists.
PEO3	To get suitable employment in government sectors after qualifying specific competitive exams conducted by service commission.
PEO4	To develop leadership, contemporary and also global outlook.
PEO5	To recognize the importance of utilizing their knowledge, skills, and initiative for the benefit of society.

Program Specific Outcomes (PSOs)
On the successful completion of M.Sc Chemistry program students will be able

PSO1	To get in-depth knowledge on advanced concepts in Inorganic, Organic, Physical, Analytical, Biological, environmental and industrial applications of chemistry.
PSO2	To get basic analytical and technical skills to work effectively in the various fields of chemistry.
PSO3	To synthesize, purify and characterize compounds using published protocols, with the help of standard and modern instrumentation techniques and to find their applications in various fields.
PSO4	To use online search tools for literature survey of the topic of research, manuscript preparation and online submission for publication.
PSO5	To qualify State, National and International eligibility exams to do research at National/International institutes and to get suitable employment.

THIAGARAJAR COLLEGE, MADURAI- 9

(Re-Accredited with 'A++' Grade by NAAC)

DEPARTMENT OF CHEMISTRY

(For those who join in 2023 and after)

MASTER OF CHEMISTRY

Semester – I

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part A								
Core theory - 1	PCH23CT11	Organic reaction mechanism-I	5	4	75	25	75	100
Core theory - 2	PCH23CT12	Structure and bonding in inorganic compounds	5	4	75	25	75	100
Core lab -1	PCH23CL11	Organic chemistry practical-I	5	4	75	25	75	100
Elective-1	PCH23ET11 A/B	Pharmaceutical Chemistry (option A) Nanomaterials and nano technology (option B)	5	3	75	25	75	100
Elective-2	PCH23ET12 A/B	Electrochemistry (option A)/ Molecular Spectroscopy(option B)/	5	3	75	25	75	100
Part B								
SEC-1	PCH23SL11	Preparation of consumer products-Lab	3	2	45	25	75	100
AECC-1	PCH23AT11	C programming in chemistry	2	2	30	25	75	100
		Total	**30**	**22**	**450**			

Semester – II

Course	Code No	Subject	Hrs/ Week	Cred.	Total Hrs	Max Mark CA	Max Marks SE	Total
Part A								
Core theory-3	PCH23CT21	Organic reaction mechanism-II	5	4	75	25	75	100
Core theory-4	PCH23CT22	Physical chemistry-I	5	4	75	25	75	100
Core lab - 2	PCH23CL21	Inorganic Chemistry practical	5	4	75	25	75	100
Elective-3	PCH23ET21 A/B	Medicinal Chemistry (option A) Green Chemistry (option B)	5	3	75	25	75	100
Elective-4	PCH23ET22 A/B	Bio-inorganic chemistry (option A) Material science (option B)	5	3	75	25	75	100
Part B								
SEC- 2	PCH23ST21	Research tools and techniques	3	2	45	25	75	100
AECC-2	PCH23AT21	ICT tools in chemistry-lab	2	2	30	25	75	100
		Total	**30**	**22**	450			

Semester-III

Course	Code No	Subject	Hrs/ Week	Cred.	Total Hrs	Max Marks CA	Max Marks SE	Total
Part A								
Core theory-5	PCH23CT31	Organic synthesis and photochemistry	5	4	75	25	75	100
Core theory-6	PCH23CT32	Coordination Chemistry-I	5	4	75	25	75	100
Core lab -3	PCH23CL31	Physical Chemistry Practical	5	4	75	25	75	100
Elective-5	PCH23ET31	Pharmacognosy (Option A) Phytochemistry (Option B)	5	3	75	25	75	100
Core Industry module	PCH23CI31	Industrial Processes/ Chemometrics and quality control in industry	5	3	75	25	75	100
Part B								
SEC-3	PCH23ST31	Literature survey & presentation	3	2	45	25	75	100
AECC-3	PCH23AT31	Spectral data interpretation	2	2	30	25	75	100
		Internship/ Industrial activity	-	2	-			
		Total	**30**	**24**	450			

Semester -IV

Course	Code No	Subject	Hrs/ Week	Cred.	Total Hrs	Max Mark CA	Max Marks SE	Total
Part A								
Core lab - 7	PCH23 CT41	Coordination Chemistry-II	5	4	75	25	75	100
Core lab -8	PCH23 CT42	Physical Chemistry-II	5	4	75	25	75	100
Core lab-4	PCH23 CL41	Analytical Instrumentation technique-practical	5	4	75	25	75	100
Elective-6	PCH23 ET41	Chemistry of Natural products(Option A) Polymer Chemistry(Option B)	5	3	75	25	75	100
Project with viva-voce	PCH23 PJ41	Project with viva-voce	4	3	60	25	75	100
Part B								
SEC-3	PCHST 41	Chemistry for NET/UGC-CSIR/SET/TRB Competitive Examinations (2 hours) & General Studies for UPSC/TNPSC/Other Competitive Examinations (2 hours)	4	2	60	25	75	100
AECC-4	PCHAT41	Research ethics	2	2	30	25	75	100
		Extension activity	-	1	-			

Total	**30**	23	450			

A) CONSOLIDATION OF CONTACT HOURS AND CREDITS: PG

Semester	Contact hours	Credits
I	30	22
II	30	22
III	30	24
IV	30	23
Total	**120**	**91**

B) CURRICULUM CREDITS: PART WISE

Part	Courses	Credits				Total credits
		Semester I	Semester II	Semester III	Semester IV	
A	Core theory	4+4	4+4	4+4	4+4	32
	Core lab	4	4	4	4	16
	Elective(Generic/Discipline specific)	3+3	3+3	3+3	3+3	24
B	SEC	2	2	2	2	08
	AECC	2	2	2+2	2	10
C	Extension activity	-	-	-	1	01
					Total	**91**

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23CT11	Organic reaction mechanism - I	Core theory - 1	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
I	I	25	75	100

Preamble

This course aims to provide knowledge

- To understand the feasibility and the mechanism of various organic reactions.
- To comprehend the techniques in the determination of reaction mechanisms.
- To understand the concept of stereochemistry involved in organic compounds.
- To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.
- To design feasible synthetic routes for the preparation of organic compounds.

Prerequisite

Students with minimum knowledge on the basic concepts of organic chemistry at undergraduate level.

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Recall the basic principles of organic chemistry.	85	80
CO2	Understand the formation and detection of reaction intermediates of organic reactions.	85	83
CO3	Predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.	80	78
CO4	Apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.	80	75
CO5	Design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.	80	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	S	S
CO2	M	S	S	S	S	M	S
CO3	S	S	M	S	S	S	S
CO4	M	S	S	S	S	M	S
CO5	M	S	M	S	S	M	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Title of the Paper: Organic reaction mechanism - I

Unit I: Methods of Determination of Reaction Mechanism **15 hrs**

Reaction intermediates, the transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate.Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism.Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.

Unit II: Aromatic and Aliphatic Electrophilic Substitution 15 hrs

Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions.Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1-Mechanism and evidences.

Unit III: Aromatic and Aliphatic Nucleophilic Substitution: 15 hrs

Aromatic nucleophilic substitution: Mechanisms - SNAr, SN1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attackingnucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet-Hauser and Smiles rearrangements. SN1, ion pair, SN2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon. SN1, SN2, SNi, and SE1 mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles.

Unit IV: Stereochemistry-I 15 hrs

Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining theconfiguration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation.D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents.Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.

Unit V: Stereochemistry-II 15 hrs

Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle.Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion,

conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.

Text Books:

1. J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, New Age International Publishers, 2015.
4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.
5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2ndedition, Oxford University Press, 2014.

References:

1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.
2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.
3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
5. I. L. Finar, Organic chemistry, Vol-1&2, 6th edition, Pearson Education Asia, 2004.

Web Resources:

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. https://www.organic-chemistry.org/

Course Designers:

1. Dr. P. Prakash
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Mrs. P. Rajam

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Methods of Determination of Reaction Mechanism**	
1.1	Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate.Methods of determining mechanism: non-kinetic methods - product analysis,	5

1.2	Determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism.	4
1.3	Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.	3
	Tutorial	3
2	**Aromatic and Aliphatic Electrophilic Substitution**	
2.1	Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes.	2
2.2	Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation	5
2.3	Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions.Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences.	5
	Tutorial	3
3	**Aromatic and Aliphatic Nucleophilic Substitution**	
3.1	Aromatic nucleophilic substitution: Mechanisms - SNAr, SN1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attackingnucleophile.	4
3.2	Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements.	3
3.3	SN1, ion pair, SN2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.SN1, SN2, SNi, and SE1 mechanism and evidences, Swain-Scott, Grunwald-Winstein relationship - Ambident nucleophiles.	5
	Tutorial	3
4	**Stereochemistry-I**	
4.1	Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers.	3
4.2	Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining theconfiguration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation.	3

4.3	D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes.	3
4.4	Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents.Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.	3
	Tutorial	3
5	**Stereochemistry-II**	
5.1	Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle.	4
5.2	Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule.	4
5.3	Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.	4
	Tutorial	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Methods of Determination of Reaction Mechanism:	15	Chalk and talk, Slides
2	Aromatic and Aliphatic Electrophilic Substitution:	15	Chalk and talk, Slides
3	Aromatic and Aliphatic Nucleophilic Substitution:	15	Chalk and talk, Slides
4	Stereochemistry – I	15	Chalk and talk, Slides
5	Stereochemistry – II	15	Chalk and talk, Slides
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23CT12	Structure and bonding in inorganic compounds	Core theory -2	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
I	I	25	75	100

Preamble

This course aims to provide knowledge

- To determine the structural properties of main group compounds and clusters.
- To gain fundamental knowledge on the structural aspects of ionic crystals.
- To familiarize various diffraction and microscopic techniques.
- To study the effect of point defects and line defects in ionic crystals.
- To evaluate the structural aspects of solids.

Prerequisite

Students with knowledge on the basic concepts of Inorganic Chemistry

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Predict the geometry of main group compounds and clusters.	80	75
CO2	Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.	85	82
CO3	Understand the various types of ionic crystal systems and analyze their structural features.	80	78
CO4	Explain the crystal growth methods.	80	75
CO5	To understand the principles of diffraction techniques and microscopic techniques.	75	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	S	S
CO2	M	S	S	S	S	M	S
CO3	S	S	M	S	S	S	S
CO4	M	S	S	S	S	M	S
CO5	M	S	M	S	S	M	S

S – Strong, M – Medium, L - Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S
CO2	S	M	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	M	S
CO5	S	S	S	M	S

S – Strong, M – Medium, L - Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Syllabus: Structure and Bonding in Inorganic Compounds

Unit I: Structure of main group compounds and clusters (15 hrs)

VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane

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

Unit II: Solid state chemistry – I **(15 hrs)**

Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry oper ations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.

Unit III: Solid state chemistry – II **(15 hrs)**

Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.

Unit IV: Techniques in solid state chemistry **(15 hrs)**

X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.

Unit V: Band theory and defects in solids **(15 hrs)**

Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.

Text Books:

1. A R West, Solid state Chemistry and its applications, 2nd Edition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders Company: Philadelphia, 1977.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983.

References:

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.

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

Web Resources:

https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

Course Designers:

1. Dr. A. Elangovan
2. Dr. D.S. Bhuvaneshwari
3. Dr. K. Selvakumar
4. Dr. S. Pitchaimuthu
5. Dr. N. Sudhan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Structure of main group compounds and clusters**	
1.1	VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules	4
1.2	Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds	4
1.3	Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster; main group clusters –zintl ions and mno rule.	4
	Tutorial	3
2	**Solid state chemistry – I**	
2.1	Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice,	4
2.2	Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group;	4
2.3	Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.	4

	Tutorial	3
3	**Solid state chemistry – II**	
3.1	Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide;	5
3.2	Spinels -normal and inverse types and perovskite structures.	3
3.3	Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.	4
	Tutorial	3
4	**Techniques in solid state chemistry**	
4.1	X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation;	4
4.2	Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections;	4
4.3	Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.	4
	Tutorial	3
5	**Band theory and defects in solids**	
5.1	Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors;	5
5.2	Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.	7
	Tutorial	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Structure of main group compounds and clusters	15	Models and PPT
2	Solid state chemistry – I	15	Models and PPT
3	Solid state chemistry – II	15	Models and PPT
4	Techniques in solid state chemistry	15	Models and PPT
5	Band theory and defects in solids	15	Models and PPT
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009

Department of Chemistry

(For those joined M.Sc. Chemistry on or after June 2023)

Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23CL11	Organic Chemistry Practical	Core lab - 1	-	1	4	4

Year	Semester	Int. Marks	Ext.Marks	Total
I	I	25	75	100

Preamble

This course aims to provide knowledge

- To understand the concept of separation, qualitative analysis and preparation of organiccompounds.
- To develop analytical skill in the handling of chemical reagents for separation of binary and ternaryorganic mixtures.
- To analyze the separated organic components systematically and derivatize them suitably.
- To construct suitable experimental setup for the organic preparations involving two stages.
- To experiment different purification and drying techniques for the compound processing.

Prerequisite

Students with minimum knowledge on basic concepts of organic chemistry

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Recall the basic principles of organic separation, qualitative analysis and preparation.	85	80
CO2	Explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.	85	80
CO3	Ddetermine the characteristics of separation of organic compounds by various chemical reactions.	80	78
CO4	Develop strategies to separate, analyze and prepare organic compounds.	80	75
CO5	Formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic	80	78

	preparations.		

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	S	S
CO2	M	S	S	S	S	M	S
CO3	S	S	M	S	S	S	S
CO4	M	S	S	S	S	M	S
CO5	M	S	M	S	S	M	S

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Title of the course: Organic chemistry practical **60 hrs**

Unit I: Separation and analysis:

A. Two component mixtures.

B. Three component mixtures.

Unit II: Estimations:

a) Estimation of Phenol (bromination)

b) Estimation of Aniline (bromination)

c) Estimation of Ethyl methyl ketone (iodimetry)

d) Estimation of Glucose (redox)
e) Estimation of Ascorbic acid (iodimetry)
f) Estimation of Aromatic nitro groups (reduction)
g) Estimation of Glycine (acidimetry)
h) Estimation of Formalin (iodimetry)
i) Estimation of Acetyl group in ester (alkalimetry)
j) Estimation of Hydroxyl group (acetylation)
k) Estimation of Amino group (acetylation)

Unit III: Two stage preparations:

a) p-Bromoacetanilide from aniline
b) p-Nitroaniline from acetanilide
c) 1,3,5-Tribromobenzene from aniline
d) Acetyl salicyclic acid from methyl salicylate
e) Benzilic acid from benzoin
f) m-Nitroaniline from nitrobenzene
g) m-Nitrobenzoic acid from methyl benzoate

Tutorial hours **15 hrs**

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved

Text Books:

1. Donald L Pavia, Gary M. Lampman, George and S Kritz, (2009).Organic Chemistry – A Lab Manual New Delhi: Sengage Learning. Print.
2. N.S. Gnanpragasam and G. Ramamurthy, Organic Chemistry Lab Manual, S. Viswanathan Pvt. Ltd.

References:

1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R. Basic Principles of Practical Chemistry, 2nd ed.; Sultan Chand: New Delhi, 2012.
2. Manna, A.K. Practical Organic Chemistry, Books and Allied: India, 2018.
3. Gurtu, J. N; Kapoor, R. Advanced Experimental Chemistry (Organic), Sultan Chand: New Delhi, 1987.
4. Furniss,B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, 5th ed.; Pearson: India,1989.

Web Resources:

https://www.vlab.co.in/broad-area-chemical-sciences

Course Designers:

1. Dr. P. Prakash
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Dr. J. Thirupathy

Thiagarajar College (Autonomous) :: Madurai – 625 009

Department of Chemistry

(For those joined M.Sc. Chemistry on or after June 2023)

Programme code: PCH

Course Code	Course title	Category	L	T	P	Credit
PCH23ET11A	Pharmaceutical chemistry(Option A)	Elective-1	3	2	-	3

Year	Semester	Int. Marks	Ext. Marks	Total
I	I	25	75	100

Preamble

This course aims to provide knowledge

- To understand the advanced concepts of pharmaceutical chemistry.
- To recall the principle and biological functions of various drugs.
- To train the students to know the importance as well the consequences of various drugs.
- To have knowledge on the various analysis and techniques.
- To familiarize on the drug dosage and its structural activities.

Prerequisite

Students with basic knowledge on drugs and doses

Course outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Identify the suitable drugs for various diseases.	80	75
CO2	Apply the principles of various drug action and drug design.	85	80
CO3	Acquire the knowledge on product development based on SAR.	80	75
CO4	Apply the knowledge on applications of computers in chemistry.	80	78
CO5	Synthesize new drugs after understanding the concepts SAR.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**

CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge-K1	15% (9)	15% (9)	20% (30)
Understand-K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

UNIT-I: Physical properties in Pharmaceuticals 15 hrs

Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.

UNIT-II: Isotopic Dilution analysis15 hrs

Principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical

properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.

UNIT-III: Drug dosage and product development 15 hrs

Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Commonterms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.

UNIT-IV: Development of new drugs15 hrs

Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory,4.3 Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.

UNIT-V: Computers in Pharmaceutical Chemistry 15 hrs

Need of computers for chemistry. Computers for Analytical Chemists-Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components. Application of computers in chemistry: Programming in high level language (C+) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation, extrapolation, data smoothing, numerical differentiation and integrations.

Text books:

1. Physical Chemistry- Bahl and Tuli.
2. Text Book of Physical Pharmaceutics, IInd edition, Vallabh Prakashan-. C.V.S. Subramanyam.
3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.R Chatwal, Himalaya Publishing house.
4. Instrumental method of Analysis: Hubert H, Willard, 7th edition.
5. Textbook of Pharmaceutical Chemistry by, Jayshree Ghosh, S. Chand & company Ltd. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultan chand & Sons.

Reference Books

1. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993.
2. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2nd edition, New age international (P) limited, New Delhi.
3. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott.

William and Wilkins.
4. Cooper and Gunn's Tutorial Pharmacy, 6th edition by S.J. Carter, CBS Publisher Ltd.
5. Ansels pharmaceutical Dosage forms and Drug Delivery System by Allen Popvich and Ansel, Indian edition-B.I. Publication Pvt. Ltd.

Web resources

https://www.ncbi.nlm.nih.gov/books/NBK482447/
https://training.seer.cancer.gov/treatment/chemotherapy/types.html

Course designer

1. Dr. P. Prakash
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Mrs. P. Rajam
5. Dr. J. Thirupathy

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Physical properties in Pharmaceuticals**	
1.1	Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction.	3
1.2	Optical activity\rotation-monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity	3
1.3	Dielectric constant & Induced Polarization- Dielectric constant explanation & determination.	2
1.4	Rheology of pharmaceutical systems: Introduction, Definition, Applications,	1
1.5	Concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.	3
	Tutorial	3
2	**Isotopic Dilution analysis**	
2.1	Principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning.	4

2.2	Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization.	4
2.3	Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.	4
	Tutorial	3
3	**Drug dosage and product development**	
3.1	Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. routes of administration of drugs products	4
3.2	Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature	4
3.3	Need for a dosage form, classification of dosage forms. Drug dosage and product development.	4
	Tutorial	3
4	**Development of new drugs**	
4.1	Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR)	4
4.2	Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory	4
4.3	Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.	4
	Tutorial	3
5	**Computers in Pharmaceutical Chemistry**	
5.1	Need of computers for chemistry. Computers for Analytical Chemists-Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components.	6
5.2	Application of computers in chemistry: Programming in high level language (C+) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation,	6

	extrapolation, data smoothing, numerical differentiation and integrations.	
	Tutorial	3
Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)		

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Physical properties in Pharmaceuticals	15	BB and PPT
2	Isotopic Dilution analysis	15	BB and PPT
3	Drug dosage and product development	15	BB and PPT
4	Development of new drugs	15	BB and PPT
5	Computers in Pharmaceutical Chemistry	15	BB and PPT
Total		**75**	

Thiagarajar College (Autonomous) : Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme Code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23ET11B	Nano materials and nano technology(Option B)	Elective -1 (Discipline specific)	3	2	-	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	**I**	**25**	**75**	**100**

Preamble

This course aims to provide basic knowledge

- To understand the concept of nano materials and nano technology.
- To understand the various types of nano materials and their properties.
- To understand the applications of synthetically important nano materials.
- To correlate the characteristics of various nano materials synthesized by new technologies.
- To design synthetic routes for synthetically used new nano materials.

Prerequisite

Students with basic knowledge of crystallography and material science

Course Outcomes

On completion of the course students will be able to

#	Course Outcomes	Expected Proficiency	Expected attainment
CO1	Eexplain methods of fabricating nanostructures.	80	78
CO2	Relate the unique properties of nanomaterials to reduce dimensionality of the material.	80	75
CO3	Describe tools for properties of nanostructures.	80	78
CO4	Discuss applications of nanomaterials.	85	80
CO5	Understand the health and safety related to nanomaterial.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	S	S
CO2	M	S	S	S	S	M	S
CO3	S	S	M	S	S	S	S
CO4	M	S	S	S	S	M	S
CO5	M	S	M	S	S	M	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M
CO2	M	S	S	S	S
CO3	S	S	M	S	S
CO4	M	S	S	S	M
CO5	M	S	M	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: Nano materials and nano technology

Unit I:15 hrs

Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.

Unit II: 15 hrs

Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation,

sol-gel, solvothermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.

Unit III:15 hrs

Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina – synthesis and properties.

Unit IV: 15 hrs

Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.

Unit V:15 hrs

Nano thin films, nanocomposites, Application of nanoparticles in different fields. Core-shell nanoparticles-types, synthesis, and properties. Nanocomposites-metal, ceramic-and polymer-matrix composites-applications. Characterization– SEM, TEM and AFM - principle, instrumentation and applications.

Text Books:

1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications, 2007.
3. Giacavazzo et.al, Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010
4. Woolfson, an Introduction to Crystallography, Cambridge University Press, 2012.
5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.

References:

1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications, 2007.
3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010
4. Woolfson, an Introduction to Crystallography, Cambridge University Press, 2012.
5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.

Web Resources:

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.
2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.

Course Designers:

Dr. T. Arumuganathan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D.	4
1.2	Synthesis-Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures	4
1.3	Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.	4
	Tutorial	3
2.1	Bonding and structure of the nanomaterials, Predicting the type of Bonding in a Substance crystal structure.	4
2.2	Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types	4
2.3	Metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.	4
	Tutorial	3
3.1	Mechanical properties of materials, theories relevant to mechanical properties.	4
3.2	Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials	4
3.3	Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina – synthesis and properties.	4
	Tutorial	3
4.1	Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials.	4
4.2	Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous,	4
4.3	Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.	4
	Tutorial	3

5.1	Nano thin films, nanocomposites. Application of nanoparticles in different fields. Core-shell nanoparticles-types, synthesis, and properties.	4
5.2	Nanocomposites-metal-, ceramic - and polymer-matrix composites-applications.	4
5.3	Characterization– SEM, TEM and AFM - principle, instrumentation and applications.	4
	Tutorial	3

Teaching method

Unit	Topic	Lecture hrs.	Teaching Method
1	Introduction of nanomaterials and nanotechnologies	15	BB and PPT
2	Bonding and structure of the nanomaterials	15	BB and PPT
3	Mechanical properties of materials	15	BB and PPT
4	Electrical properties	15	BB and PPT
5	Nano thin films, nanocomposites	15	BB and PPT
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23ET12A	Electrochemistry(Option A)	Elective-II (Discipline specific)	3	2	-	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	I	25	75	100

Preamble

This course aims to provide knowledge

- To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
- To familiarize the structure of the electrical double layer of different models.
- To compare electrodes between current density and over potential.
- To discuss the mechanism of electrochemical reactions.
- To highlight the different types of over voltages and its applications in electroanalytical techniques.

Prerequisite

Students with knowledge on basic concepts of electrochemistry

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.	80	75
CO2	Predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations	80	75
CO3	Study different thermodynamic mechanism of corrosion,	75	73
CO4	Discuss the theories of electrolytes, electrical double layer, electrodics and activity coefficient of electrolytes	80	78
CO5	Gain knowledge on storage devices and electrochemical reaction mechanism.	80	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	M	S	M
CO2	S	M	M	M	M	L	M
CO3	M	S	M	S	M	S	M
CO4	M	M	M	S	M	M	M
CO5	S	S	M	S	M	L	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSO

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	S
CO2	S	M	M	L	S
CO3	S	M	S	M	S
CO4	S	S	M	M	S
CO5	S	S	S	M	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title:Electrochemistry

UNIT-I: Ionics15 hrs

Arrhenius theory-limitations, Van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength, Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions. Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting

law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere. Ion association and triple ion formations.

UNIT-II:Electrode-electrolyte interface **15 hrs**

Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electro capillary curves. Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations.

UNIT-III: Electrodics of Elementary Electrode Reactions **15 hrs**

Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.

UNIT-IV: Electrodics of Multistep Multi Electron System **15 hrs**

Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number. Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of I^{3-}, Fe^{2+}, and dissolution of Fe to Fe^{2+}. Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.

UNIT-V: Concentration Polarization, Batteries and Fuel cells **15 hrs**

Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography-principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.

Text Books:

1. D. R. Crow, Principles and applications of electrochemistry, 4thedition, Chapman & Hall/CRC, 2014.

2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai,2007.
5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004.

References:

1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008.
2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010.
4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.

Web Resources:

1. https://www.pdfdrive.com/modern-electrochemistry-e34333229.

Course Designers:

1. Dr. R. Sayeekannan
2. Dr. A.R.Ramesh
3. Dr. T. Arumuganathan
4. Dr. M. Sathiya
5. Dr. A. Baish Nisha
6. Dr. K. Ganesan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Ionics**	
1.1	Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength,	3
1.2	Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions. formations.	3
1.3	Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications.	2
1.4	Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations.	2
1.5	Evidence for ionic atmosphere. Ion association and triple ion	2

	Tutorial	3
2	**Electrode-electrolyte interface**	
2.1	Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces,	3
2.2	Electrocapillary phenomena - Lippmann equation electro capillary curves.	2
2.3	Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes.	3
2.4	Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer.	2
2.5	Zeta potential and potential at zero charge. Applications and limitations.	2
	Tutorial	3
3	**Electrodics of Elementary Electrode Reactions**	
3.1	**Electrodics of Elementary Electrode Reactions:** Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions.	3
3.2	Nernst equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential.	2
3.3	Rate of electro chemical reactions: Rates of simple elementary reactions.	2
3.4	Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor.	3
3.5	Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.	2
	Tutorial	3
4	**Electrodics of Multistep Multi Electron System**	
4.1	Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction.	3
4.2	Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number.	2
4.3	Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage.	2
4.4	Reduction of I^{3-}, Fe^{2+}, and dissolution of Fe to Fe^{2+}.	1
4.5	Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials.	2

4.6	Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.	2
	Tutorial	3
5	**Concentration Polarization, Batteries and Fuel cells**	
5.1	Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes.	3
5.2	Polarography-principle and applications. Principle of square wave polarography.	2
5.3	Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries.	2
5.4	Mechanism of charge storage: conversion and alloying. Capacitors - mechanism of energy storage, charging at constant current and constant voltage.	2
5.5	Energy production systems: Fuel Cells:classification, alkaline fuel cells,	2
5.6	Phosphoric acid fuel cells, high temperature fuel cells.	1
	Tutorial	3

Teaching method

Unit	Topic	Lecture hrs.	Teaching Method
1.1	**Ionics**: Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength	3	Chalk & board
1.2	Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions formations.	3	Chalk & board
1.3	Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications.	3	Chalk & board
1.4	Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations.	3	PPT
1.5	Evidence for ionic atmosphere. Ion association and triple ion	3	Chalk & board

2.1	**Electrode-electrolyte interface:** Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces,	3	Chalk & board
2.2	Electrocapillary phenomena - Lippmann equation electro capillary curves.	3	Chalk & board
2.3	Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes.	3	PPT
2.4	Structure of double layer: Helmholtz -Perrin, Guoy-Chapman and Stern models of electrical double layer.	3	Chalk & board
2.5	Zeta potential and potential at zero charge. Applications and limitations.	3	Chalk & board
3.1	**Electrodics of Elementary Electrode Reactions:** Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions.	3	Chalk & board
3.2	Nernst equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential.	3	Chalk & board
3.3	Rate of electro chemical reactions: Rates of simple elementary reactions.	3	PPT
3.4	Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor.	3	Chalk & board
3.5	Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.	3	Chalk & board
4.1	**Electrodics of Multistep Multi Electron System:** Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction.	3	Chalk & board
4.2	Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number.	3	Chalk & board
4.3	Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage.	2	PPT
4.4	Reduction of I^{3-}, Fe^{2+} and dissolution of Fe to Fe^{2+}.	2	Chalk & board
4.5	Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials.	2	Chalk & board
4.6	Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.	3	Chalk & board
5.1	**Concentration Polarization, Batteries and Fuel cells:** Modes of Transport of electro active species -	3	Chalk & board

	Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes.		
5.2	Polarography-principle and applications. Principle of square wave polarography.	3	Chalk & board
5.3	Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries.	3	Chalk & board
5.4	Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage.	2	Chalk & board
5.5	Energy production systems: Fuel Cells: classification, alkaline fuel cells,	2	Chalk & board
5.6	phosphoric acid fuel cells, high temperature fuel cells.	2	PPT
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23ET12B	Molecular spectroscopy(Option B)	Elective-2 (Discipline specific)	3	2	-	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	I	25	75	100

Preamble

This course aims to provide knowledge

- To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
- To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy and fragmentation patterns in Mass spectroscopy.
- To highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions.
- To interpret the first and second order NMR spectra in terms of splitting and coupling patterns using correlation techniques such as COSY, HETCOR, NOESY.
- To carry out the structural elucidation of molecules using different spectral techniques.

Prerequisite

Students with basic knowledge of spectroscopy at undergraduate level

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Understand the importance of rotational and Raman spectroscopy.	80	78
CO2	Apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.	80	78
CO3	Evaluate different electronic spectra of simple molecules using electronic spectroscopy.	85	80
CO4	Outline the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}F NMR and ESR spectroscopic techniques.	75	70

CO5	Develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy techniques.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	M	S	S
CO2	S	M	S	M	M	L	S
CO3	M	S	M	S	M	L	S
CO4	M	M	M	S	M	M	S
CO5	S	S	M	S	M	L	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	L	S
CO2	S	S	S	L	S
CO3	S	S	S	M	S
CO4	S	S	S	M	S
CO5	S	S	S	M	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title:Molecular spectroscopy

Unit I: Rotational and Raman Spectroscopy **15 hrs**

Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.

Unit II: Vibrational Spectroscopy **15 hrs**

Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.

Unit III: Electronic spectroscopy **15 hrs**

Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, Xray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems.

Unit IV: NMR and ESR spectroscopy **15 hrs**

Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. 13CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR. ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples.

Unit V: Mass Spectrometry, EPR and Mossbauer Spectroscopy **15 hrs**

Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high

resolution. Effect of isotopes on the appearance of mass spectrum. EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Zero-field splitting (ZFS) and Kramer's degeneracy. Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.

Text Books:

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

References:

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

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview

2. https://www.digimat.in/nptel/courses/video/104106122/L14.html

Course Designers:

1. Dr. R. Sayeekannan
2. Dr. A.R.Ramesh
3. Dr. T. Arumuganathan
4. Dr. M. Sathiya
5. Dr. A. Baish Nisha
6. Dr. K. Ganesan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Rotational and Raman Spectroscopy**	
1.1	Rotational spectra of diatomic and polyatomic molecules.	3
1.2	Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators	3
1.3	Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids,	2
1.4	Quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines.	2
1.5	Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.	2
	Tutorial	3
2	**Vibrational Spectroscopy**	
2.1	Vibrations of molecules, harmonic and anharmonic oscillators-vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules	3
2.2	Expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution.	3
2.3	Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation.	2
2.4	Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies.	2
2.5	Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.	2
	Tutorial	3
3	**Electronic Spectroscopy**	
3.1	Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra.	3
3.2	$\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules.	3
3.3	Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, Xray photoelectron spectroscopy (XPS).	2

3.4	Lasers: Laser action, population inversion	2
3.5	Pproperties of laser radiation, examples of simple laser systems.	2
	Tutorial	3
4	**NMR and ESR spectroscopy**	
4.1	Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding.	2
4.2	Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling.	3
4.3	Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. 13CNMR and structural correlations, Satellites.	2
4.4	Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR.	1
4.5	ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction.	2
4.6	Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples.	2
	Tutorial	3
5	**Mass Spectrometry, EPR and Mossbauer Spectroscopy**	
5.1	Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI),	2
5.2	isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum.	2
5.3	EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfinesplitting caused by quadrupole nuclei.	3
5.4	Zero-field splitting (ZFS) and Kramer's degeneracy.	1
5.5	Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy	2

5.6	Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.	2
	Tutorial	3
	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)	

Teaching method

Unit	Topic	Lecture hrs.	Teaching Method
1.1	**Rotational and Raman Spectroscopy:** Rotational spectra of diatomic and polyatomic molecules.	3	Chalk & board
1.2	Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators	3	Chalk & board
1.3	Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids,	3	Chalk & board
1.4	Quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines.	3	PPT
1.5	Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.	3	Chalk & board
2.1	**Vibrational Spectroscopy:** Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules	3	Chalk & board
2.2	Expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution.	3	Chalk & board
2.3	Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation.	3	PPT
2.4	Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies.	3	Chalk & board

2.5	Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.	3	Chalk & board
3.1	Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra.	3	Chalk & board
3.2	$\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules.	3	Chalk & board
3.3	Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, Xray photoelectron spectroscopy (XPS).	3	PPT
3.4	Lasers: Laser action, population inversion	3	Chalk & board
3.5	Properties of laser radiation, examples of simple laser systems.	3	Chalk & board
4.1	**NMR and ESR spectroscopy:** Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding.	3	Chalk & board
4.2	Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling.	3	Chalk & board
4.3	Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. 13CNMR and structural correlations, Satellites.	2	PPT
4.4	Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR.	2	Chalk & board
4.5	ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction.	2	Chalk & board
4.6	Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples.	3	Chalk & board
5.1	**Mass Spectrometry, EPR and Mossbauer Spectroscopy:** Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization	3	Chalk & board

	(ESI)		
5.2	Isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum.	3	Chalk & board
5.3	EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei.	3	Chalk & board
5.4	Zero-field splitting (ZFS) and Kramer's degeneracy.	2	Chalk & board
5.5	Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy	2	Chalk & board
5.6	Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.	2	PPT
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course title	Category	L	T	P	Credit
PCH23SL11	Preparation of consumer products - Lab	SEC-1	-	-	3	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	I	25	75	100

Preamble

This course aims at familiarizing the preparation of consumer products which are used in daily life.

Prerequisite

Students with minimum knowledge on consumer products.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Identify the various ingredients present in the consumer products.	75%	75%
CO2	Gain theoretical knowledge on the preparation of consumer products.	75%	75%
CO3	Prepare consumer products like detergent powder, cleaning powder, tooth powder, etc., on their own.	75%	75%
CO4	Prepare consumer cum cosmetic products like Kaajal, Moisturizer, Lipsticks, etc., on their own.	75%	75%
CO5	Become an entrepreneur in making consumer products	75%	75%

Mapping of COs and POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**S**

CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**	**S**	**S**

S-Strong; M-Medium; L-Low

Mapping of COs and PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Course title:Preparation of Consumer Products - Lab

The following Consumer Products will be prepared at Lab.

1. Instant Dhoop
2. Pain Balm
3. Detergent Powder /Liquid
4. Face Powder
5. Candles
6. Chalk
7. Cleaning Powder
8. Soap oil
9. Tooth Powder
10. Phenoyl
11. Shampoo
12. Lips Sticks
13. Kaajal
14. Moisturizer
15. Sanitizer

Text Books

1 Poucher, W.A. Perfumes, Cosmetics and soaps, Vol. III, Modern Cosmetics;

2 Simons, J.V. Chemistry and the beauty business.

3 B.K.Sharma, Industrial Chemistry, Goel publishing House, Meerut, 2003, New Delhi.

Reference Books

1. R.V.Shreve, Industrial Chemical Process, Tata McGraw Hill publishing company, 2005, Mumbai. 2. Mohan Malhotra, Latest Cottage Industries, 20th Edition Edn, Vishal publishers, 1980, Meerut

Course Designers

1. Dr. D. S. Bhuvaneshwari
2. Dr. M. Sathiya

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course title	Category	L	T	P	Credit
PCH23AT11	C- Programming in chemistry	AECC-1	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	I	25	75	100

Preamble

The course explains the importance of C-programming and various terms used in C. It also explains the applications of C in solving problems in chemistry.

Prerequisite

Students with basic knowledge on computer.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Learn the overview of C-programming	85%	80%
CO2	Comprehend the basic ideas of operators, Data input and Output	85%	83%
CO3	Write C-programming in Physical Chemistry	80%	75%
CO4	Apply C-programming in Inorganic Chemistry	80%	75%
CO5	Apply C-programming in Organic Chemistry	80%	75%

Mapping of COs and POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**M**
CO2	**M**	**S**	**S**	**M**	**M**	**M**	**M**
CO3	**S**	**S**	**M**	**S**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**M**	**M**	**M**
CO5	**S**	**M**	**S**	**S**	**M**	**M**	**S**

S – Strong, M – Medium, L – Low

Mapping of COs and PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Bloom's Taxonomy and assessment pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title:C- Programming in Chemistry

UNIT- I: Introduction6 hrs

Importance of C-structure of C-programs- Simple programs-style of the language. Characters– Keywords, Variables and parameters-Data types-Constants-Declaration of and assignments of values to variables.

Operators-Arithmetic, Relational, Logical, assignment, Increment and Decrement, Conditional and bitwise operators-Special operators. Formatted input and output data-the gets, puts, getchar, putchar functions - Scanf and printf - - preparing and running a complete program.

UNIT – II: Decision making and branching **6 hrs**

Decision making with IF statement –simple IF statement-the IF…ELSE statement- Nesting of IF…Else statements – The ELSE IF ladder –The Switch statement – The ?: operator – the GOTO statement.

Decision making and Looping: The WHILE statement – The DO statement-The FOR statement – Jumps in loops

Arrays: One dimensional array –Two dimensional arrays –Initializing two dimensional arrays Multidimensional arrays.

User defined functions: Need for user–defined functions – A multifunction program – The form of C functions - Return values and their types- Calling a function –Category of function - No arguments and no return values – Nesting functions - Recursions - The scope and life time of variables in function.

UNIT – III: Application of C-programming in Physical Chemistry 6 hrs

1. Calculation of RMS, average and MPV of gases.
2. Solving Quadratic equation to evaluate the Equilibrium constant for the reaction
   $H_2 + I_2 = 2HI$
3. Mean activity coefficient of an Electrolyte (KCl)
4. Calculation of pH.
5. Determination on First Order rate constant for the given reaction
6. Determination of enthalpy of a given reaction
7. Evaluation of Cell constant

UNIT – IV: Application of C-programming in Inorganic Chemistry 6 hrs

1. Array manipulation to balance the chemical equations.
2. Half -life and average life periods of radioactive nuclei.
3. Binding energy of nucleus.
4. Program to get output as First ten elements of Periodic Table with their Name, Symbol, Atomic number and Atomic Weight.
5. Evaluation of lattice energy using
   i). Born- Haber Cycle
   ii). Born - Lande equation
6. Computing ionic radii- Lande's method and Pauling's method
7. Calculation of energy of Hydrogen atom spectral lines.

UNIT – V: Application of C-programming in Organic Chemistry 6 hrs

1. Calculation of Molecular weight of Organic Compounds.
2. Use of Recursive functions to calculate the number of pi Resonance structures for an organic conjugated system using res - str = n! / ((n/2)! * ((n/2) + 1)!)
3. Empirical formula of Hydrocarbons and other Organic compounds.
4. Calculation of Normality, Molarity and Molality of a given solution
5. Converting Kelvin to Celsius temperature and vice versa.

Text Books

1. E. Balagurusamy, 2005. Programming in ANSI C, Tata McGraw- Hill Publishing

Company Ltd., New Delhi, 3rd Edn. 10th reprint.

Reference Books

1. Brian W. Kernighan & Dennis M. Ritchie, 2001. The C Programming Language, Prentice Hall of India Private Limited, New Delhi, 2nd Edn.
2. Byron S. Gottfried, 2001. Programming with C, Tata McGraw- Hill Publishing Company Ltd., New Delhi, 2nd Edn.
3. R. Rajaram, 1999. C Programming Made Easy, Scitech Publications, Chennai.
4. Yeshavant Kanitkar, 1999. Let Us C, BPB Publications, New Delhi, 3rd Edn..
5. Yeshavant Kanitkar, C 1998 - Projects, BPB Publications, New Delhi,.
6. K. V. Raman, 1993 Computers in Chemistry, Tata McGraw- Hill Publishing Company Ltd., New Delhi, 3rd Edn.

Course Designers

1. Dr. A. Elangovan
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Dr. M. Sathiya

Course contents and lecture schedule

Unit	Topic	No. of lecture hrs
1	**Introduction**	
1.1	Importance of C-structure of C-programs- Simple programs-style of the language. Characters–Keywords, Variables and parameters	1
1.2	Data types-Constants-Declaration of and assignments of values to variables. Operators-Arithmetic, Relational, Logical, assignment, Increment and Decrement, Conditional and bitwise operators-Special operators.	3
1.3	Formatted input and output data-the gets, puts, getchar, putchar functions - Scanf and printf - preparing and running a complete program.	2
2	**Decision making and branching**	
2.1	Decision making and branching: Decision making with IF statement –simple IF statement-the IF…ELSE statement	1
2.2	Nesting of IF…Else statements – The ELSE IF ladder –The Switch statement – The?: operator – the GOTO statement.	1
2.3	Decision making and Looping: The WHILE statement – The DO statement-The FOR statement – Jumps in loops	1
2.4	**Arrays**: One dimensional array –Two dimensional arrays – Initializing two dimensional arrays Multidimensional arrays.	1

2.5	**User defined functions**: Need for user–defined functions – A multifunction program, The form of C functions-Return values and their types.	1
2.6	Calling a function –Category of function-No arguments and no return values –Nesting functions- Recursions- The scope and life time of variables in function	1
3	**Application of C-programming in Physical Chemistry**	
3.1	1. Calculation of RMS, average and MPV of gases. 2. Solving Quadratic equation to evaluate the Equilibrium constant for the reaction $H_2 + I_2 = 2HI$	2
3.2	3. Mean activity coefficient of an Electrolyte (KCl) 4. Calculation of pH.	2
3.3	5. Determination on First Order rate constant for the given reaction 6. Determination of enthalpy of a given reaction 7. Evaluation of Cell constant	2
4	**Application of C-programming in Inorganic Chemistry**	
4.1	1. Array manipulation to balance the chemical equations. 2. Half -life and average life periods of radioactive nuclei. 3. Binding energy of nucleus.	2
4.2	4. Program to get output as First ten elements of Periodic Table with their Name, Symbol, Atomic number and Atomic Weight. 5. Evaluation of lattice energy using i). Born- Haber Cycle ii). Born - Lande equation	22
4.3	6. Computing ionic radii- Lande's method and Pauling's method 7. Calculation of energy of Hydrogen atom spectral lines.	2
5	**Application of C-programming in Organic Chemistry**	
5.1	Calculation of Molecular weight of Organic Compounds	1
5.2	Use of Recursive functions to calculate the number of pi Resonance structures for an organic conjugated system using res - str = n! / ((n/2)! * ((n/2) + 1)!)	2
5.3	Empirical formula of Hydrocarbons and other Organic compounds.	1
5.4	Calculation of Normality, Molarity and Molality of a given solution	1
5.5	Converting Kelvin to Celsius temperature and vice versa.	1

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23CT21	Organic reaction mechanism-II	Core theory -3	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
I	**II**	**25**	**75**	**100**

Preamble

This course aims to provide knowledge

- To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.
- To understand the mechanism involved in various types of organic reactions with evidences.
- To understand the applications of synthetically important reagents.
- To correlate the reactivity between aliphatic and aromatic compounds.
- To design synthetic routes for synthetically used organic reactions.

Prerequisite

Students with knowledge on the basic concepts of organic chemistry.

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Recall the basic principles of aromaticity of organic and heterocyclic compounds.	80	75
CO2	Understand the mechanism of various types of organic reactions.	85	80
CO3	Predict the suitable reagents for the conversion of selective organic compounds.	80	78
CO4	Correlate the principles of substitution, elimination, and addition reactions.	80	75
CO5	Design new routes to synthesis organic compounds.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	S	S

CO2	M	S	S	S	S	M	M
CO3	S	S	M	S	S	S	S
CO4	M	S	S	S	S	M	M
CO5	M	S	M	S	S	M	S

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: Organic reaction mechanism-II

Unit I: Elimination and Free Radical Reactions 15 hrs

Mechanisms: E2, E1, and E1cB mechanisms. Syn and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.

Unit II: Oxidation and Reduction Reactions 15 hrs

Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated

hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexyl carbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.

Unit III: Rearrangements **15 hrs**

Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements.Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann and abnormal Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements.Fries and Photo Fries rearrangement.Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements.

Unit IV: Addition to Carbon Multiple Bonds 15 hrs

Mechanisms:(a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prinsreaction. Stereochemical aspects of addition reactions. Addition to Carbon-Hetero atom Multiplebonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates –Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

Unit V: Reagents and Modern Synthetic Reactions **15 hrs**

Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride (NaBH3CN), meta-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-Bu3SnD, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), N-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB).Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate (Cu(acac)2), TiCl3, NaIO4, Pyridinium chlorochromate (PCC),Pyridinium dichromate (PDC), Meisenheimer complex.Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.

Text Books:

1. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and Sons.2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P. S. Kalsi, Stereochemistry of carbon compounds, 8thedn, New Age International Publishers, 2015.

4. P. Y.Bruice, Organic Chemistry, 7th edn., Prentice Hall, 2013.
5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee Organic Chemistry, 7th edn., Pearson Education, 2010.

References:

1. S. H. Pine, Organic Chemistry, 5thedn, McGraw Hill International Editionn, 1987.
2. L. F. Fieser and M. Fieser, Organic Chemistry, Asia Publishing House, Bombay, 2000.
3. E.S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
4. T. L. Gilchrist, Heterocyclic Chemistry, Longman Press, 1989.
5. J. A. Joule and K. Mills, Heterocyclic Chemistry, 4th ed., John-Wiley, 2010.

Web Resources:

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. https://www.organic-chemistry.org/

Course Designers:

1. Dr. P. Prakash
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Mrs. P. Rajam
5. Dr. J. Thirupathy

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Elimination and Free Radical Reactions**	
1.1	Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium.	4
1.2	Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical,	4
1.3	Reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.	4
	Tutorial	3

2	**Oxidation and Reduction Reactions**	
2.1	Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions, reduction.	3
2.2	Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines.	4
2.3	Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide - dicyclohexyl carbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation,Hydroboration with cyclic systems, MPV and Bouveault-Blanc	5
	Tutorial	3
3	**Rearrangements**	
3.1	Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements.	4
3.2	Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann and abnormal Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements.	4
3.3	Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements.Fries and Photo Fries rearrangement.Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements.	4
	Tutorial	3
4	**Addition to Carbon Multiple Bonds**	
4.1	Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms- Addition to Carbon-Hetero atom Multiplebonds:	4

4.2	Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prinsreaction. Stereochemical aspects of addition reactions.	4
4.3	Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates–Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.	4
	Tutorial	3
5	**Reagents and Modern Synthetic Reactions**	
5.1	Reagents and Modern Synthetic Reactions: Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride (NaBH3CN), meta-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-Bu_3SnD, Triethylamine (TEA)	4
5.2	Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), N-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB).	4
5.3	Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($Cu(acac)_2$), $TiCl_3$, $NaIO_4$, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex.Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.	4
	Tutorial	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Elimination and Free Radical Reactions	15	Chalk and talk, Slides
2	Oxidation and Reduction Reactions	15	Chalk and talk, Slides
3	Rearrangements	15	Chalk and talk, Slides
4	Addition to Carbon Multiple Bonds	15	Chalk and talk, Slides

5	Reagents and Modern Synthetic Reactions	15	Chalk and talk, Slides
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: UCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23CT22	Physical chemistry-I	Core theory -4	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims to provide knowledge

- To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
- To understand the classical and statistical approach of the functions
- To compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein
- To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.
- To study the mechanism and kinetics of reactions.

Prerequisite

Students with minimum knowledge on the basics of thermodynamics and kinetics.

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Explain the classical and statistical concepts of thermodynamics.	80	75
CO2	Compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.	85	80
CO3	Discuss the various thermodynamic and kinetic determinations.	80	78
CO4	Evaluate the thermodynamic methods for real gases ad mixtures.	80	75
CO5	Compare the theories of reactions rates and fast reactions.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	S	M	M	M	M	S	M
CO2	S	M	S	S	S	M	M
CO3	S	S	S	M	M	S	M
CO4	S	S	M	S	M	S	M
CO5	S	M	M	M	M	S	M

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	S
CO2	S	M	M	L	S
CO3	S	S	S	M	S
CO4	S	S	S	M	S
CO5	S	S	S	M	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: Physical chemistry-I

Unit I: Classical Thermodynamics **15 hrs**

Partial molar properties-Chemical potential, Gibb's-Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity-determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.

Unit II: Statistical thermodynamics **15 hrs**

Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics-comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition principle. Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.

Unit III: Irreversible Thermodynamics **15 hrs**

Theories of conservation of mass and energy entropy production in open systems by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification- Onsager reciprocal relationships. Electro kinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.

Unit IV: Kinetics of Reactions **15 hrs**

Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis.

Unit V: Kinetics of complex and fast reactions **15 hrs**

Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of $H_2 - Cl_2$ & $H_2 - Br_2$ reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods - stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation.

Text Books:

1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition, S.L.N.Chand and Co., Jalandhar, 1986.
2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. Benjamin Publishers, California, 1972.
3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995.

4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013.
5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation, Macmillan India Ltd, Reprint - 2011.

References:

1. D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999.
2. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.
3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974
4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press, 1996.

Web Resources:

1. https://nptel.ac.in/courses/104/103/104103112/
2. https://bit.ly/3tL3GdN

Course Designers:

1. Dr. R. Sayeekannan
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3. Dr. T. Arumuganathan
4. Dr. M. Sathiya
5. Dr. A. Baish Nisha
6. Dr. K. Ganesan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Classical Thermodynamics**	
1.1	Partial molar properties-Chemical potential, Gibb's-Duhem equation-binary and ternary systems.	2
1.2	Determination of partial molar quantities.	2
1.3	Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition.	3
1.4	Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures.	3
1.5	Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.	2
	Turotial	3

2	**Statistical thermodynamics**	
2.1	Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles.	3
2.2	Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications.	2
2.3	Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases.	2
2.4	Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition principle.	3
2.5	Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.	2
	Tutorial	3
3	**Irreversible Thermodynamics**	
3.1	Theories of conservation of mass and energy entropy production in open systems by heat, matter and current flow, force and flux concepts.	3
3.2	Onsager theory-validity and verification	2
3.3	Onsager reciprocal relationships.	2
3.4	Electro kinetic and thermo mechanical effects-	3
3.5	Application of irreversible thermodynamics to biological systems.	2
	Tutorial	3
4	**Kinetics of Reactions**	
4.1	Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates,	2
4.2	Unimolecular reactions -Lindeman and Christiansen hypothesis-molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces.	2
4.3	Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation.	2
4.4	Factors determine the reaction rates in solution - primary salt effect and secondary salt effect,	2

4.5	Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law,	2
4.6	Enzyme catalysis-Michelis-Menton catalysis.	2
	Tutorial	3
5	**Kinetics of complex and fast reactions**	
5.1	Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions.	2
5.2	Chain reactions-chain length, kinetics of $H_2 – Cl_2$ & $H_2 – Br_2$ reactions (Thermal and Photochemical reactions) Rice Herzfeld mechanism.	3
5.3	Study of fast reactions-relaxation methods - temperature and pressure jump methods electric and magnetic field jump methods.	2
5.4	Stopped flow flash photolysis methods and pulse radiolysis.	2
5.5	Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation.	3
	Tutorial	3

Lecture schedule with teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1.1	**Classical Thermodynamics:** Partial molar properties-Chemical potential, Gibb's-Duhem equation-binary and ternary systems.	3	Chalk & board
1.2	Determination of partial molar quantities.	3	Chalk & board
1.3	Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition.	3	Chalk & board
1.4	Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures.	3	PPT
1.5	Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.	3	Chalk & board
2.1	**Statistical thermodynamics:** Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles.	3	Chalk & board

2.2	Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics-comparison and applications.	3	Chalk & board
2.3	Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases.	3	PPT
2.4	Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition principle.	3	Chalk & board
2.5	Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.	3	Chalk & board
3.1	**Irreversible Thermodynamics:** Theories of conservation of mass and energy entropy production in open systems by heat, matter and current flow, force and flux concepts.	4	Chalk & board
3.2	Onsager theory-validity and verification-	3	Chalk & board
3.3	Onsager reciprocal relationships.	2	PPT
3.4	Electro kinetic and thermo mechanical effects-	3	Chalk & board
3.5	Application of irreversible thermodynamics to biological systems.	3	Chalk & board
4.1	**Kinetics of Reactions:** Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates,	3	Chalk & board
4.2	Unimolecular reactions -Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces.	3	Chalk & board
4.3	Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation.	2	PPT
4.4	Factors determine the reaction rates in solution - primary salt effect and secondary salt effect,	2	Chalk & board
4.5	Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law,	3	Chalk & board
4.6	enzyme catalysis-Michelis-Menton catalysis.	2	Chalk & board
5.1	**Kinetics of complex and fast reactions:** Kinetics of	3	Chalk & board

	complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions.		
5.2	Chain reactions-chain length, kinetics of $H_2 – Cl_2$& $H_2 – Br_2$ reactions (Thermal and Photochemical reactions) Rice Herzfeld mechanism.	3	Chalk & board
5.3	Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods	3	Chalk & board
5.4	-stopped flow flash photolysis methods and pulse radiolysis.	2	Chalk & board
5.5	Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation.	4	PPT
Total		**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23CL21	Inorganic chemistry practical	Core lab - 2	-	1	4	4

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims to provide knowledge

- To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.
- To recall the principle and theory in preparing standard solutions.
- To train the students for improving their skill in estimating the amount of ion accurately present in the solution.
- To estimate metal ions, present in the given solution accurately without using instruments.
- To determinethe amount of ions, present in a binary mixture accurately.

Prerequisite

Students with minimum knowledge on qualitative analysis of inorganic salts at undergraduate level.

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Identify the anions and cations present in a mixture of salts.	85	80
CO2	Apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals.	85	83
CO3	Acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests.	80	78
CO4	Choose the appropriate chemical reagents for the detection of anions and cations.	80	78

CO5	Synthesize coordination compounds in good quality.	80	80

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**M**	**S**	**S**	**M**	**S**

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong, M – Medium, L – Low

Course title: Inorganic chemistry practical **75 hrs**

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

Group-I : W, Tl and Pb.

Group-II : Se, Te, Mo, Cu, Bi and Cd.

Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U.

Group-IV : Zn, Ni, Co and Mn.

Group-V : Ca, Ba and Sr.

Group-VI : Li and Mg.

Unit II: Preparation of metal complexes: Preparation of inorganic complexes:

a. Preparation of tristhiourea copper(I)sulphate

b. Preparation of potassium trioxalate chromate(III)

c. Preparation of tetramminecopper(II) sulphate

d. Preparation of Reineck's salt

e. Preparation of hexathioureacopper(I) chloridedihydrate

f. Preparation of *cis*-Potassium tri oxalate diaquachromate(III)

g. Preparation of sodium trioxalatoferrate(III)

h. Preparation of hexathiourealead(II) nitrate

Unit III: Complexometric Titration:

1. Estimation of zinc, nickel, magnesium, and calcium.

2. Estimation of mixture of metal ions-pH control, masking and demasking agents.

3. Determination of calcium and lead in a mixture (pH control).

4. Determination of manganese in the presence of iron.

5. Determination of nickel in the presence of iron.

Text Books:

1. A. JeyaRajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.
2. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rd ed., the National Publishing Company, Chennai, 1974.
3. Vogel's Text book of Inorganic Qualitative Analysis, 4th ed., ELBS, London.

References:

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

2. W. G. Palmer, Experimental *Inorganic Chemistry*; Cambridge University Press, 1954.

Web Resources:

1) http://www.federica.unina.it/agraria/analytical-chemistry/volumetricanalysis
2) https://chemdictionary.org/titration-indicator/

Course Designers:

Dr.A.Elangovan
Dr.D.S.Bhuvaneshwari
Dr.K.Selvakumar

Dr.S.Pitchaimuthu
Dr.N.Sudhan

Course Contents and lecture Schedule

Unit	Topic	Lecture / Practical hrs.
1	**Analysis of mixture of cations:** Analysis of a mixture of four cations containing two common cations and two rare cations.Cations to be tested. **(Any 3 salt mixtures)**	25
2	Preparation of metal complexes **(Any 6)**	25
3	Complexometric Titration **(Any 3)**	25

Teaching method

Unit	Topic	Lecture hrs.	Teaching Method
1	**Analysis of mixture of cations:** Analysis of a mixture of four cations containing two common cations and two rare cations.Cations to be tested. **(Any 3 salt mixtures)**	25	Practical
2	Preparation of metal complexes (Any 6)	25	Practical
3	Complexometric Titration (Any 3)	25	Practical
	Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23ET21	Medicinal chemistry(option A)	Elective-3	4	1	-	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims to provide knowledge

- To study the chemistry behind the development of pharmaceutical materials.
- To gain knowledge on mechanism and action of drugs.
- To understand the need of antibiotics and usage of drugs.
- To familiarize with the mode of action of diabetic agents and treatment of diabetes.
- To identify and apply the action of various antibiotics.

Prerequisite

Students with minimum knowledge on drugs and their properties.

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Predict drugs properties based on its structure.	80	75
CO2	Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design.	78	75
CO3	Explain the relationship between drug's chemical structure and its therapeutic properties.	80	75
CO4	Designed to give the knowledge of different theories of drug actions at molecular level.	75	75
CO5	To identify different targets for the development of new drugs for the treatment of infectious and GIT.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	S	S
CO2	M	S	S	S	S	M	S
CO3	S	S	M	S	S	S	S
CO4	M	S	S	S	S	M	S
CO5	M	S	M	S	S	M	S

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: Medicinal Chemistry

Unit I: Introduction to receptors **15 hrs**

Introduction, targets, Agonist, antagonist, partial agonist. Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action.

Unit II: Antibiotics **15 hrs**

Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicllins and tetracyclins, clinical application of penicillins, cephalosporin.Current trends in antibiotic therapy.

Unit III: Antihypertensive agents and diuretics **15 hrs**

Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.

Unit IV: Antineoplastic Agents and Psychoactive drugs **15 hrs**

Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer

The chemotherapy of Mind:

Introduction, neutotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, neurochemistry of mental diseases

Unit V:Analgesics, Antipyretics and Anti-inflammatory Drugs15 hrs

Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonyl urea.

Text Books:

1. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry, Lippincott Williams & Wilkins, 2004.
2. Wilson, Charles Owens: Beale, John Marlowe; Block, John H, Lipincott William, 12th edition, 2011.
3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 edn.
4. O. LeRoy, Natural and synthetic organic medicinal compounds, Ealemi, 1976.
5. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.

References:

1. Foye’s Princles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012
2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010.
3. Wilson and Gisvold’s Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12th edn.
4. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers.1995.
5. S. Ramakrishnan, K. G. Prasannan and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 3rd edition, 2001.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/books/NBK482447/
2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html
3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908

Course Designers:

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3. Dr. A. Tamil Selvi
4. Mrs. P. Rajam
5. Dr. J. Thirupathy

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Introduction to receptors**	
1.1	Introduction, targets, Agonist, antagonist, partial agonist.	4
1.2	Receptors, Receptor types, Theories of Drug – receptor interaction	4
1.3	Drug synergism, Drug resistance, physicochemical factors influencing drug action.	4
	Tutorial	3
2	**Antibiotics**	
2.1	Introduction, Targets of antibiotics action, classification of antibiotics	4
2.2	Enzyme-based mechanism of action, SAR of penicllins and tetracyclins	4
2.3	Clinical application of penicillins, cephalosporin.Current trends in antibiotic therapy.	4
	Tutorial	3
3	**Antihypertensive agents and diuretics**	
3.1	Classification of cardiovascular agents	4
3.2	Introduction to hypertension, etiology, types, classification of antihypertensive agents	4
3.3	Classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.	4
	Tutorial	3
4	**Antineoplastic Agents and Psychoactive drugs**	
4.1	Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer	4

4.2	The chemotherapy of Mind: Introduction, neutotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives,	4
4.3	Neurochemistry of mental diseases	4
	Tutorial	3
5	**Analgesics, Antipyretics and Anti-inflammatory Drugs**	
5.1	Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine.	4
5.2	Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemical classification,	4
5.3	Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonyl urea.	4
	Tutorial	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Introduction to receptors	15	Chalk and talk, Slides
2	Antibiotics	15	Chalk and talk, Slides
3	Antihypertensive agents and diuretics	15	Chalk and talk, Slides
4	Antineoplastic Agents and Psychoactive drugs	15	Chalk and talk, Slides
5	Analgesics, Antipyretics and Anti-inflammatory Drugs	15	Chalk and talk, Slides
Total		**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23ET21	Green chemistry(Option B)	Elective-3	4	1	-	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims to provide knowledge

- To discuss the principles of green chemistry.
- To propose green solutions for chemical energy storage and conversion.
- Propose green solutions for industrial production of Petroleum and Petrochemicals.
- Propose solutions for pollution prevention in Industrial chemical and fuel production, Automotive industry and Shipping industries.
- Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.

Prerequisite

Students with minimum knowledge on green chemistry and its principles

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Recall the basic chemical techniques used in conventional industrial preparations and in green innovations.	85	82
CO2	Understand the various techniques used in chemical industries and in laboratory.	80	80
CO3	Compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.	80	78
CO4	Apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organic synthesis.	80	75
CO5	Design and synthesize new organic compounds by green methods.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO4	**M**	**S**	**S**	**S**	**S**	**M**	**S**
CO5	**M**	**S**	**M**	**S**	**S**	**M**	**S**

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: Green chemistry

Unit I: **15 hrs**

Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, International green chemistry organizations and Twelve principles of Green Chemistry with examples.

Unit II: **15 hrs**

Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water,Ionic liquids-criteria, general methods of preparation, effect on organic reaction.

Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in $scCO_2$. Green synthesis-adipic acid and catechol.

Unit III: **15 hrs**

Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.

Unit IV: **15 hrs**

Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.

Unit V: **15 hrs**

Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.

Text Books:

1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.
2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7thedition, McGraw-Hill, NewDelhi, 2005.
3. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall, 1974.
4. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2001.
5. A. K. De, Environmental Chemistry, New Age Publications, 2017.

References:

1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry-Theory and Practical, University Press, 1998
2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001
3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000
4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002.
5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.

Web Resources:

1. https://www.organic-chemistry.org/
2. https://www.studyorgo.com/summary.php

Course Designers:

1. Dr. P. Prakash
2. Dr. R. Mahalakshmy
3. Dr. A. Tamil Selvi
4. Mrs. P. Rajam
5. Dr. J. Thirupathy

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction-Need for Green Chemistry.	4
1.2	Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies	4
1.3	International green chemistry organizations and Twelve principles of Green Chemistry with examples.	4
	Tutorial	3
2.1	Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate.	4
2.2	Green solvents: Water, Ionic liquids-criteria, general methods of preparation, effect on organic reaction.	4
2.3	Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in sc.CO_2. Green synthesis-adipic acid and catechol.	4
	Tutorial	3
3.1	Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts	4
3.2	Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts	4
3.3	Poly supported photosensitizers	4
	Tutorial	3
4.1	Phase transfer catalysis in green synthesis	4
4.2	oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation	4
4.3	Elimination reaction, Displacement reaction. Applications in organic synthesis.	4
	Tutorial	3
5.1	Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications.	4

5.2	Sonochemistry – Instrumentation, Cavitation theory	4
5.3	Ultra sound assisted green synthesis and Applications.	4
	Tutorial	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Introduction	15	Chalk and talk, Slides
2	Choice of starting materials, reagents, catalysts and solvents	15	Chalk and talk, Slides
3	Environmental pollution, Green Catalysis	15	Chalk and talk, Slides
4	Phase transfer catalysis in green synthesis	15	Chalk and talk, Slides
5	Micro wave induced green synthesis	15	Chalk and talk, Slides
Total		**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc. Chemistry on or after June 2023)
Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23ET22	Bioinorganic Chemistry (Option A)	Elective-4	4	1	-	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims to provide knowledge

- To understand the role of trace elements.
- To understand the biological significance of iron, sulpur.
- To study the toxicity of metals in medicines.
- To have knowledge on diagnostic agents.
- To discuss on various metalloenzymes properties.

Prerequisite

Students with minimum knowledge on Bioinorganic chemistry at undergraduate level.

Course Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Analyse trace elements.	80	75
CO2	Explain the biological redox systems.	85	80
CO3	Gain skill in analyzing the toxicity in metals.	80	78
CO4	Get experience in diagnosis.	80	75
CO5	Learn about the nitrogen fixation and photosynthetic mechanism.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	L	**S**	L	M
CO2	**S**	S	M	S	**S**	S	M
CO3	**S**	**L**	M	S	S	L	M
CO4	**S**	**S**	M	L	M	S	M
CO5	**S**	**S**	M	S	M	S	M

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	S	M	M	**S**
CO2	**S**	S	M	S	**S**
CO3	**S**	M	M	L	**S**
CO4	**S**	M	L	M	**S**
CO5	**S**	M	M	M	**S**

S – Strong, M – Medium, L – Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Syllabus: Bio-Inorganic Chemistry

Unit I: Essential trace elements **15 hrs**

Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and potassium transport, Calcium signalling proteins. Metalloenzymes: Zinc enzymes–

carboxypeptidase and carbonic anhydrase. Iron enzymes–catalase, peroxidase. Copper enzymes – superoxide dismutase, Plast ocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.

Unit II: Transport Proteins **15 hrs**

Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin. Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450. Non-heme oxygen carriers-Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.

Unit III: Nitrogen fixation **15 hrs**

Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property - Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis: photosystem-I and photosystem-II-chlorophylls structure and function.

Unit IV: Metals in medicine **15 hrs**

Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs; Platinum-Containing Anticancer Agents.Chelation therapy; Cancer treatment. Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. temperature and critical magnetic Field.

Unit V: Enzymes **15 hrs**

Introduction and properties - nomenclature and classification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.

Text Books:

6. Williams, D.R. –Introdution to Bioinorganic chemistry.
7. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry,RoyolSoceity of Chemistry, Monograph for Teachers-31
8. K.F. Purcell and Kotz, Inorganic chemistry, WB Saunders Co., USA.
9. G.N. Mugherjea and Arabinda Das, Elements of Bioinorganic Chemistry - 1993.
10. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, S. Chand, **2001**.

References:

1. M.Satake and Y.Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996)
2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London.
3. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.
4. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002.
5. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.

Web Resources:

1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html
2. https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html

Course Designers:

1. Dr. A. Elangovan
2. Dr. D. S. Bhuvaneshwari
3. Dr. K. Selvakumar
4. Dr. S. Pitchaimuthu
5. Dr. N. Sudhan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1	**Essential trace elements**	
1.1	Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and potassium transport, Calcium signalling proteins.	5
1.2	Metalloenzymes: Zinc enzymes–carboxypeptidase and carbonic anhydrase.	3
1.3	Iron enzymes–catalase, peroxidase. Copper enzymes – superoxide dismutase, Plast ocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.	4
	Tutorial	3
2	**Transport Proteins**	
2.1	Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation. Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin.	4
2.2	Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450. Non-heme oxygen carriers-Hemerythrin and hemocyanin.	4
2.3	Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.	4

	Tutorial	3
3	**Nitrogen fixation**	
3.1	Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property	4
3.2	Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia.	4
3.3	Photosynthesis: photosystem-I and photosystem-II-chlorophylls structure and function.	4
	Tutorial	3
4	**Metals in medicine**	
4.1	Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs	4
4.2	Platinum-Containing Anticancer Agents.Chelation therapy; Cancer treatment.	4
4.3	Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. Temperature and critical magnetic Field.	4
	Tutorial	3
5	**Enzymes**	
5.1	**I**ntroduction and properties -nomenclature and classification.	3
5.2	Enzyme kinetics, free energy of activation and the effects of catalysis.	4
5.3	Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.	5
	Tutorial	3

Teaching methods

Unit	Topic	Lecture hrs.	Teaching Method
1	Essential trace elements	15	BB & PPT
2	Transport Proteins	15	BB & PPT
3	Nitrogen fixation	15	BB & PPT
4	Metals in medicine	15	BB & PPT
5	Enzymes	15	BB & PPT

Total	**75**	

Thiagarajar College (Autonomous) :: Madurai – 625 009

Department of Chemistry

(For those joined M.Sc. Chemistry on or after June 2023)

Programme code: PCH

Course Code	Course Title	Category	L	T	P	Credit
PCH23ET22	Material Science (Option B)	Elective-4	4	1	-	3

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course aims to provide knowledge

- To understand the crystal structure, growth methods and X-ray scattering.
- To explain the optical, dielectric and diffusion properties of crystals.
- To recognize the basis of semiconductors, superconductivity materials and magnets.
- To study the synthesis, classification and applications of nanomaterials.
- To learn about the importance of materials used for renewable energy conversion.

Prerequisite

Students with basic knowledge on material synthesis and characterization.

Outcomes

On completion of the course students will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Understand and recall the synthesis and characteristics of crystal structures, semiconductors, magnets, nanomaterials and renewable energy materials.	80	75
CO2	Integrate and assess the structure of different materials and their properties.	80	75
CO3	Analyse and identify new materials for energy applications.	75	73
CO4	Explain the importance of crystal structures, piezoelectric and pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, structures and synthesis.	75	75

CO5	To design and develop new materials with improved property for energy applications.	78	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**M**
CO2	**M**	**S**	**S**	**S**	**S**	**M**	**M**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**M**
CO4	**M**	**S**	**S**	**S**	**S**	**M**	**M**
CO5	**M**	**S**	**M**	**S**	**S**	**M**	**M**

S – Strong, M – Medium, L – Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	S	M	S	**S**
CO2	**S**	S	S	S	**S**
CO3	**S**	M	S	S	**S**
CO4	**S**	S	M	S	**S**
CO5	**S**	S	M	S	**S**

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: Material Science

UNIT-I: Crystallography **15 hrs**

Symmetry - unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups - X-ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure–powder and single crystal applications. Electron charge density maps, neutron diffraction-method and applications.

Unit II: Crystal growth methods **15 hrs**

Nucleation–equilibrium stability and metastable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growthmethods-nucleation–equilibrium stabilityandmetastablestate.Singlecrystal–Lowandhightemperature, solution growth– Gel and sol-gel. Melt growth - Bridgeman-Stockbarger,Czochralskimethods.Fluxtechnique,physicalandchemical vapourtransport. Lorentz and polarization factor - primary and secondary extinctions.

Unit III: Properties of crystals **15 hrs**

Optical studies - Electromagnetic spectrum (qualitative) refractive index – reflectance – transparency, translucency and opacity. Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, Inorganic and polymer LED materials - Applications. Dielectric studies- Polarisation - electronic, ionic, orientation, and space charge polarisation. Effect of temperature. dielectric constant, dielectric loss. Types of dielectric breakdown–intrinsic, thermal, discharge, electrochemical and defect breakdown.

Unit IV: Special Materials **(15 hrs)**

Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications. Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and gian magneto resistance. Ferro, ferri and antiferromagnetic materials-applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory Alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and $LiNbO_3$.

Unit V: Materials for Renewable Energy Conversion **(15 hrs)**

Solar Cells: Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO2 and N2. Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.

Text Books:

1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.

2. Arumugam, Materials Science, Anuradha Publications, 2007.

3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010

4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.

5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.

References:

1. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001.

2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001.

3.. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.

4. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998.

5. A.R. West, Solid State Chemistry and Applications, John-Wiley and sons, 1987.

Web Resources:

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.
2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.
3. https://bit.ly/3QyVg2R

Course Designers:

1. Dr. A. Elangovan
2. Dr. D. S. Bhuvaneshwari
3. Dr. K. Selvakumar
4. Dr. S. Pitchaimuthu
5. Dr. N. Sudhan

Course Contents and lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Symmetry - unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups	4
1.2	X-ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography.	4
1.3	Crystal structure–powder and single crystal applications. Electron charge density maps, neutron diffraction-method and applications.	4

	Tutorial	3
2.1	Nucleation–equilibrium stability and metastable state. Single crystal – Low and high temperature, solution growth– Gel and sol-gel.	4
2.2	Crystal growthmethods-nucleation–equilibrium stabilityandmetastablestate.Singlecrystal–Lowandhightemperature, solution growth– Gel and sol-gel.	4
2.3	Melt growth - Bridgeman-Stockbarger,Czochralskimethods.Fluxtechnique,physicalandchemical vapourtransport. Lorentz and polarization factor - primary and secondary extinctions.	5
	Tutorial	2
3.1	Optical studies - Electromagnetic spectrum (qualitative) refractive index – reflectance – transparency, translucency and opacity.	3
3.2	Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, Inorganic and polymer LED materials - Applications.	4
3.3	Dielectric studies- Polarisation - electronic, ionic, orientation, and space charge polarisation. Effect of temperature. dielectric constant, dielectric loss. Types of dielectric breakdown–intrinsic, thermal, discharge, electrochemical and defect breakdown.	6
	Tutorial	2
4.1	Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications.	4
4.2	Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and gian magneto resistance. Ferro, ferri and antiferromagnetic materials-applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications.	5
4.3	Shape memory Alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and $LiNbO_3$.	4
	Tutorial	3
5.1	Solar Cells: Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes.	6
5.2	Photochemical activation and splitting of water, CO2 and N2.	4

	Manganese based photo systems for water-splitting.	
5.3	Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.	3
	Tutorial	3

Lecture Schedule

Unit	Topic	Lecture hrs.	Teaching Method
1	Crystallography	15	Models & PPT
2	Crystal growth methods	15	BB & PPT
3	Properties of crystals	15	BB & PPT
4	Special Materials	15	BB & PPT
5	Materials for Renewable Energy Conversion	15	BB & PPT
	Total	**75**	

Thiagarajar College(Autonomous), Madurai – 625 009

(Re-Accredited with A^{++} Grade by NAAC)

Department of Chemistry

(For those joined M.Sc., Chemistry on or after June 2023)

Programming Code: PCH

Course Code	Course title	Category	L	T	P	Credit
PCH23ST21	Research tools and techniques	SEC-2	3	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	II	25	75	100

Preamble

The course explains the importance of research tools and techniques which used in research related problems in chemistry.

Prerequisite

Students with basic knowledge on computer.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Understand the concept of research and research methodology Research and Publication Ethics: Patent, Copyright and Plagiarism	75%	75%
CO2	Do systematic literature review and Scientific journal Finder	75%	75%
CO3	Type equations and make a scientific report using LATEX	75%	75%
CO4	Learn about referencing tools, plagiarism identifying tools	75%	75%
CO5	Understand the instrumentation techniques used in chemistry research	75%	75%

Mapping of COs and POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L – Low

Mapping of COs and PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Bloom's Taxonomy and assessment pattern

Blooms Taxonomy	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: Research Tools and Techniques **45 hrs**

UNIT- I: Research and Research Methodology **9 hrs**

Definition and purpose of research - goals of scientific research - types of research – Difference between qualitative and quantitative research. Types of research methodology. Research - Publication ethics: Copy right, Patent, Plagiarism.

UNIT – II: Systematic Literature Review **9 hrs**

Searching the chemical literature - primary sources & secondary sources of literature survey - Scientific journal finder- Chemical abstracts online. Difference between research article and research review.

UNIT – III: LATEX in Report Making **9 hrs**

Introduction to Latex- Typing chemical equations using LATEX (Schrodinger Equation, Cell constant, Arrhenius Equation, first order rate equation, Molar Conductance, Equivalent Conductance). Making a scientific report using Latex.

UNIT – IV: Referencing Tools and Plagiarism tools **9 hrs**

Thesis layout – appendices - use of appendix and its format - presenting a scientific seminar - Referencing in documents – Referencing tools- Plagiarism identifying tools.

UNIT – V: Instrumentation techniques in chemistry research **9 hrs**

Principle, instrumentation and applications: Flame Emission spectroscopy - Atomic absorption spectroscopy (AAS), inductively coupled plasma (ICP), HPLC, GC-MS and Electro analytical Techniques (CV, DPV, LSV, EIS, Amperometry) – Spectro fluorimetry.

Text Books

1. Research Methodology for Scientific Research, K. Prathapan, 2019.
2. D.A. Skoog, D.M. West & F.J. Holler, Fundamentals of Analytical Chemistry, VII Edn., Saunders College Publishing, New York, 1996.
3. Hobart H. Willard, Lynne L. Merritt,Jr., John A. Dean, Frank A. Settle, Jr, Instrumental Methods of Analysis, VII edition, CBS publishers and distributors, New Delhi, 1986.
4. F.A. Settle Handbook of Instrumental techniques for analytical chemistry, Editor – prentice Hall Inc. 1997.

Reference Books

1. Kaur, Instrumental Methods of Chemical analysis. 8. Willam Kemp, Organic Spectroscopy, Palgrave, 3rdedition, 1991.
2. R.M. Silverstein, G.C. Bassler & T.C. Morril, Spectrometric Identification of Organic Compounds, John Wiley & Sons, V Edn., New York, 2001.
3. R.S Drago, Physical Methods in Chemistry, Saunders College Publishing, Philadelphia, 1977.
4. J. Anderson, B.H. Durston and M. Poole, Thesis and Assignment Writing, Wiley Eastern Ltd., New Delhi, 1997.
5. F. Abdul Rahim - Thesis Writing - A Manual Researcher, New age International Ltd., New Delhi, 1996.

Course Designers

1. Dr. M. Sathiya

Course contents and lecture schedule

Unit	TOPIC	No. of lecture hrs
1	**Research and Research Methodology**	
1.1	Definition and purpose of research - goals of scientific research	2
1.2	Types of research – Difference between qualitative and quantitative	2

	research	
1.3	Types of research methodology.	2
1.4	Research -Publication ethics: Copy right, Patent, Plagiarism	3
2	**Systematic Literature Review**	
2.1	Searching the chemical literature	2
2.2	primary sources & secondary sources of literature survey	2
2.3	Scientific journal finder- Chemical abstracts online.	3
2.4	Difference between research article and research review.	2
	UNIT – III **LATEX in Report Making**	
3.1	Introduction to Latex	2
3.2	- Typing chemical equations using LATEX (Schrodinger Equation, Cell constant, Arrhenius Equation, first order rate equation, Molar Conductance, Equivalent Conductance).	4
3.3	Making a scientific report using Latex	3
	UNIT – IV **Referencing Tools and Plagiarism tools**	
4.1	Thesis layout – appendices - use of appendix and its format -	2
4.2	presenting a scientific seminar - Referencing in documents – Referencing tools	4
4.3	Plagiarism identifying tools.	3
	UNIT – V **Instrumentation techniques in chemistry research**	
5.1	Principle, instrumentation and applications: Flame Emission spectroscopy - Atomic absorption spectroscopy (AAS),	3
5.2	Inductively coupled plasma (ICP), HPLC, GC-MS	3
5.3	Electro analytical Techniques (CV, DPV, LSV, EIS, Amperometry) – Spectro fluorimetry.	3

Thiagarajar College(Autonomous), Madurai – 625 009

(Re-Accredited with A^{++} Grade by NAAC)

Department of Chemistry

(For those joined M.Sc., Chemistry on or after June 2023)

Programming Code: PCH

Course Code	Course title	Category	L	T	P	Credit
PCH23AT21	ICT tools in chemistry – Lab	AECC- 2	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	II	25	75	100

Preamble

This lab course enables the students to build, optimize and to interpret the molecules.

Prerequisite

Students with basic knowledge on handling computer.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Build molecules and optimize its geometry	85%	85%
CO2	Convert the molecules into various file formats	85%	80%
CO3	Conformational analysis in chem3D	80%	75%
CO4	Interpret the HOMO/LUMO of the molecule	80%	75%
CO5	Visualizing the various 3D structures of biomolecules	75%	75%

Mapping of COs and POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**	**S**	**S**

S-Strong; M-Medium; L-Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Bloom's Taxonomy and assessment pattern

Blooms Taxonomy	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course title: ICT tools in Chemistry - Lab **30 hrs**

1. Construction of molecules in MarvinSketch, ChemSketch and Chem Draw online, Raxsyssoftware
2. Converting the molecules into different file
3. Energy Optimization in Chem3D
4. Conformational analysis in chem3D Molecular dynamics in chem3D
5. Interpreting HOMO and LUMO orbitals using chem3D
6. Visualizing biomolecules using Rasmol
7. Identifying various 3D strctures, active site using rasmol
8. Generating plots and graphs using Matlab
9. Visualizing molecules in Avogadro and UCSF chimera.
10. Selection and coloring of various atoms in drug molecules using rasmol.

Text Books

1. ChemDraw – User's guide, 2016, Perkin Elmer Informatics Inc., USA
2. Chem3D – User's guide, 2016, Perkin Elmer Informatics Inc., USA
3. Rasmol Manual

4. Matlab Manual
5. Avogadro Manual and Chimera Manual

Course Designers

1. Dr. M. Sathiya

VALUE ADDED COURSES

UG: Certificate Course

PG: Diploma course

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined B.Sc. Chemistry on or after June 2023)

Course Code	Course title	Category	L	T	P	Credit
CC1	Processing of Consumer Products – Lab	Certificate course (Value added course)	-	-	4	4

Year	Semester	Int. Marks	Ext. Marks	Total
I	I&II	25	75	100

Preamble

This course aims at familiarizing the preparation of consumer products which are used in daily life.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Identify the various ingredients present in the consumer products.	85%	85%
CO2	Gain theoretical knowledge on the preparation of consumer products.	80%	75%
CO3	Prepare consumer products like detergent powder, cleaning powder, tooth powder, etc., on their own.	80%	75%
CO4	Prepare consumer cum cosmetic products like Kaajal, Moisturizer, Lipsticks, etc., on their own.	80%	75%
CO5	Become an entrepreneur in making consumer products	80%	75%

Mapping of COs and POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**

CO5	**S**	**M**	**S**	**S**	**S**	**S**

S-Strong; M-Medium; L-Low

Mapping of COs and PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong; M-Medium; L-Low

Course title:Preparation of Consumer Products - Lab

The following Consumer Products will be prepared at Lab.

1. Instant Dhoop
2. Pain Balm
3. Detergent Powder /Liquid
4. Face Powder
5. Candles
6. Chalk
7. Cleaning Powder
8. Soap oil
9. Tooth Powder
10. Phenoyl
11. Shampoo
12. Lips Sticks
13. Kaajal
14. Moisturizer
15. Sanitizer

Text Books

1. Poucher, W.A. Perfumes, Cosmetics and soaps, Vol. III, Modern Cosmetics;
2. Simons, J.V. Chemistry and the beauty business.
3. B.K.Sharma, Industrial Chemistry, Goel publishing House, Meerut, 2003, New Delhi.

Reference Books

1. R.V.Shreve, Industrial Chemical Process, Tata McGraw Hill publishing company, 2005, Mumbai. 2. Mohan Malhotra, Latest Cottage Industries, 20th Edition Edn, Vishal publishers, 1980, Meerut

Course Designers

1. Dr. D. S. Bhuvaneshwari
2. Dr. M. Sathiya

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Chemistry
(For those joined M.Sc Chemistry on or after June 2023)

Course Code	Course title	Category	L	T	P	Credit
DC1	Molecular Modeling & Spectroscopy	Diploma (Value added course)	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	I & II	25	75	100

Preamble

This course enables the students to acquire knowledge on spectral techniques, QSAR studies and molocular modeling.

Prerequisites

Minimum knowledge on principle and application of analytical and technical tools.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Interpret IR spectral data.	85	80
CO2	Analyze UV-Visible spectroscopic data.	85	80
CO3	Make use of the basic principles of Fluorescence Spectroscopy.	80	78
CO4	Apply the QSAR relationship to identify the lead compounds as drug.	80	75
CO5	Draw the chemical structures, examin the theory of computational chemistry and calculate the energy minimization using the chemdraw software.	80	75

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	S	S
CO2	S	S	M	S	S	S	S
CO3	M	S	L	M	S	S	S
CO4	S	S	M	M	S	S	S
CO5	S	S	M	M	S	S	S

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	M	S	L	M	S
CO4	S	S	M	M	S
CO5	S	S	M	M	S

S-Strong; M-Medium; L-Low

Bloom's Taxonomy and assessment pattern

Blooms Taxanomy	**CA**		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Course title:Molecular Modeling & Spectroscopy

Unit I: FTIR spectroscopy 6 Hrs

FTIR- BasicPrinciple- Selection Rules-Instrumentation. Applications-Interpretation of FT-IR spectra of organic and Inorganic samples.

Unit II: UV-Visible spectroscopy 6 Hrs

Basic Principle-Selection Rules-Instrumentation, splitting of spectral terms-Orgel diagram, Evaluation of 10Dq. Evaluation of 10Dq and β values, Determination of unknown concentration of Ni^{2+}, Cu^{2+} and Fe^{2+}.

Unit III: Fluorescence spectroscopy 6 Hrs

Basic theory, principle, instrumentation and applications. Study of selected fluorescence molecule.

Unit IV: QSAR Studies 6 Hrs

QSAR- Partition coefficient, hydrophobicity constant, Hammet substituent constant, Taft steric factor, Hunsch equation, Craig plot, Topliss scheme, QSAR studies of comparing, identifying suitable organic lead compoundsas drug using softwares like Alchemy/Hyper Chem.

Unit V: Molecular modeling and Docking Studies 6 Hrs

Structure drawing, visualization and energy minimization of simple molecule using Chem Office, Rasmol. Docking of organic molecule, drugs in relevant enzyme or protein using Hex software.

Text Books:

1. C.M.Banwell, 2005, Introduction of Molecular Spectroscopy, IV Ed., TMH Company Ltd.
2. B.P.Straughan and S.Walkar, 1976, Spectroscopy, Vol.I, II and III, Chapman and Hill, UK.
3. R.S.Drago, 1999, Physical methods in chemistry, Saunders collge publishing, New Delhi.
4. Nakamato, Kazuo, Paul J.Macartry, 1986, Spectroscopy and structure of metal chelate Compounds, IV Ed, John Wiley and sons, Inc., New York .
5. B.K.Sharma, 1993, Instrumental method of chemical Analysis, GOEL publishing house, 12th Reprint, New Delhi.
6. W. Kemp, 1994, Organic spectroscopy, 4th Ed, ELBS, UK.
7. Y.R. Sharma, 1991, Elementry organic Absorption spectroscopy, S. Chand & Co., New Delhi.

Reference Books:

1. R.M.Silverstein, G.C.Bassler and T.C. Morrill, 2005, Spectrometric Identification of Organic Compounds 6th Ed, John Wiley, New York.
2. M.I. Gangwal, 2007, Medical Chemistry Lectures on Drug Design and Synthetic Drugs, Student publishing house.
3. Chem Office, Rasmol, and Hex-docking: Hand book prepared in the Department.

Course Designer

1. Dr. A. Elangovan
2. Dr. A. Tamil Selvi
3. Dr. T. Arumuganathan
4. Dr. S. Sathiya

Course contents and lecture schedule

Unit	Topic	No. of lecture hrs
I	**FTIR spectroscopy**	
1.1	FTIR - Basic Principle - Selection Rules	1
1.2	Instrumentation. Applications	3
1.3	Interpretation of FT-IR spectra of organic and Inorganic samples	2
II	**UV-Visible spectroscopy**	
2.1	Basic Principle - Selection Rules	1
2.2	Instrumentation, splitting of spectral terms	1
2.3	Orgel diagram, Evaluation of 10Dq. Evaluation of 10Dq and β values,	2
2.4	Determination of unknown concentration of Ni^{2+}, Cu^{2+} and Fe^{2+}.	2
III	**Fluorescence spectroscopy**	
3.1	Basic theory, principle, instrumentation and applications.	4
3.2	Study of selected fluorescence molecule.	2
IV	**QSAR Studies**	
4.1	QSAR-Partition coefficient, hydrophobicity constant, Hammet substituent constant, Taft steric factor, Hunsch equation, Craig plot, Topliss scheme, QSAR studies of comparing	4
4.2	Identifying suitable organic lead compoundsas drug using softwares like Alchemy/Hyper Chem.	2

V	**Molecular modeling and Docking Studies**	
5.1	Structure drawing, visualization and energy minimization of simple molecule using Chem Office, Rasmol.	4
5.2	Docking of organic molecule, drugs in relevant enzyme or protein using Hex software.	2

THIAGARAJAR COLLEGE (Autonomous), MADURAI-625 009
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Department of Chemistry
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Course Code	Course title	Category	L	T	P	Credit
DCL1	Spectroscopic Analysis & Software Utility-Lab	Diploma (Value added course)	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
I	I & II	25	75	100

Preamble

This course enables the students to acquire knowledge on recording and interpretation of spectral data, software usage for chemical structure drawing, QSAR and molocular modeling Studies.

Prerequisite

Minimum knowledge on spectroscopy and handling computer at undergraduate level.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected attainment
CO1	Record and interpret IR spectra.	80	75
CO2	Determine the concentration of metal ions using UV-Visible spectroscopic techniques.	85	80
CO3	Record and interpret fluorescence spectra.	80	78
CO4	Use chem softwares for chemical structure drawing and QSAR studies.	85	83
CO5	Use chem softwares for molecular modeling and docking studies.	85	80

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	S
CO2	S	S	M	M	S	M	S

CO3	M	S	M	S	S	M	S
CO4	M	S	S	S	S	M	S
CO5	M	S	S	S	S	M	S

S-Strong; M-Medium; L-Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S
CO2	S	S	M	M	S
CO3	M	S	M	S	S
CO4	M	S	S	S	S
CO5	M	S	S	S	S

S-Strong; M-Medium; L-Low

Course title: Spectroscopic Analysis & Software Utility-Lab

1. FT-IR spectroscopy 6 Hrs

FT-IR spectral recording of organic and inorganic samples and their interpretation.

2. UV-Visible spectroscopy 6 Hrs

Determination of unknown concentration of Ni^{2+}, Cu^{2+} and Fe^{2+} complexes

3. Fluorescence spectroscopy 6 Hrs

Spectral Recording and Study of selected fluorescence molecule and their interpretation

4. QSAR Studies 6 Hrs

Drawing of some organic molecules using Chem office. File conversion using Open BABEl. QSAR Studies using Alchemy/Hyper Chem softwares.

5. Molecular modeling and Docking Studies 6 Hrs

Structure drawing, visualization and energy minimization of simple molecule using Chem Office, Rasmol. Docking of organic molecule, drugs in relevant enzyme or protein using Hex software.

Course Designer

1. Dr. A. Elangovan
2. Dr. A. Tamil Selvi
3. Dr. T. Arumuganathan
4. Dr. M. Sathiya