HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam - 625 533.

PG DEPARTMENT OF CHEMISTRY

MASTER OF SCIENCE - CHEMISTRY

SYLLABUS

Choice Based Credit System – CBCS

With

Outcome Based Education (OBE)

(Academic Year 2026 - 2027 onwards)

HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

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College Vision and Mission

Vision

Our vision is to provide the best type of higher education to all, especially to students hailing from minority Muslim community, rural agricultural families and other deprived, under privileged sections of the society, inculcating the sense of social responsibility in them. Our college is committed to produce talented, duty- bound citizens to take up the challenges of the changing times.

Mission

Our mission is to impart and inculcate social values, spirit of service and religious tolerance as envisioned by our beloved Founder President Hajee Karutha Rowther.

The Vision beckons ..... the Mission continues forever.

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Department Vision and Mission

Vision

- Generate knowledgeable Chemists and scientists to enhance services to the society.

Mission

- Enable the students to excel in the subject, research and services.
- Elevate students to international standards.
- Encourage the students to take up competitive examinations.

Programme Educational Objectives (PEO)

Our graduates will be progressive, efficient, value based, academically excellent, creative, collaborative, empowered and globally competent literates with the skills required for societal change.

They will demonstrate

PEO1	Comprehensive knowledge and expertise, employability, the acumen of creative and critical thinking, the spirit of enquiry and professional attitude required for a successful career
PEO2	Accountability, linguistic competence and communication skills in the work environment and beyond
PEO3	Perseverance, effective collaboration, team spirit, leadership and problem solving skills
PEO4	Keen sense of civility, professional ethics, receptivity and moral righteousness
PEO5	Commitment to address social and environmental threats and to act as responsible service-minded, duty-bound global citizens

Programme Outcomes (PO)

On the successful completion of M. Sc., Chemistry programme, the students will be able to

PO1	Understand the essential parts of organic, inorganic and physical chemistry.
PO2	Categorize and apply the concepts of medicinal, environmental, nano, industrial, polymer, supramolecular and Computer Chemistry in real life situations.
PO3	Utilize basic analytical and technical skills in the various fields of chemistry to become as academically sound researchers and intellectuals.
PO4	Formulate novel research ideas in different areas of chemistry to solve various challenges of the society.
PO5	Formulate novel research ideas in different areas of chemistry to solve various challenges of the society.

Program Specific Outcomes (PSO)

A graduate of M. Sc. Chemistry after two years will

PSO1	Outline the essential parts of advanced fields of chemistry and pursue higher studies.
PSO2	Perform as employers in private/government institutions rising up to top positions by applying the learned concepts of chemical science.
PSO3	Utilize modern research and technological skills amongst the master students in order to become professionals and leaders in the various sectors of Chemical science.
PSO4	Recognize the importance of utilizing their research knowledge, skills and initiative for the benefit of society.
PSO5	Participate and succeed in various state, national and international level competitive examinations to get suitable employment in government and global research sectors.

Programme Scheme

Eligibility

A candidate who has passed B.Sc., Chemistry as the major subject with physics as one ancillary. The other ancillary subject may be Mathematics or Botany or Zoology is eligible for the Master of Science – Chemistry Degree. Duration of the Course: M.Sc., Chemistry – 2 years (4 Semesters).

For Programme Completion

A Candidate shall complete:

- Part III - Core papers in semesters I, II, III and IV respectively
- Part III - Generic Elective papers in semesters I and II respectively
- Part III - Discipline Elective Papers in semesters III and IV respectively
- Part IV - Skill Enhancement Course (NME) Paper in Semester III respectively
- Part IV - Summer Internship/Industrial Training Paper in semester III respectively
- Part IV - Skill Enhancement Course (Professional Competency Skill) Paper in Semester IV respectively
- Part V - Extension activity in semester IV

Scheme of Examinations under Choice Based Credit System

Term End Examinations (TEE)	- 75 Marks
Continuous Internal Assessment Examinations (CIAE)	- 25 Marks
Total	- 100 Marks

Pattern of Continuous Internal Assessment Examinations (CIAE)

Average of Two Internal Tests (each 20 marks)	- 20 Marks
Assignment	- 05 Marks
Total	- 25 Marks

Pattern of Term End Examinations
(Max. Marks: 75 / Time: 3 Hours)

External Examinations Question Paper Pattern for Part III and Part IV (Non- Major Elective & Skill based Subject)

Section – A (10 X 2 = 20 Marks)

Answer ALL questions.

- Questions 1 - 10
- One question from each unit
- Short answer questions

Section – B (5 X 5 = 25 Marks)

Answer ALL questions (Choose either a or b).

- Questions 11 - 15
- One question from each unit
- Paragraph

Section – C (3 X 10 = 30 Marks)

Answer any THREE out of five questions.

- Questions 16 - 20
- One question from each unit
- Essay type

Part V (Extension Activities)

- Internal Evaluation only

Passing Marks

Minimum 34 for External Exam
Eligibility for the degree – passing minimum is **50%**

Practical Examination

Internal	– 40 marks
External	– 60 marks (minimum 27 marks)
Total	– 100 marks

Passing minimum is **50%**

Weightage

Weightage for Bloom's Taxonomy	Percentage	Marks	
		CIAE	TEE
Knowledge (Remembering) – K1	8	2	6
Understanding – K2	9	2	7
Applying – K3	12	3	9
Analyzing – K4	12	3	9
Evaluate – K5	40	10	30
Create – K6	19	5(Seminar)	14
Gross Total	**100**	**25**	**75**

Assessment

Distribution of questions and marks for Continuous Internal Assessment Examinations

Bloom's Taxonomy	Section A	Section B	Section C	Total
Knowledge(K1)	1(2)	-	**-**	**Total 25 marks**
Understanding(K2)	1(2)	**-**	**-**	
Apply(K3)	-	1(3)	-	
Analyzing (K4)	-	1(3)		
Evaluate (K5)	-	-	2(10)	
Create (K6)	**Seminar (5)**			

Distribution of questions and marks for Term End Examinations

Bloom's Taxonomy	Section A	Section B	Section C	Total
Knowledge(K1)	3(6)	-	-	**Total 75 Marks**
Understanding(K2)	1(2)	1(5)	-	
Apply(K3)	2(4)	1(5)	-	
Analyzing (K4)	2(4)	1(5)	-	
Evaluate (K5)	-	-	3(30)	
Create (K6)	2(4)	2(10)	-	

Note: Figures in parenthesis are Marks

Credits Distribution

S.No	Part	Category	No of Courses	No of Credits
1	Part - III	Core (Theory / Practical / Project)	15	72
		Discipline Elective (Theory / Practical)	2	6
		Generic Elective (Theory / Practical)	2	6
2	Part - IV	NME	1	2
		Professional Competency	1	2
		Internship	1	2
3	Part - V	Extension Activity	1	1
Total			**23**	**91**

M.Sc., CHEMISTRY

Details of Course Category, Code, Credits & Title

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max. Marks	Credits
Semester – I							
Part – III							
Core -I	26PCHCC11	Organic Chemistry - I	6	25	75	100	5
Core -II	26PCHCC12	Inorganic Chemistry - I	6	25	75	100	5
Core -III	26PCHCC13	Physical Chemistry - I	5	25	75	100	5
Core -IV (Lab)	26PCHCC1P	Organic Chemistry Practical	8	40	60	100	4
Generic Elective -I	26PCHGE11	Medicinal & Pharmaceutical Chemistry	5	25	75	100	3
Total			**30**				**22**
Semester – II							
Part – III							
Core –V	26PCHCC21	Organic Chemistry - II	6	25	75	100	5
Core –VI	26PCHCC22	Inorganic Chemistry- II	5	25	75	100	5
Core –VII	26PCHCC23	Physical Chemistry - II	6	25	75	100	5
Core –VIII (Lab)	26PCHCC2P	Physical Chemistry Practical	8	40	60	100	4
Generic Elective -II	26PCHGE21	Analytical Chemistry	5	25	75	100	3
Total			**30**				**22**

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC11	**ORGANIC CHEMISTRY - I**	**Core-I**	**6**	**5**	**25**	**75**	**100**

Course Objectives

The course has been framed with an objective of instilling maximum knowledge on various chemical reaction and mechanism of aliphatic substitution, aromatic substitution, elimination and addition reactions.

UNIT	Contents	No. of Hours
I	**Electron Displacement:** Inductive and field effects – bond distances – bond energies – delocalized bonds – cross conjugation – rules of resonance – resonance energy – resonance effect – steric inhibition of resonance – Hyper conjugation – hydrogen bonding - Generation, structure, stability, and reactions of carbocations, carbanions, free radicals -Carbenes: Stability - Structure – Generation – Types – Reactions. Nitrenes: Generation and reactions – additional compounds – EDA complexes – Crown ether complexes – inclusion compounds – effect of structure on the association constants of acids and bases – concept of hard and Soft acids and bases.	18
II	**Introduction to reaction mechanism:** Guidelines for proposing reasonable mechanism – Energetics and energy profile diagrams– transition state – Intermediate – Hammond's postulate – principle of microscopic reversibility - kinetic and thermodynamic controls – kinetic and non-kinetic methods of determining organic reaction mechanism – primary and secondary kinetic isotope effects– Quantitative treatments – Hammett and Taft equation.	18
III	**Aliphatic substitution reaction:** Aliphatic Nucleophilic Substitution Reactions - Mechanism of S_N1, S_N2 and S_Ni- Effect of substrate structure, attacking nucleophile, leaving group and reaction medium on reactivity - Neighboring group participation by n, π and σ bonds – Reactivity at an allylic, aliphatic trigonal and vinylic carbon – Ambident nucleophiles. Electrophilic substitution reactions: Aliphatic Electrophilic Substitution Reactions - S_{E1}, S_{E2} and S_{Ei}.	18
IV	**Aromatic substitution reaction:** Aromatic character in Benzene, - aromatic sextets-Huckel's rule- Craig's Rule- concept of Homo aromaticity and Anti aromaticity- Alternate and Non- alternate hydrocarbons. Chemistry of Cyclopentadienyl anion-Fulvene, Azulene, tropolone, sydnones, annulenes. – orientation and reactivity - partial rate factors– Aromatic nucleophilic substitution reactions - S_NAr, S_N1 and benzyne mechanisms – Chichibabin reaction.	18
V	**Elimination and addition reactions:** Elimination: α-elimination - β-elimination – E1 and E2 and E1CB mechanisms- Hofmann Rule - Saytzeff rule -Bredt's rule - pyrolytic Elimination- Cope elimination- Chugaev reaction. Electrophilic, Nucleophilic & free radical addition – addition to α, β-unsaturated carbonyl - Michael addition – Enamine reaction - Reformatsky reaction- Darzen reaction- Mannich reaction - Wittig reaction - Stobbe and	18

	Dieckman condensation.	
Total		**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Classify the concept of chemical delocalization and intermediates in the chemical reaction	K1, K2
2	Examine the methods of determining organic reaction mechanism.	K1, K2, K3, K4
3	Interpret the mechanism in relation to aliphatic substitution reactions.	K1, K2, K3, K4, K5
4	Construct the mechanism aromatic substitution reactions.	K1, K2, K3, K4, K5, K6
5	Predict the reaction mechanism of various elimination and addition reactions.	K1, K2, K3, K4, K5, K6

K1-Knowledge K2-Understand K3-Apply K4- Analyse K5- Evaluate K6- Creating

Text books	
1.	Jerry March, ***Advanced Organic Chemistry Reaction mechanism and structure***, John Wiley and sons, New York, 2020, 8th Edition.
2.	R.O.C. Norman, ***Principles of organic synthesis***, Nelson Thornes, Hong Kong, reprint in 2017, 3rd Edition.
3.	P.J. Garrat., ***Aromaticity***, McGraw Hill, India,1991.
4.	F.A. Carey and R.J. Sundberg, ***Advanced Organic Chemistry***, ***Part A and B***, Plenum Press, 2007, 5th Edition.
5.	G.M. Badger, ***Aromatic character and Aromaticity***, Cambridge, USA, 2013.
Reference Books	
1.	Clayden, Greeves, Warren and Wothers., ***Organic Chemistry***, Oxford Uni Press, UK, 2014, 2rd Edition
2.	E.S. Gould., ***Mechanism and structure in Organic Chemistry***, Holtoo INC, 1973.
3.	G. Solomon., ***Organic Chemistry***, John Wiley and sons INC, 2017, 12th Edition.
4.	R.K. Mackie and D.M. Smith, ***Guide Book to Organic synthesis***, Longman, UK, 1999.
5.	Peter Sykes, A Guidebook to ***Mechanism in Organic Chemistry***, Longman, 2003, 6th Edition.
e-Resources	
1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	3
CO2	3	2	1	3	3
CO3	3	1	3	3	3
CO4	2	3	2	2	3
CO5	3	3	2	3	2

Strong-3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	3	1	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2

Strong-3 **Medium-2** **Low-1**

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	Inductive and field effects – bond distances – bond energies – delocalized bonds – cross conjugation –rules of resonance – resonance energy – resonance effect –steric inhibition of resonance.	4
1.2	Hyper conjugation – hydrogen bonding - Generation, structure, stability, and reactions of carbocations, carbanions, free radicals.	4
1.3	Carbenes: Stability, Structure, Generation, Types Reactions. Nitrenes: Generation and reactions.	4
1.4	Additional compounds – EDA complexes – Crown ether complexes – inclusion compounds.	3
1.5	Effect of structure on the association constants of acids and bases – concept of hard and soft acids and bases.	3
	UNIT - II	
2.1	Guidelines for proposing reasonable mechanism – Energetics and energy profile diagrams– transition state– Intermediate.	6
2.2	Hammond's postulate – principle of microscopic reversibility - kinetic and thermodynamic controls–kinetic and non-kinetic methods of determining organic reaction.	6
2.3	Mechanism – primary and secondary kinetic isotope effects– Quantitative treatments – Hammett and Taft equation.	6
	UNIT - III	
3.1	Mechanism – S_N1, S_N2 and S_Ni - Effect of substrate structure, attacking nucleophile, leaving group and reaction medium.	8
3.2	Neighboring group participation by n, π and σ bonds – Reactivity at an allylic, aliphatic trigonal and vinylic carbon – Ambident nucleophiles.	6
3.3	Aliphatic Electrophilic Substitution Reactions - SE_1, SE_2 and SE_i.	4
	UNIT - IV	
4.1	Aromatic character in Benzene, - aromatic sextets- Huckel's rule- Craig's Rule.	3
4.2	Concept of Homo aromaticity and Anti-aromaticity - Alternate and Non-alternate hydrocarbons.	3
4.3	Chemistry of Cyclopentadienyl anion-Fulvene, Azulene, tropolone,	6

	sydnones, annulenes.	
4.4	orientation and reactivity - partial rate factors.	3
4.5	Aromatic nucleophilic substitution reactions - S_NAr, S_N1 and benzyne mechanisms – Chichibabin reaction.	3
UNIT - V		
5.1	Elimination: α- elimination - β-elimination – $E1$ and $E2$ and $E1CB$ mechanisms.	4
5.2	Hofmann Rule- Saytzeff rule - Bredt's rule – pyrolytic elimination - Cope elimination- Chugaev reaction.	4
5.3	Electrophilic, Nucleophilic & free radical addition	3
5.4	Addition to α, β-unsaturated carbonyl-Michael addition – Enamine reaction - Reformatsky reaction.	4
5.5	Darzen reaction- Mannich reaction - Wittig reaction - Stobbe and Dieckman condensation.	3
	Total	**90**

Course Designer
Name: Mr. G. Arivalagan
Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC12	**INORGANIC CHEMISTRY - I**	**Core -II**	**6**	**5**	**25**	**75**	**100**

Course Objectives

The course gives in-depth knowledge on electronic structure of atom, solid state chemistry, various types of chemical bonding and acid-base concepts.

UNIT	Contents	No. of Hours
I	**Modern views of atomic structure:** Periodicity - Ionic radii – calculation of ionic radii by Pauling's method – NaC*l* and KC*l* - Computation of effective nuclear charge - applications of Slater's rule. Electronegativity – Applications of electronegativity. **Atomic term symbols**: methods of determining ground state term. Pigeon hole diagram, ground and higher states and Russel-Saunders microstate method for p^2 and d^2 configurations-term symbol for non-equivalent electrons. Molecular term symbols: di- and poly atomic molecules - H_2O and NH_3. Walsh diagram of AH_2 molecules.	18
II	**Solid state chemistry -I**: Packing of ions in crystals - ccp, hcp, bcc and fcc. Tetrahedral and octahedral voids/interstitial sites - edge length, radius, size of interstitial site and radius ratio rule. Stoichiometry and crystal structures – AB, AB_2 and ABX_3 - Structure of typical lattices such as calcite, cesium chloride, Fluorite, Antifluorite, Cadmium iodide, Perovskite and Spinels - normal and inverse.	18
III	**Solid-state chemistry-II:** Derivation of Born-Lande equation, Born-Haber cycle-thermochemical calculations, factors affecting hydration, lattice energy and solvation energy. Fajan's rule and applications. Bragg 's equation- problems involving Bragg 's equation. Crystal structure determination- X-ray diffraction study, Electron and Neutron diffractions. Crystal defects- point – Schottky and Frenkel defect - line and plane defects- colour centers- non- stoichiometric Compounds - effect of imperfections and non- stoichiometry on physical properties.	18
IV	**Chemical bonding:** Covalent bond – Valence bond theory – Hybridization - Molecular orbital theory - LCAO model. Application of VB and MO theories to the structure of homo nuclear (H_2, N_2 and O_2) and hetero nuclear (CO, NO, HC*l*, HF) diatomic and selective polyatomic molecules (NH_3, H_2O, NO_2, BeH_2, CO_2, CO_3^{2-}) - comparison of VB and MO theories. VSEPR theory and its applications – XeO_3, XeF_2, XeF_3, XeF_4, XeF_6, XeOF.	18
V	**Acid-base systems and non-aqueous solvents**: Generalized acid base concepts – Arrhenius, Bronsted-Lowry, Lux-Flood, Lewis and Usanovich acid-base concepts – steric effects and solvation effects – Measures of Acid Base strength –Factors affecting the strength of acids and bases- Common ion effect and Henderson 's equation- Hard and Soft acids and bases – symbiosis – theoretical basis of hardness and softness. Classification of solvents –	18

	properties of ionizing solvents. Typical reactions in non–aqueous solvents- liquid HF, liquid SO_2, liquid N_2O_4, and sulphuric acid.	
Total		**90**

Course Outcomes

CO	On completion of this course, students will	Knowledge Level
1	Categorize the electronic structure of atom and term symbols.	K1, K2, K3, K4
2	Distinguish the ionic bonding and some typical ionic lattices.	K1, K2, K3, K4
3	Interpret the concepts of lattice energy and defects of crystals.	K1, K2, K3, K4, K5
4	Invent the concepts of VBT, MOT and VSEPR theory to structure of molecules.	K1, K2, K3, K4, K5, K6
5	Predict the acid-base concepts and chemical reactions in non–aqueous solvents.	K1, K2, K3, K4, K5, K6

K1-Knowledge K2-Understand K3-Apply K4- Analyse K5- Evaluate K6- Creating

Text books

1.	Huheey, J. E. Ellen A. Keiter, Richard L. Keiter, ***Inorganic Chemistry***, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2022, 5th Edition.
2.	Lee, J. D. Concise ***Inorganic Chemistry***, Blackwell Science Ltd., London. 2002, 5th Edition.
3.	Madan R. D. Modern ***Inorganic Chemistry***, S. Chand & Company Ltd., New Delhi, 2022.

Reference Books

1.	Chandra, A. K. ***Introductory Quantum Chemistry***, Tata McGraw Hill, New Delhi, reprint in 2017,4th Edition.
2.	Wahid U. Malik, G. D. Tuli and R. D. Madan, ***Selected Topics in Inorganic Chemistry***, S. Chand & Co. Ltd., New Delhi, 2022.
3.	Gary L. Miessler and Donald A. Tarr, ***Inorganic Chemistry***, Pearson Education, Inc., New Delhi, 2025, 5th Edition.
4.	William W. Porterfield, ***Inorganic Chemistry***, Elsevier, New Delhi, 2013, 2ndEdition.
5.	Shriver D. F. and Atkins, P.W. ***Inorganic Chemistry***, Oxford University Press, London, 2009, 5th Edition.
6.	Azaroff, ***Introduction to Solids***, Tata McGraw hill, New Delhi, 2004.
7.	K. Chakrabarthy, ***Solid State Chemistry***, New Age International Publishers, (P) Ltd., 2005.

e-Resources

1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	3
CO2	3	2	3	3	3
CO3	2	2	3	2	3
CO4	3	2	3	2	2
CO5	3	3	2	3	2

Strong-3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	2	2	2	3
CO3	3	2	2	2	3
CO4	3	2	2	3	3
CO5	3	3	3	3	3

Strong-3 **Medium-2** **Low-1**

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	Periodicity - Ionic radii – calculation of ionic radii by Pauling's method – NaCl and KCl - Computation of effective nuclear charge - applications of Slater's rule.	6
1.2	Electronegativity – Applications of electronegativity.	3
1.3	Atomic term symbols: methods of determining ground state term. Pigeon hole diagram, ground and higher states and Russel-Saunders microstate method for p^2 and d^2 configurations - term symbol for non-equivalent electrons.	6
1.4	Molecular term symbols: di- and poly atomic molecules - H_2O and NH_3. Walsh diagram of AH_2 molecules.	3
	UNIT - II	
2.1	Solid state chemistry -I: Packing of ions in crystals - ccp, hcp, bcc and fcc. Tetrahedral and octahedral voids/interstitial sites - edge length, radius, size of interstitial site and radius ratio rule.	6
2.2	Stoichiometry and crystal structures – AB, AB_2 and ABX_3.	4
2.3	Structure of typical lattices such as calcite, cesium chloride, Nickel arsenide, Fluorite, Antifluorite, Cadmium iodide.	5
2.4	Perovskite, Spinels (normal and inverse).	3
	UNIT - III	
3.1	Solid state chemistry -II: Derivation of Born-Lande equation, Born-Haber cycle-thermochemical calculations, factors affecting hydration, lattice energy and solvation energy.	5
3.2	Fajan's rule and applications.	3
3.3	Bragg's equation- problems involving Bragg's equation. Crystalstructure determination- X-ray diffraction study, Electron and Neutron diffractions.	5
3.4	Crystal defects- point – Schottky and Frenkel defect - line and plane defects- colour centers- non- stoichiometric Compounds - effect of imperfections and non- stoichiometry on physical properties.	5
	UNIT - IV	
4.1	Chemical bonding: Covalent bond – Valence bond theory – Hybridisation - Molecular orbital theory - LCAO model.	4
4.2	Application of VB and MO theories to the structure of homo nuclear (H_2,	5

	N_2 and O_2) and hetero nuclear (CO, NO, HCl, HF) diatomic molecules.	
4.3	selective polyatomic molecules (NH_3, H_2O, NO_2, BeH_2, CO_2, CO_3^{2-}) - comparison of VB and MO theories.	5
4.4	VSEPR theory and its applications – XeO_3, XeF_2, XeF_3, XeF_4, XeF_6, XeOF.	4
UNIT - V		
5.1	Generalized acid base concepts – Arrhenius, Bronsted- Lowry, Lux-Flood, Lewis and Usanovich acid-base concepts – steric effects and solvation effects.	4
5.2	Measures of Acid Base strength –Factors affecting the strength of acids and bases- Common ion effect and Henderson's equation- Hard and Soft acids and bases.	6
5.3	symbiosis – theoretical basis of hardness and softness. Classification of solvents – properties of ionizing solvents.	3
5.4	Typical reactions in non–aqueous solvents- liquid HF, liquid SO_2, liquid N_2O_4, and sulphuric acid.	5
	TOTAL	**90**

Course Designer
Name: Dr. M.P. Kesavan
Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC13	**PHYSICAL CHEMISTRY - I**	**Core -III**	**5**	**5**	**25**	**75**	**100**

Course Objectives

The course enables the students to gain knowledge on quantum chemistry, application of quantum chemistry, properties and kinetic approach of gases, acquire analytical skills in the field of photochemistry & radiation.

UNIT	Contents	No. of Hours
I	**Quantum Chemistry – I:** Classical Mechanics: Assumptions and failures – Photoelectric effect, Compton Effect, Energy distribution in black body radiation –Wien's and Stefan- Boltzmann's laws of emissive power, Hydrogen atomic spectrum- problems. Postulates of Quantum Mechanics – Concept of operators- linear and nonlinear, angular momentum, Hermitian and Hamiltonian operators- Eigen functions and Eigen values- Orthogonality, normalization and orthonormal functions- Derivation of time dependent and time independent Schrodinger wave equations.	15
II	**Quantum Chemistry - II:** Application of Schrodinger wave equation: Particle in a box (1D & 3D) – Bohr's correspondence principle – QM tunneling – Particle in a ring- rigid rotor – Simple Harmonic Oscillator- Setting and solving Schrodinger wave equation to hydrogen atom and H–like ion (He^+) – Significance of n, l and m- Shapes of atomic orbitals- radial and angular probability distribution functions.	15
III	**Application of QM to H-atom and Multi-Electron Atoms:** Need for Approximation methods: Variation method - Application to Hydrogen atom- Perturbation (first order) method to Helium atom. Two electron systems: The electron spin, Pauli Exclusion Principle and Slater determinant for He atom. Theory of Chemical bonding: Huckel's molecular orbital (HMO) theory and its applications to Ethylene and butadiene.	15
IV	**Kinetic Theory Of Gases and liquid crystals:** Equations of states – molecular speeds - Maxwell distribution of molecular velocities - one, two and three dimensions; Energy distribution-Maxwell – Boltzmann distribution law Rotation, vibrations and translational degree of freedom- principle of equipartition of energy - Molecular collisions- collision diameter, cross-section, number, frequency, mean free path (definition only); Transport phenomena in gases - Viscosity of gases – viscosity in terms of momentum transfer. Liquid crystals- Nematic (p-methoxy cinnamic acid), cholesteric (cholestryl benzoate), smectic (ethyl-p-azoxy benzoate)- Theory and its application in liquid crystals display.	15
V	**Photochemistry:** Photophysical processes in electronically excited molecules - Fluorescence, Phosphorescence and other deactivating processes. Stern-Volmer equation - electronically energy transfer	15

	mechanisms –photosensitization and chemiluminescence. Experimental techniques - light sources - chemical actinometry. **Radiation chemistry:** Source of high energy- Interaction of high energy radiation with matter Radiolysis of water- definition of G value- mode of reactions of hydrated electrons OH^- and H^+. Experimental techniques - Dosimetry.	
Total		**75**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Illustrate the various concepts involved in quantum mechanics and determine the solution for each system.	K1, K2, K3, K4
2	Inspect quantum mechanical approach to concepts that govern atomic structure.	K1, K2, K3, K4
3	Interpret the quantum chemistry concepts and their applications.	K1, K2, K3, K4, K5
4	Invent the distribution, motion and energy of gases.	K1, K2, K3, K4, K5, K6
5	Predict the physical concepts of Photochemistry and Radiation chemistry.	K1, K2, K3, K4, K5, K6

K1-Knowledge K2-Understand K3-Apply K4- Analyse K5- Evaluate K6- Creating

Text books	
1.	Glasstone S. A., ***Text book of Physical Chemistry***, McMillan India Ltd., 2013.
2.	Alberty R. A. and Daniels F., ***Physical Chemistry***, John Wiley & Sons, New York, 1992.
3.	Castellan G. W., ***Physical chemistry***, Wesley Publishing Company, UK, 2004, 3rd Edition.
4.	Atkins P, ***Physical Chemistry***, Oxford University Press, UK, 2022. 12th Edition.
5.	Atkins P. W., ***Molecular Quantum Mechanics***, Oxford University Press, UK, 2010,5th Edition.
6.	Hanna H. W., ***Quantum Mechanics in Chemistry***, Benjamin- Cummiza London Publishing Company, UK, 1983.
7.	Chandra A.K., ***Introductory quantum chemistry***, Tata McGrow- Hill Publishing Co Ltd., New Delhi, India. 2017, 4th Edition.
8.	Prasad R.K., ***Quantum Chemistry***, 2024, 6th revised edition.
Reference Books	
1.	Glasstone S., ***A text book of Physical Chemistry***, McMillan India Ltd., Alasca,1999.
2.	Walter J. Moore, ***Physical Chemistry***, Orient Longman, New York, 2006, 6thEdition.
3.	Levine, ***Quantum Chemistry***, Prentice-Hall, New Delhi, 2014, 7th Edition.
4.	Mcquarrie D. A., ***Quantum Chemistry***,Viva Books Pvt. Ltd., New Delhi, 2008.
5.	Levine, ***Quantum Chemistry***, Prentice-Hall, UK, 2003, 5th Edition.
6.	Raymond Chang, ***Physical Chemistry with application to biochemical system***, McMillan Publishing Company. Inc., New Delhi. 2012, 5thEdition.
7.	Rohatgi-Mukherjee K.K., ***Fundamentals of Photochemistry***, Wiley EasternLtd., New York, 2021, 4thEdition.
e-Resources	
1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	3
CO2	3	2	2	2	3
CO3	2	3	3	2	3
CO4	2	2	2	3	3
CO5	2	3	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	3	3	2	2	3
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	Classical Mechanics: Assumptions and failures – Photoelectric effect, Compton Effect, Energy distribution in black body radiation.	3
1.2	Ultraviolet catastrophe, Wien's and Stefan- Boltzmann's laws of emissive power, Hydrogen atomic spectrum-problems.	3
1.3	Postulates of Quantum Mechanics – Concept of operators- linear and nonlinear, angular momentum, Hermitian and Hamiltonian operators.	3
1.4	Eigenfunctions and Eigen values- Orthogonality, normalization and orthonormal functions.	3
1.5	Derivation of time dependent and time independent Schrodinger wave equations.	3
	UNIT - II	
2.1	Application of Schrodinger wave equation: Particle in a box (1D & 3D)	3
2.2	Bohr's correspondence principle – QM tunneling – Particle in a ring- rigid rotor – Simple Harmonic Oscillator.	3
2.3	Setting and solving Schrodinger wave equation tohydrogen atom and H–like ion (He^+)	3
2.4	Significance of n, l and m- Shapes of atomic orbitals.	3
2.5	Radial and angular probability distribution functions.	3
	UNIT - III	
3.1	Need for Approximation methods: Variation method - Application to Hydrogen atom.	3
3.2	Perturbation (first order) method to Helium atom.	4

3.3	Two electron systems: The electron spin, Pauli Exclusion Principle and Slater determinant for He atom.	4
3.4	Theory of Chemical bonding: Huckel's molecular orbital (HMO) theory and its applications to Ethylene and butadiene.	4
UNIT - IV		
4.1	Equations of states - molecular speeds- Maxwell distribution of molecular velocities - one, two and three dimensions.	3
4.2	Energy distribution-Maxwell – Boltzmann distribution law- Rotation, vibrations and translational degree of freedom- principle of equipartition of energy.	3
4.3	Molecular collisions- collision diameter, cross-section, number, frequency, mean free path (definition only).	3
4.4	Transport phenomena in gases - Viscosity of gases –viscosity in terms of momentum transfer.	3
4.5	Liquid crystals- Nematic (p methoxy cinnamic acid), cholesteric (cholestryl benzoate), smectic (ethyl-p - azoxybenzoate)-Liquid crystals theory and its application in liquid crystals display.	3
UNIT - V		
5.1	Photo physical processes in electronically excited molecules - Fluorescence, Phosphorescence and other deactivating processes. Stern-Volmer equation.	5
5.2	Electronically energy transfer mechanisms –photosensitization and chemiluminescence. Experimental techniques - light sources - chemical actinometry.	4
5.3	Source of high energy- Interaction of high energy radiation with matter Radiolysis of water- definition of G value	3
5.4	Mode of reactions of hydrated electrons OH^- and H^+. Experimental techniques - Dosimetry.	3
Total		**75**

Course Designer
Name: Dr. A. Nihath Nazleen
Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC1P	**ORGANIC CHEMISTRY PRACTICAL**	**Core -IV (Lab)**	**8**	**4**	**40**	**60**	**100**

Course Objectives

This lab course enhances the laboratory skill of analyzing the functional groups present in a mixture of organic compounds qualitatively, preparing organic compounds, estimation of simple organic compounds.

UNIT	Contents	No. of Hours
I	**Qualitative analysis-I** Separation and analysis of two component mixtures (1-3). Identification of the components and preparation of solid derivative.	30
II	**Qualitative analysis-II** Separation and analysis of two component mixtures (4-6). Identification of the components and preparation of solid derivative.	30
III	**Quantitative analysis:** 1. Estimation of glucose by lane and Eynon method and Bertrand method 2. Estimation of glycine	20
IV	**Quantitative analysis:** 1. Estimation of formalin 2. Estimation of methyl ketone	20
V	**Organic preparations**: (Only for class work) About 3 (five) two-stage preparation: 1. p-Nitro aniline from acetanilide benzophenone 2. p-Bromo aniline from acetanilide Aniline 3. m-Nitro benzoic acid from methyl benzoate.	20
	Total	**120**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Classify the organic molecules.	K1, K2, K3, K4
2	Separate the organic mixture by chemical methods.	K1, K2, K3, K4
3	Predict the amount of glucose and amino acid viz., glycine and Formaldehyde.	K1, K2, K3, K4, K5
4	Invent the iodometric method to estimate Ketonic compound.	K1, K2, K3, K4, K5, K6
5	Create the derivatives for the given organic compound.	K1, K2, K3, K4, K5, K6

K1-Knowledge K2-Understand K3-Apply K4- Analyse K5- Evaluate K6- Creating

Textbooks

1. Dr. N. S. Gnanapragasam, ***Organic Chemistry: Lab Manual***, Viswanathan**,** S., Printers & Publishers Pvt Ltd, 2013.

Reference Books

1.	Brian S. Furniss, ***Vogel's Textbook of Practical Organic Chemistry,*** Pearson India, 2003, 5th Edition.
e-Resources	
1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO1	3	1	3	3	2
CO2	3	1	3	3	2
CO3	3	1	3	2	2
CO4	3	1	2	2	2
CO5	3	2	3	3	1

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	3	3	2	1	2
CO3	3	3	3	3	3
CO4	3	3	2	1	2
CO5	3	3	3	3	2

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LAB SCHEDULE

Module No.	Topic	No. of Hours
UNIT - I		
1.1	Separation and analysis of two component mixtures (1-3). Identification of the components and preparation of solid derivative.	30
UNIT - II		
2.1	Separation and analysis of two component mixtures (4-6). Identification of the components and preparation of solid derivative.	30
UNIT - III		
3.1	Estimation of glucose by lane and Eynon method and Bertrand method	10
3.2	Estimation of glycine	10
UNIT - IV		
4.1	Estimation of formalin	10
4.2	Estimation of methyl ketone	10

UNIT - V		
5.1	p-Nitro aniline from acetanilide benzophenone	7
5.2	p-Bromo aniline from acetanilide Aniline	7
5.3	m-Nitro benzoic acid from methyl benzoate	6
Total		**120**

Course Designer
Name: Ms. A. Mumthaj
Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHGE11	**MEDICINAL & PHARMACEUTICAL CHEMISTRY**	**Generic Elective -I**	**5**	**3**	**25**	**75**	**100**

Course Objectives

Construe the drugs and their interactions with various organs of humans, synthesis of new drugs and their biological activities, therapeutic uses of hypoglycemic drugs, alkaloids and antibiotics.

UNIT	Contents	No. of Hours
I	**Fundamentals of Medicinal Chemistry:** Pharmacology and Molecular Pharmacology - Major process involved in drug action - Pharmacokinetics phase – Quantitative Structure Activity Relationship (QSAR) - Hansch approach – Concept of bioisosterism – Receptors and classification of membrane bound receptors - Enzyme inhibitors as drugs (illustrated with one example).	15
II	**Medicinally useful antibiotics:** Structural features and mode of action of the following antibiotics – penicillin G, Cephalosporin and their semi synthetic analogs (β-lactum), Streptomycin (Aminogylcoside), Terramycin (Tetracycline), Erythromycin (Macrolide) and Chloramphenicol. **Diabetes and Hypoglycemic drugs:** Chemical structure and therapeutic uses of Chlorpropamide, Gilbenclamide, Biguanides and Metformin.	15
III	**Chemotherapeutic Agents:** **Antineoplastic Agents:** Classification, synthesis e.g., Cyclophosphamide, Ifofamide, Chlorambucil, Busulfan, Decarbazine,. **Anti-tubercular drugs:** Classification, synthesis, e.g., Isoniazid, Pyrazinamine, Ethambutol, Thiacetoazone and Ethionamide. **Antimalarial drugs:** Classification, synthesis, e.g., Chloroquine, Primaquine, Amaodiaquine and Pyrimethamine. **Diuretics:** Classification, Synthesis, e.g., Furesemide, Acetazolamide, Chlorothiazide.	15
IV	**Synthesis and Therapeutic action and SAR of certain drugs:** **Antihypertensive drugs**: Nifedipine, Captopril, Hydralazine, Sodium nitroprusside and Clonidine. **Antihistamines**: H1-Antagonists: Pheniramine, Chlorpheniramine, Diphenylhydramine, Mepyramine, Promethazine, H2-Antogonist: Cimetidine, Ranitidine and Fomotidine.	15
V	**Anti-inflammatory drugs:** Antipyretics & Non-narcotic analgesics; Aspirin, sodium salicylate, Paracetamol, phenylbutazone, Oxypheylbutazone, Ibuprofen, Mefenamic acid and Dichlofenac sodium. **CNS stimulant Drugs:** Amphetamine, Caffeine, Theobromine, Theophylline, Bemegride, Nikethamide and Methylphenidate. **CNS depressant Drugs:** Phenelazine, Isocarboxazide, Imipramine,	15

	Nortiptyline, Amitriptyline and Desipramine.	
Total		**75**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Illustrate the fundamentals of medicinal chemistry, QSAR, bioisosterism, receptor and enzyme inhibitors as drugs.	K1, K2, K3, K4
2	Discover and evaluate medicinally useful antibiotics and hypoglycemic drugs.	K1, K2, K3, K4
3	Interpret the drugs such as Antineoplastic Agents, Anti-tubercular drugs, Antimalarial drugs and Diuretics.	K1, K2, K3, K4, K5
4	Predict the synthesis drugs such as Antihypertensive drugs and Antihistamines.	K1, K2, K3, K4, K5, K6
5	Construct the basic concepts of Anti-inflammatory drugs, CNS stimulant drugs and CNS depressant drugs.	K1, K2, K3, K4, K5, K6

K1-Knowledge K2-Understand K3-Apply K4- Analyse K5- Evaluate K6- Creating

Textbooks	
1.	G.L. Patrick, ***An introduction to Medicinal chemistry***, Oxford, 2023, 7th Edition.
2.	Ashutoshkar, ***Medicinal Chemistry***, New Age International Pvt. Ltd., 2023, 8th Edition.
3.	G.R. Chatwal, ***Medicinal Chemistry***, Himalaya Publishing House, 2010, 2nd Edition.
4.	J. Dharuman, ***Pharmaceutical Organic Chemistry***, AITBS Publishers, 2022, 2nd Edition.
Reference Books	
1.	T. Nagradi, ***Medicinal Chemistry*** – A Biochemical Approach, Oxford University, 2005. 3rd Edition.
2.	J. B. Taylor and P.D. Kennewall, ***Introductory Medicinal Chemistry***, Ellisworth Publishers, 1985.
e-Resources	
1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	1	3	1	3	1
CO2	1	3	1	3	2
CO3	1	3	2	2	2
CO4	1	3	2	2	1
CO5	1	3	1	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	3
CO2	3	1	1	3	2
CO3	2	2	1	3	2
CO4	3	2	3	3	2
CO5	2	3	1	3	2

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	Pharmacology and Molecular Pharmacology- Major process involved in drug action – Pharmacokinetics phase.	6
1.2	Quantitative structure Activity relationship (QSAR) - Hansch approach – Concept of bio-isosterism.	5
1.3	Receptors and classification of membrane bound receptors - enzyme inhibitors as drugs.	4
	UNIT - II	
2.1	Structural features and mode of action of the following antibiotics: penicillin G, Cephalosporin and their semi synthetic analogs (β-lactum).	6
2.2	Streptomycin (aminoglycoside), Terramycin (tetracycline) - Erythromycin (macrolide) and Chloramphenicol.	4
2.3	Diabetes and Hypoglycemic drugs - Chemical structure and therapeutic uses of Chlorpropamide- Gilbenclamide, Biguanides and Metformin.	5
	UNIT - III	
3.1	Antineoplastic agents: Classification and synthesis of Cyclophosphamide, Ifofamide, Chlorambucil- Classification and synthesis of Busulfan, Decarbazine, Methotrexate, 6-Mercaptopurine.	6
3.2	Anti-tubercular drugs: Classification, synthesis of Isoniazid, Pyrazinamine, Ethambutol, Thiacetoazone and Ethionamide.	3
3.3	Antimalarial drugs: Classification, synthesis of Chloroquine, Primaquine, Amaodiaquine, Proguanil and Pyrimethamine.	3
3.4	Diuretics: Classification, Synthesis ofFuresemide, Acetazolamide, Chlorothiazide.	3
	UNIT - IV	
4.1	Antihypertensive drugs: Nifedipine, Hydralazine	3
4.2	Sodium nitroprusside and Clonidine.	3
4.3	Antihistamines: HI- Antagonist: Chlorpheniramine.	3
4.4	Diphenylhydramine, Mepyramine, Promethazine, H2-Antogonist.	3
4.5	Cimetidine, Ranitidine and Fomotidine.	3
	UNIT - V	

5.1	Anti-inflammatory drugs: Antipyretics & Non-narcotic analgesics; Aspirin, sodium salicylate, Paracetamol.	4
5.2	Phenylbutazone, Oxypheylbutazone, Ibuprofen, Mefenamic acid, Dichlofenac sodium.	3
5.3	CNS stimulant Drugs: Amphetamine, Caffeine, Theobromine, and Theophyline - Bemegride, Nikethamide, MethylPhenidate.	5
5.4	CNS depressant Drugs: Phenelazine, Isocarboxazide, Imipramine, Nortiptyline, Amitriptyline, Desipramine.	3
Total		**75**

Course Designer
Name: Ms. A. Soniya
Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC21	**ORGANIC CHEMISTRY – II**	**Core -V**	**6**	**5**	**25**	**75**	**100**

Course Objectives

The research in chemistry does require the knowledge on stereochemistry, conformational analysis, oxidation and reduction, chemistry of heterocyclic compounds and green chemistry.

UNIT	Contents	No. of Hours
I	**Stereochemistry-I:** Optical isomerism **-** Symmetry elements - concept of chirality, necessary and sufficient condition for chirality - Projection formulae - Wedge, Fischer, Sawhorse and Newman. Optical isomerism due to center of chirality. Molecules with one stereogenic center and molecules with more than one chiral center. Properties of enantiomers and diastereoisomers. Erythro and Threo nomenclature. Cahn, Ingold and Prelog system of designation of configuration. Geometrical isomerism - E-Z nomenclature - determination of configuration of geometrical isomers using physical and chemical methods.	18
II	**Conformational analysis:** Configuration and conformation – conformations analysis of ethane, n- butane and cyclohexane– conformation of mono substituted and disubstituted cyclohexane – correlation of the conformation of acyclic and cyclic systems with their physical and chemical properties - conformation and reactivity of cyclohexanones - conformational analysis of fused ring system – decalins and perhydro phenanthrene.	18
III	**Oxidation and Reduction:** Mechanism and applications of the following oxidations – reduction reactions: Oxidation reactions involving CrO_3, SeO_2, OsO_4, Lead Tetra acetate, Periodic acid, NBS, H_2O_2-Oppenauer oxidation. Catalytic hydrogenation reactions involving lithium aluminum hydride, Sodium Borohydride, Birch reduction, Meerwin-pondoff-verley reduction, Wolff-Kishner reduction.	18
IV	**Chemistry of Heterocyclic Compounds:** Heterocyclic – Nomenclature – Compounds containing two hetero atoms: Synthesis and reactivity of pyrazole, imidazole, oxazole, thiazole. diazines: the chemistry of pyridazine, pyrimidine and pyrazine – Comparison of basicity of diazines. Anthrocyanins – Cyanidin Chloride – Malvidin Chloride - flavonoids.	18
V	**Green Chemistry:** Principles of green chemistry – planning a green synthesis in a laboratory – general interest for solvent free processes. Microwave synthesis: Introduction and characteristics of microwave heating – difference between conventional heating and microwave heating. Dielectric polarization – dipolar polarization – application and advantages of microwave heating over conventional heating.	18

Total		**90**
Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Illustrate the fundamentals concepts of Optical isomerism and Geometrical isomerism.	K1, K2, K3, K4
2	Examine the conformational analysis of acyclic, cyclic and Fused ring system.	K1, K2, K3, K4
3	Interpret the mechanism and applications of oxidations and reduction reactions.	K1, K2, K3, K4, K5
4	Predict the chemistry of nitrogen and oxygen containing heterocyclic compounds and natural products.	K1, K2, K3, K4, K5, K6
5	Invent their knowledge to synthesis compounds in a greener way.	K1, K2, K3, K4, K5, K6
Text books		
1.	D. Nasipuri, ***Stereochemistry of Organic compounds***, New Age International, New Delhi 2020, 4th Edition.	
2.	I.L. Finar, **Organic Chemistry**, Vol. II, ELBS, New York, 2005, 5th Edition.	
Reference Books		
1.	E. L. Eliel and S. H. Wiley, ***Stereochemistry of carbon compounds***, John Wiley & Son, Inc, 2003.	
2.	V. M. Potapov, ***Stereochemistry***, MIR Publisher, Moscow, 1999.	
3.	H. Kagan, ***Organic Stereochemistry***, Edward Arnold, London, 2001.	
4.	Gurdeep Chatwal, **Organic Chemistry of natural products** Vol. I, Himalaya Publishing House, 1997.	
5.	V.K. Ahluwalia, M. Kidwai, **New trends in Green Chemistry**, Anamaya Publishers, New Delhi, 2006, Second Edition.	
e-Resources		
1.	https://shahulhmr.blogspot.com	
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7	

Mapping with Programme Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	3	3
CO2	3	3	3	3	3
CO3	3	1	2	3	2
CO4	3	1	2	2	3
CO5	3	3	1	2	2

Strong-3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	2
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	1	2	3
CO5	3	1	1	1	3

Strong-3 **Medium-2** **Low-1**

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT – I	
1.1	Optical isomerism **-** Symmetry elements - concept of chirality, necessary and sufficient condition for chirality - Projection formulae - Wedge, Fischer, Sawhorse and Newman. Optical isomerism due to centre of chirality. Molecules with one stereogenic center and molecules with more than one Chiral Centre.	9
1.2	Properties of enantiomers and diastereoisomers. Erythro and Threo nomenclature. Cahn, Ingold and Prelog system of designation of configuration – Geometrical isomerism-E-Z nomenclature- determination of configuration of geometrical isomers using physical and chemical methods.	9
	UNIT – II	
2.1	Configuration and conformation – conformations analysis of ethane, n-butane and cyclohexane. Conformation of mono substituted and disubstituted cyclohexane.	7
2.2	Correlation of the conformation of acyclic and cyclic systems with their physical and chemical properties - conformation and reactivity of cyclohexanones.	6
2.3	Conformational analysis of fused ring system – decalins and perhydro phenanthrene.	5
	UNIT – III	
3.1	Mechanism and applications of the following oxidations – reduction reactions: Oxidation reactions involving CrO_3, SeO_2, OsO_4, Lead Tetra acetate, Periodic acid, NBS, H_2O_2-Oppenauer oxidation.	10
3.2	Catalytic hydrogenation reactions involving lithium aluminum hydride, Sodium Borohydride, Birch reduction, Meerwin-pondoff-verley reduction, Wolff-Kishner reduction.	8
	UNIT – IV	
4.1	Heterocyclic – Nomenclature – Compounds containing two hetero atoms: Synthesis and reactivity of pyrazole, imidazole, oxazole and thiazole.	8
4.2	Diazines: Chemistry of pyridazine, pyrimidine and pyrazine –	10

	Comparison of basicity of diazines -Anthrocyanins – Cyanidin Chloride – Malvidin Chloride – flavonoids.	
UNIT – V		
5.1	Principles of green chemistry – planning a green synthesis in a laboratory – general interest for solvent free processes.	6
5.2	Microwave synthesis: Introduction and characteristics of microwave heating – difference between conventional heating and microwave heating.	6
5.3	Dielectric polarization–dipolar polarization–application and advantages of microwave heating over conventional heating.	6
	TOTAL	**90**

Course Designer
Name: Mr. G. Arivalagan
Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC22	**INORGANIC CHEMISTRY - II**	**Core -VI**	**5**	**5**	**25**	**75**	**100**

Course Objectives

The course explains the various theories and reaction mechanism of coordination compounds and their spectral characterization techniques.

UNIT	Contents	No. of Hours
I	**Coordination Compounds-I:** Nomenclature of coordination complexes- Stereochemistry of coordination compounds: Geometrical isomerism- optical isomerism of complexes having C.N. 4, 6 – Stability constants – Determination of Stability constant Spectrophotometric method- Factors affecting Stability constant in solution. Theories of bonding – VBT – CFT – Splitting of d-orbitals in Octahedral, Tetrahedral and Square planar geometries – CFSE calculation in terms of Dq - Factors affecting crystal field splitting – Spectrochemical series – MO theories – MOT diagram for octahedral geometries.	15
II	**Coordination Compounds -II:** Substitution reactions of octahedral complexes S_N1, S_N2 - lability-inertness- square planar substitution reactions - Factors affecting reactivity of square planar complexes- Trans effect- Theories of Trans effect and its applications - Reactions of coordinated ligands - Acid hydrolysis - Anation reactions and base hydrolysis - S_N1CB Mechanism. Mechanism of electron transfer reactions - Outer sphere, inner sphere electron transfer reactions - complementary reactions and non-complementary reactions.	15
III	**Electronic spectra**: Selection rules – term states - hole formulation, calculation of number of microstates - splitting of spectral terms – Orgel diagrams Oh and Td complexes- limitations. Tanabe-Sugano diagrams. Evaluation of Racah parameter, 10 Dq and beta values for d^2, d^3, d^7, d^8 systems. Charge transfer spectra- LMCT, MLCT and MMCT. **IR spectroscopy**: principles of IR spectroscopy - Effect of coordination on the stretching frequency-carboxylic acids, sulphato and aqua, perchlorate, cyano - linkage isomers- nitro- and nitrito-, thiocyanato- and isothiocyanato complexes, terminal and bridging carbonyls.	15
IV	**Nuclear magnetic resonance spectroscopy:** Basic principles of H^1 NMR, C^{13} NMR. Application of chemical shift and spin coupling to structure determination using multiple NMR (^{15}N, ^{19}F and ^{31}P) - Isomers of $Rh(PPh_3)_3Cl_3$, $[PtX_2(PR_3)_2]$, $P_3N_3Cl_4F_2$, $P_4N_4Cl_6(NHC_6H_5)_2$, P_3N_3 $(C_6H_5)_3F_3$, R_2PF_3 - Fluxional NMR of metal carbonyls and allyl complexes.	15
V	**Mossbauer spectroscopy**: Basic principles - Doppler effect- Isomer shift- Electron nuclear hyperfine interactions - Quadrupole and magnetic interactions in the study of structure and bonding in Iron and Tin complexes and in Biological systems. **Electron paramagnetic resonance spectroscopy**: Applications of	15

	hyperfine splitting and g factor to structural elucidation- Zero field splitting- Krammer's Degeneracy- EPR spectra of Cu (II) and Mn(II) in various site symmetry- covalency of metal-ligand bonding by EPR- study of dynamic processes in solids- Study of phase transition by Mn(II) – John Teller distortions in Cu(II) complexes.	
Total		**75**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Explain various theories and properties of coordination compounds.	K1, K2
2	Examine the mechanism of coordination chemistry reactions.	K1, K2, K3, K4
3	Invent the principle of electronic spectra and IR in determining the mode of bonding and structure of coordination compounds.	K1, K2, K3, K4, K5, K6
4	Evaluate the applications of NMR and Mossbauer spectroscopy in the structural analysis of coordination complexes.	K1, K2, K3, K4, K5
5	Formulate the applications of magnetism and hyperfine splitting and g factor.	K1, K2, K3, K4, K5, K6

Text books

1.	Shriver D. F. and Atkins, P.W, ***Inorganic Chemistry***, Oxford University Press, London, 1999.
2.	Cotton F.A. and Wilkinson, G, ***Advanced Inorganic Chemistry***, Wiley-Interscience publications, John Wiley & Sons, New York, 2007, 6th Edition.
3.	Gurdeep R. Chatwal & M.S. Yadav, ***Coordination Chemistry,*** Himalaya Publishing House, 1993, Ist Edn.
4.	Purcell, K. F. Kotz, J.C. Holt Saunders, ***Inorganic Chemistry***, Philedelphia, USA, 1980.
5.	Drago, R. S. Van Nostrand and Reinhold, ***Physical methods in Chemistry,*** 1976.
6.	Raymond Chang M, ***Basic principles of Spectroscopy,*** McGraw Hill, New Delhi, 1971.

Reference Books

1.	E. Huheey, Ellen A. Keiter, Richard L. Keiter, ***Inorganic Chemistry,*** Pearson Education, P. Ltd., Delhi, 2004, 4th Edition.
2.	Wahid U.Malik, G.D.Tuli and R.D. Madan, ***Selected Topics in Inorganic Chemistry, S. Chand & Co. Ltd., New Delhi, 2006.***
3.	Banerjea, D, ***Coordination Chemistry***, Tata McGraw- Hill Publishing Co. Ltd., 1993.
4.	William W. Porterfield, ***Inorganic Chemistry***, Elsevier, New Delhi, 2005, 2nd Edition.
5.	A.G. Sharpe***, Inorganic Chemistry, Addition***, Wesley Longman, UK, 2004, 3rd Edition.
6.	Gary L. Miessler and Donald A. Tarr, ***Inorganic Chemistry***, Pearson Education, Inc., New Delhi, 2004, 3rd Edition.
7.	D.N. Sathyanarayana, ***Electronic Absorption Spectroscopy and Related Techniques,*** Universities Press (India) Limited, 2001.

e-Resources

1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	2	3
CO2	3	1	2	3	3
CO3	2	2	3	2	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	2	2	3	2
CO3	3	1	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT – I	
1.1	Nomenclature of coordination complexes-Stereochemistry of coordination compounds: Geometrical isomerism- optical isomerism of complexes having C. N. 4, 6.	3
1.2	Stability constants – Determination of Stability constant Spectrophotometric method - Factors affecting Stability Constant in solution.	3
1.3	Theories of bonding – VBT – CFT – Splitting of d-orbitals in Octahedral, Tetrahedral and Square planar geometries – CFSE calculation in terms of Dq.	4
1.4	Factors affecting crystal field splitting – Spectrochemical Series.	3
1.5	MO theories – MOT diagram for octahedral geometries.	2
	UNIT – II	
2.1	Substitution reactions of octahedral complexes SN1, SN2.	2
2.2	Lability-inertness- square planar substitution reactions - Factors affecting reactivity of square planar complexes.	4
2.3	Trans effect- Theories of Trans effect and its applications - Reactions of coordinated ligands - Acid hydrolysis - Anation reactions and base hydrolysis - SN1CB Mechanism.	3
2.4	Mechanism of electron transfer reactions - Outer sphere, Inner sphere electron transfer reactions.	4
2.5	Complementary reactions and non-complementary Reactions.	2
	UNIT – III	

3.1	Electronic spectra: selection rules – term states - hole formulation, calculation of number of microstates – splitting of spectral terms.	2
3.2	Orgel diagrams Oh and Td complexes- limitations. Tanabe-Sugano diagrams.	4
3.3	Evaluation of Racah parameter, 10 Dq and beta values for d^2, d^3, d^7, d^8 systems. Charge transfer spectra- LMCT, MLCT and MMCT.	4
3.4	IR spectroscopy – principles of IR spectroscopy -Effect of coordination on the stretching Frequency-carboxylic acids, sulphato and aqua, perchlorate, cyano.	3
3.5	Linkage isomers- nitro- and nitrito-, thiocyanato- and isothiocyanato complexes, terminal and bridging carbonyls.	2
UNIT – IV		
4.1	Nuclear magnetic resonance spectroscopy: Basic principles of H^1 NMR, C^{13} NMR - Application of Chemical shift and spin coupling to structure determination using multiple NMR (^{15}N, ^{19}F and ^{31}P).	5
4.2	Isomers of $Rh(PPh_3)_3Cl_3$, $[PtX_2(PR_3)_2]$, $P_3N_3Cl_4F_2$, $P_4N_4Cl_6(NHC_6H_5)_2$, P_3N_3 $(C_6H_5)_3F_3$, R_2PF_3.	6
4.3	Fluxional NMR of metal carbonyls and allyl complexes.	4
UNIT – V		
5.1	**Mossbauer spectroscopy**: Basic principles - Doppler effect- Isomer shift- Electron nuclear hyperfine interactions.	4
5.2	Quadrupole and magnetic interactions in the study of structure and bonding in Iron and Tin complexes and in Biological systems.	3
5.3	Applications of hyperfine splitting and g factor to structural elucidation- Zero field splitting-Krammer‘s Degeneracy.	3
5.4	EPR spectra of Cu (II) and Mn(II) in various site symmetry- covalency of metal-ligand bonding by EPR- Study of phase transition by Mn(II) – John Teller distortions in Cu(II) complexes.	5
Total		**75**

Course Designer:

Name: Dr. M.P. Kesavan

Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC23	**PHYSICAL CHEMISTRY – II**	**Core -VII**	**6**	**5**	**25**	**75**	**100**

Course Objectives

The course enables the students to gain knowledge on Thermodynamic equilibrium, statistical thermodynamics and apply theories of electrochemistry to understand electrode kinetics and theoretical aspects of electrochemical application.

UNIT	Contents	No. of Hours
I	**Chemical Thermodynamics**: A general review of enthalpy, entropy and free energy concepts - Nernst heat Theorem-Genesis of third law and its limitations - derivation of third law and their application to real gases- Partial molar properties- Gibbs – Duhem equation- Duhem Margules equation- fugacity and its determination. Activity and activity coefficient, determination of activity coefficients - Onsager's reciprocity relation. Postulates of non-equilibrium thermodynamics. Entropy production. Linear laws relative to fluxes and forces. Curie's theorem.	18
II	**Statistical Thermodynamics-I:** Permutation and combination. Laws of probability. Distribution laws. Gaussian distribution. Microstates and macrostates for distinguishable and indistinguishable particles-Ensemble-types of ensemble – micro canonical -canonical and grand canonical ensemble; Phase space- Maxwell Boltzmann classical distribution law derivation in term of degeneracy; Partition function (Q) – relation between partition function and the following thermodynamic functions – internal energy (E), Helmholtz free energy (A), Pressure (P), Enthalpy (H), Gibbs free energy (G), chemical potential (μ_i), heat capacity (C_v) and entropy(S);Derivation of Sackur-Tetrode equation.	18
III	**Statistical Thermodynamics-II:** Bose-Einstein Quantum Statistics-Statistics derivation- application of Bose-Einstein statistics for a photon gas – Planck's radiation formula - Derivation of Rayleigh - Jeans law-Stefan Boltzmann equation. Fermi-Dirac statistics derivation - Application of Fermi Dirac statistics to electron gas in metals; Population inversion-negative absolute temperature - heat capacity of diatomic gases-Einstein's theory and Debye's theory of heat capacities of solids- hydrogen ortho and para nuclear.	18
IV	**Electrochemistry - I:** Theory of strong electrolytes – Interionic attraction theory – Debye- Huckel theory of strong electrolytes - Debye- Huckel model of ionic atmosphere–Debye- Huckel Onsager equation- derivation, verification and modifications- Debye – Falkenhagen effect and Wien effect; Electrical double layers – formation – Structure of electrified interfaces – Stern model. Debye-Huckel limiting law- extension- Huckel-Bronsted equation - Determination of activity coefficients using Bronsted equation – Applications of conductivity measurements; Nernst equation and its	18

	significance – reversible and irreversible cells - electrodes – SHE – Calomel– Glass electrode – Platinum electrode – ion selective electrode and measurement of pH.	
V	**Electrochemistry-II:** Over voltage – Theories of over voltage – applications of over voltage- hydrogen and oxygen overvoltage; Butler-Volmer equation-Tafel equation; Corrosion - principles of electrochemical corrosion – factor influencing corrosion – Corrosion Prevention - Anodic metal coating (Galvanization) - Cathodic metal coating (Tinning) - Sacrificial anodic protection method - Impressed current cathodic protection –Electroplating. Electrochemical energy Conversions-Nickel Cadmium, lead acid battery; Fuel cells – H_2 - O_2 Fuel cell – methyl alcohol fuel cell. Principles of Polorography - Cyclic Voltametry –quasi – reversible – irreversible voltamogram	18
Total		**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Compare the thermodynamic equilibrium and non-equilibrium studies.	K1, K2, K3, K4
2	Examine the applications of statistical thermodynamics	K1, K2, K3, K4
3	Interpret the need and fundamental derivation of statistical Thermodynamics.	K1, K2, K3, K4, K5
4	Construct the fundamental concepts and theories of electrochemistry.	K1, K2, K3, K4, K5, K6
5	Gain the knowledge in applications of electrochemistry.	K1, K2, K3, K4, K5, K6

Text books	
1.	Glasstone S., ***Thermodynamics for Chemists***, Eastern Wiley Publication, 2002.
2.	Lee, Sears, Tercotte, ***Statistical Thermodynamics***, Addision Wesley Publishing Co., London, 1973, 1stEdition.
3.	Crow Dr., ***Principles and Applications of Electrochemistry***, Chapman Hall, UK,1988,
4.	VenkataramanR.,Rengarajan K., Raghavan P. S., ***Electrochemistry***, 2007, 1st edition
Reference Books	
1.	Gupta M. C.,***Statistical Thermodynamics***, Wiley Eastern limited, NewDelhi, 1993.
2.	Kuriakose J. C., Rajaram, J.***Thermodynamics***, ShobanlalNaginChand,NewDelhi, India,1999.
3.	L. Antropov, ***Theoretical electrochemistry***, MIR Publications, New Delhi, 1999.
4.	S. Glasstone , ***An Introduction to Electrochemistry***, Von Nostrand Co. Inc., Toronto, 2002.
e-Resources	
1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	2	2	3	3	3
CO3	2	3	2	2	3
CO4	2	2	2	2	3
CO5	3	3	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2
CO2	3	3	3	2	3
CO3	3	3	2	3	2
CO4	3	3	2	2	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT – I	
1.1	Chemical Thermodynamics: A general review of enthalpy, entropy and free energy concepts - Nernst heat theorem	4
1.2	Genesis of third law and its limitations - derivation of third law and their application to real gases.	4
1.3	Partial molar properties- Gibbs – Duhem equation- Duhem Margules equation- fugacity and its determination.	4
1.4	Activity and activity coefficient, determination of activity Coefficients.	2
1.5	Postulates of non-equilibrium thermodynamics. Entropy Production. Linear laws relative to fluxes and forces. Curie's theorem. Onsager's reciprocity relation.	4
	UNIT - II	
2.1	Permutation and combination. Laws of probability. Distribution laws. Gaussian distribution. Microstates and macrostates for distinguishable and indistinguishable particles.	6
2.2	Ensemble- types of ensembles – micro canonical – canonical and grand canonical ensemble; Phase space. Maxwell Boltzmann classical distribution law derivation in term of degeneracy.	5
2.3	Partition function (Q) – relation between partition function and the following thermodynamic functions – internal energy (E), Helmholtz free energy (A), Pressure (P), Enthalpy (H), Gibbs free energy (G),	7

	chemical potential (μi), heat capacity (Cv) and entropy(S)- Derivation of Sackur-Tetrode equation.	
UNIT – III		
3.1	Bose-Einstein Quantum Statistics - Statistics derivation- application of Bose-Einstein statistics for a photon gas.	4
3.2	Planck's radiation formula - Derivation of Rayleigh - Jeans law-Stefan Boltzman equation. Fermi-Dirac statistics derivation.	5
3.3	Application of Fermi Dirac statistics to electron gas in metals; Population inversion-negative absolute temperature.	5
3.4	Heat capacity of diatomic gases-Einstein's theory and Debye's theory of heat capacities of solids - Hydrogen ortho and para nuclear.	4
UNIT - IV		
4.1	Theory of strong electrolytes – Interionic attraction theory – Debye-Huckel theory of strong electrolytes - Debye-Huckel model of ionic atmosphere.	4
4.2	Debye-Huckel Onsager equation- derivation, verification and modifications- Debye – Falkenhagen effect and Wien effect; Electrical double layers formation.	4
4.3	Structure of electrified interfaces – Stern model. Debye- Huckel limiting law- extension- Huckel-Bronsted equation - Determination of activity coefficients using Bronsted equation.	4
4.4	Applications of conductivity measurements; Nernst equation and its significance – reversible and irreversible cells.	3
4.5	Electrodes – SHE – Calomel – Glass electrode – Platinum electrode – ion selective electrode and measurement of pH.	3
UNIT - V		
5.1	Over voltage – theories of over voltage- applications of over voltage- hydrogen and oxygen overvoltage; Butler-Volmer equation- Tafel equation	6
5.2	Corrosion- principles of electrochemical corrosion	2
5.3	factor influencing corrosion – corrosion control- cathodic production - corrosion inhibitors.	4
5.4	Principles of Polorography -Cyclic Voltametry –quasi – reversible – irreversible voltamogram	3
5.5	Electrochemical energy conversions-Nickel Cadmium, lead acid battery; Fuel cells – H_2 - O_2 Fuel cell – methyl alcohol fuel cell.	3
Total		**90**

Course Designer

Name: Dr. A. Nihath Nazleen

Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHCC2P	**PHYSICAL CHEMISTRY PRACTICAL**	**Core -VIII**	**8**	**4**	**40**	**60**	**100**

Course Objectives

This lab course enables the students to acquire practical knowledge on physical chemistry experiments such as electrochemical, kinetics, surface chemistry and colorimetric estimations.

UNIT	Contents	No. of Hours
I	1. Estimation of HCl & CH_3COOH by conductometrically. 2. Estimation of HCl & NH_4Cl by conductometrically. 3. Estimation of Na_2CO_3 by conductometrically.	25
II	4. Estimation of K_2SO_4 by conductometrically. 5. Kinetics of base hydrolysis of an ester by conductometrically 6. Estimation of Fe(II) using $KMnO4$ by potentiometrically.	25
III	7. Estimation of Fe(II) using CAS potentiometrically. 8. Estimation of KI with $KMnO4$ by potentiometrically	20
IV	9. Determination of pH of buffer solution by potentiometrically. 10. Estimation of mixture of halides (KI and KCl) by potentiometrically.	20
V	11. Adsorption of oxalic acid on to activated charcoal. 12. Adsorption of acetic acid on to activated charcoal. 13. Determination of concentration of $KMnO4$ solution by spectrophotometrically.	30
	Total	**120**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Classify the various types of conductometric titrations.	K1, K2, K3, K4
2	Differentiate the various types of potentiometric titrations.	K1, K2, K3, K4
3	Evaluate the analytical skill on adsorption of oxalic acid.	K1, K2, K3, K4, K5
4	Invent the analytical skill on adsorption of acetic acid	K1, K2, K3, K4, K5, K6
5	Predict the colorimetric estimation techniques.	K1, K2, K3, K4, K5, K6
Text books		
1.	B. Viswanathan and P.S. Raghavan, **Practical Physical Chemistry**, Viva Books, New Delhi, 2009.	
2.	E.G. Lewers, Computational Chemistry: **Introduction to the Theory and Applications of Molecular and Quantum Mechanics**, 2nd Ed., Springer, New York, 2011.	
Reference Books		
1.	J. B. Yadav, **Advanced Practical Physical Chemistry**, Goel Publishing House, 2001.	
2.	G.W. Garland, J.W. Nibler, D.P. Shoemaker, **Experiments in Physical Chemistry**, 8th	

	edition, McGraw Hill, 2009.
3.	Shailendra K Sinha, Physical Chemistry: **A laboratory Manual**, Narosa Publishing House Pvt, Ltd., New Delhi, 2014.
e-Resources	
1.	https://shahulhmr.blogspot.com
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47 FV2p6AjAyl6&si=zLbhayIC0ietiyt7

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	1	2	1
CO2	2	3	1	2	2
CO3	3	3	2	3	3
CO4	2	3	2	3	2
CO5	2	3	1	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	2
CO2	3	3	1	1	2
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	2	1	2	1

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LAB SCHEDULE

Module No.	Topic	No. of Hours
UNIT – I		
1.1	Estimation of HCl & CH_3COOH by conductometrically.	9
1.2	Estimation of HCl & NH_4Cl by conductometrically.	8
1.3	Estimation of Na_2CO_3 by conductometrically.	8
UNIT – II		
2.1	Estimation of K_2SO_4 by conductometrically.	9
2.2	Kinetics of base hydrolysis of an ester by conductometrically	8
2.3	Estimation of Fe(II) using $KMnO4$ by potentiometrically.	8
UNIT – III		
3.1	Estimation of Fe(II) using CAS potentiometrically.	10
3.2	Estimation of KI with $KMnO4$ by potentiometrically	10
UNIT – IV		
4.1	Determination of pH of buffer solution by potentiometrically.	10
4.2	Estimation of mixture of halides (KI and KCl) by potentiometrically.	10
UNIT – V		

5.1	Adsorption of oxalic acid on to activated charcoal.	12
5.2	Adsorption of acetic acid on to activated charcoal.	12
5.3	Determination of concentration of KMnO4 solution by spectrophotometrically.	6
Total		**120**

Course Designer
Name: Ms. A. Mumthaj
Assistant Professor of chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26PCHGE21	**ANALYTICAL CHEMISTRY**	**Generic Elective -II**	**5**	**3**	**25**	**75**	**100**

Course Objectives

To gain knowledge about data analysis, electro analytical, thermo analytical and separation methods.

UNIT	Contents	No. of Hours
I	**Precipitation Techniques:** Introduction - properties and precipitating reagents - Colloidal precipitates - Co-precipitation –Post-precipitation – Precipitates from homogenous solutions – Surface adsorption – Drying and ignition of precipitates – Application of gravimetric methods.	15
II	**Error analysis:** Classification of errors – accuracy and precision – minimization of errors – significant figures – significant figures in computation – statistical treatment of data- mean, median, standard deviation, variance, relative standard deviation – spread, errors – standard deviation of computed results-reliability of results - Q test, T-test – confidence limit - comparison of results - Student's test – F-test T-test – comparison of the means of two samples - correlation and regression: linear regression (least square analysis).	15
III	**Electroanalytical Methods:** Theory of electrogravimetric analysis - Electroanalytical separation and determination of metal ions -Electrolytic cell- working electrodes - auxiliary electrode and reference electrode – Coulometric titrations. Cyclic voltammetry – stripping voltammetry – chronopotentiometry – DPV - Amperometric titrations.	15
IV	**Thermoanalytical Methods:** Thermal analysis: Theory and principles of TGA and DTA – factors affecting the position of DT and TG traces - application of DTA and TGA to the thermal behavior of the following compounds- crystalline copper sulphate, calcium oxalate monohydrate, calcium acetate monohydrate, - principle and application of DSC.	15
V	**Chromatographic Technique:** Principle – classification - adsorption and partition chromatography – Column chromatography - Ion exchange chromatography - Thin layer chromatography - Paper Chromatography – gas-solid and gas-liquid chromatography- applications.	15
	Total	**75**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Illustrate the principles of Precipitation Techniques and their applications.	K1, K2, K3, K4
2	Inspect the minimization of errors, standard deviation, Student's test, Q test and T-test.	K1, K2, K3, K4
3	Interpret the Electrogravimetry, Coulometry, Voltammetry and	K1, K2, K3, K4, K5

	Amperometry.	
4	Organize the thermal analyses such as TGA, DTA and DSC.	K1, K2, K3, K4, K5, K6
5	Construct the various separation methods involved in Chromatographic techniques.	K1, K2, K3, K4, K5, K6
Text books		
1.	D. A. Skoog, D. M. West and F. J. Holler, ***Fundamentals of Analytical Chemistry***, Saunders College Publishing, Philadelphia, 1996, 7th Edition.	
2.	Willard HH, Merritt LL, Dean JA, Settle PA. ***Instrumental Methods of Analysis***, NewYork: Van Nostrand, 1988, 6th Edition.	
Reference Books		
1.	Basset et al., ***Vogel's Text book of Qualitative Inorganic Analysis***, Longman, ELBS, Essex, 1989, 5th Edition.	
2.	J. G. Dick, ***Analytical Chemistry***, Tata-McGraw Hill, 1973.	
e-Resources		
1.	https://shahulhmr.blogspot.com	
2.	https://youtube.com/playlist?list=PLPGAZpI4a4LjbDWuIcOu47FV2p6AjAyl6&si=zLbhayIC0ietiyt7	

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	2	2
CO2	1	3	3	2	3
CO3	2	3	2	2	2
CO4	1	3	3	3	2
CO5	3	1	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	2
CO2	3	3	1	2	3
CO3	3	3	2	1	2
CO4	3	3	3	2	3
CO5	3	3	3	1	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
UNIT – I		
1.1	Introduction-properties and precipitating reagents	3

1.2	Colloidal precipitates - Co-precipitation – Post Precipitation	3
1.3	Precipitates from homogenous solutions	3
1.4	Surface adsorption-Drying and ignition of precipitates	3
1.5	Application of gravimetric methods.	3
UNIT – II		
2.1	Error analysis: Classification of errors –accuracy and precision – minimization of errors	3
2.2	significant figures – significant figures in computation	3
2.3	statistical treatment of data- mean, median, standard deviation, variance, relative standard deviation –spread, errors	3
2.4	standard deviation of computed results-reliability of results-Q test, T-test – confidence limit-comparison of results	3
2.5	Student's test –F-test T-test – comparison of the means of two samples-correlation and regression: linear regression (least square analysis).	3
UNIT – III		
3.1	Electroanalytical methods: Electrogravimetry: Theory of electro gravimetric analysis	3
3.2	Electro analytical separation and determination of metal ions.	3
3.3	Electrolytic cell - working electrodes – auxiliary electrode and reference electrode	3
3.4	Voltammetry - Cyclic voltammetry.	3
3.5	stripping voltammetry – chronopotentiometry–Amperometric titrations.	3
UNIT – IV		
4.1	Thermal analysis: Theory and principles of TGA and DTA	3
4.2	Factors affecting the position of DT and TG traces	3
4.3	Application of DTA and TGA to the thermal behavior of the following compounds- crystalline copper sulphate, calcium oxalate monohydrate and calcium acetate monohydrate.	6
4.4	Principle and application of DSC.	3
UNIT – V		
5.1	Principle – classification - adsorption and partition chromatography	4
5.2	Column chromatography - Ion exchange chromatography.	4
5.3	Thin layer chromatography - Paper Chromatography	4
5.4	Gas-solid and gas-liquid chromatography - applications.	3
Total		**75**

Course Designer
Name: Ms. A. Soniya
Assistant Professor of chemistry