INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
Marching Beyond 30 Years Successfully
INSTITUTION WITH UGC 12B STATUS

POSTGRADUATE DEGREE PROGRAMME

M.Sc., Chemistry

Two Years

CURRICULUM & SYLLABUS

REGULATION 2024

Choice Based Credit System (CBCS)

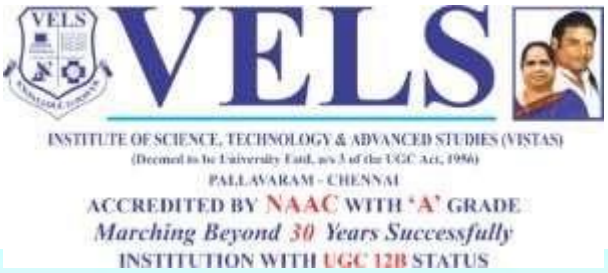
&

Learning Outcomes Based Curriculum Framework (LOCF)

Effective from the Academic Year

2024 -2025

Department of Chemistry



DEPARTMENT OF CHEMISTRY

VISION OF THE DEPARTMENT
The Vision of the Department is to enhance our reputation as a world-class teaching and research institution reputed for its innovation, excellence and discovery, and to attract best students and staff worldwide.

MISSION OF THE DEPARTMENT	
M1	To actively promote and preserve higher values and ethics in education and research and will pursue excellence in all these areas.
M2	To undertake research in emerging areas of Chemical Sciences & Nanotechnology and transform the findings for the benefit of society

PROGRAMME EDUCATIONAL OUTCOMES (PEO)	
PEO1	Postgraduate will have significant opportUNITies in various service domains at National and International level, and can work as scientist, analyst, quality controller, academics, research organizations and set chemical testing labs.
PEO2	On the basis of specialized knowledge and experience, postgraduate students will be able to do synthesis, separation, analysis, computational design and development of new products.
PEO3	Post-graduate have leadership quality to handle all kind of circumstances in diversities by providing interdisciplinary and multidisciplinary learning environment.
PEO4	To encourage leadership qualities in graduates with strong communication skills, mold them as good team players and managers so that they have the competence to function effectively in multi-disciplinary orientation teams.
PEO5	Postgraduate will be able to formulate, investigate and analyze scientifically real life problems along with ethical attitude which works in multidisciplinary team.

PROGRAMME OUTCOMES (PO)	
PO1	**Problem analyze:** Graduates will be able to identify, formulate, and critically analyze chemical problems by reviewing research literature. Graduate will reach well-substantiated conclusions using advanced concepts and methodologies from organic, inorganic, physical, and analytical chemistry
PO2	**Design and development of solutions:** Graduates will be able to design innovative solutions for complex chemical problems and design systems, components, or processes that address specified needs, incorporating appropriate considerations for public health and safety, as well as cultural, social impacts.
PO3	**Conduct investigations of complex problems:** Graduates will be able to apply research-based knowledge to design and conduct experiments, analyze and interpret data, and synthesize information from various sources to draw valid and scientifically sound conclusions
PO4	**Modern tool Usage**: Graduate will proficiently use modern tools, techniques, and technologies to solve complex industrial challenges, enhancing efficiency and innovation in chemical processes and production.
PO5	**Research Attitude and Environmental Sustainability:** Graduates will develop a strong research attitude, with a focus on exploring and contributing to frontier topics in chemistry that promote environmental sustainability.
PO6	**Skilled Project Manager:** Graduate acquiring knowledge in chemistry project management, effective planning, scientific writing, and understanding ethical standards, rules, and regulations related to the execution of scientific projects.
PO7	**Lifelong Learner: T**o foster a continuous learning mindset by encouraging the use of advanced ICT tools, as well as other resources like books and journals, to support personal academic growth and enhance employability opportUNITies.

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO1	Global level research opportUNITies to pursue PhD programme and targeted approach of CSIR –NET examination.
PSO2	Competent to take challenging positions in industry, academics and government sectors by learning various analytical techniques, pharms and drugs analysis etc.
PSO3	To execute new ideas in the field of research and to develop principles and techniques of science through seminars and the project.

BOARD OF STUDIES
List of Members

Department of Chemistry

S.No	Name & Designation	Address	Role
1.	**Dr. R.A. Kalaivani** Professor & Dean	Department of Chemistry, School of Basic Sciences, VISTAS, Chennai- 600 117 Tamilnadu. Email: dean.sbs@velsuniv.ac.in Mobile: 9962506223	Chairperson (Internal Member)
2.	**Mr.M.S. Ramasamy** Head R&D	Head R&D Sanjeev Biomedical Research Centre Kumaran Nagar, Keelkatalai, Chennai- 600 117, Tamilnadu. Email: director@sanjeevbiomed.com Mobile: 9176049309	Industrial Expert (External Member)
3.	**Dr. Prabhu** Assistant Professor	Department of Physical Chemistry University of Madras Guindy Campus, Chennai – 600 025 Tamilnadu. Email: pprabhumu@gmail.com Mobile: 9841349544	Academic Expert (External Member)
4.	**Ms. N. Vanitha** Research Associate	Research Scholar SRM Institute of Science Technology, Kattankulathur, Chennai 603 203, Tamilnadu. Mobile: 9790790146	Alumni Member (External Member)
5.	**Dr. D. Gavaskar** Associate Professor & Head i/c	Department of Chemistry, VISTAS, Chennai- 600 117, Tamilnadu. Email: hodchemistry@velsuniv.ac.in, Mobile:6380645669	Internal Member
6.	**Dr. K. Ramamurthy** Assistant Professor	Department of Chemistry, VISTAS, Chennai- 600 117, Tamilnadu. Email: ramamurthy.sbs@velsuniv.ac.in Mobile: 9655024848	Internal Member
7.	**Dr. S. Deepa** Assistant Professor	Department of Chemistry, VISTAS, Chennai – 600 117, Tamilnadu. Email: sdeepa.sbs@velsuniv.ac.in Mobile: 8667064951	Internal Member
8.	**Dr. M. Priya** Assistant Professor	Department of Chemistry, VISTAS, Chennai – 600 117, Tamilnadu	Internal Member

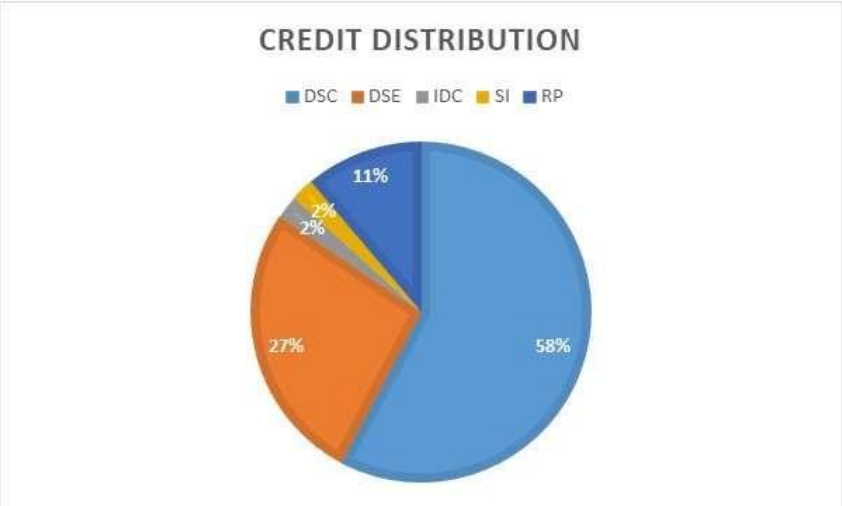
		Email: priya.sbs@velsuniv.ac.in Mobile: 8939318775	
9.	**Dr. A. Padmapriya** Assistant Professor	Department of Chemistry, VISTAS, Chennai – 600 117, Tamilnadu. Email: apadmapriya.sbs@velsuniv.ac.in Mobile:8754559359	Internal Member

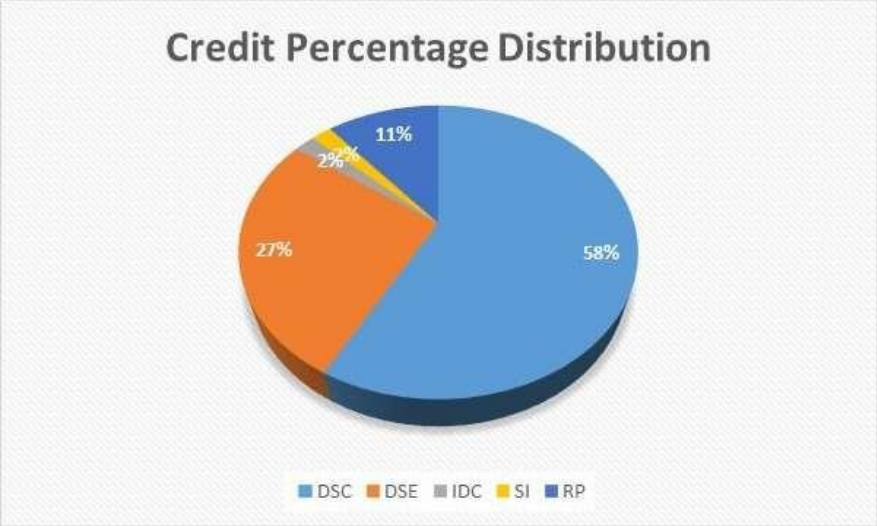
CREDIT DISTRIBUTION

M.Sc., in Chemistry

Minimum credits to be earned: 90

Component	I Sem	II Sem	III Sem	IV Sem	Total Credits
DSC	15	18	15	4	52
DSE / IDC / Minor	8	4	8	4	24
SI	-	-	2	-	2
RP	-	-	-	10	10
GE	-	-	-	2	2
Total Credits	23	22	25	20	90





ABBREVIATIONS

DSC	Disciplinary Specific Core
DSE	Disciplinary Specific Elective
IDC	Interdisciplinary Courses
SI	Summer Internship
RP	Research Project

CURRICULUM STURCTURE

M.Sc., Chemistry Two Years

Total number of Credits: 90

	M.Sc., Chemistry :90									
	Hours/Week						Maximum Marks			
SEMESTER 1										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 1	24CMSG11	Organic Reaction Mechanism and Stereochemistry	4	0	0	2	4	40	60	100
DSC 2	24CMSG12	Concept in Inorganic Chemistry	4	0	0	2	4	40	60	100
DSC 3	24CMSG13	Advanced thermodynamics and kinetics	4	0	0	2	4	40	60	100
DSE 1/ IDC 1 / Minor 1	24DMSG11	DSE 1	4	0	0	2	4	40	60	100
DSE 2/ IDC 2 / Minor 2	24DMSG12	DSE 2	4	0	0	2	4	40	60	100
DSC 1	24PMSG11	Organic Chemistry Practical-Practical I	0	0	6	1	3	40	60	100
			20	**-**	**6**	**-**	**23**	**-**	**-**	**-**

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study**

SEMESTER 2										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 4	24CMSG21	Organic chemistry and Molecular rearrangement	4	0	0	2	4	40	60	100
DSC 5	24CMSG22	Coordination Chemistry	4	0	0	2	4	40	60	100
DSC 6	24CMSG24	Quantum Chemistry & group theory	4	0	0	2	4	40	60	100
DSE 3 / IDC 3 / Minor 3	24DMSG21	DSE - 3	4	0	0	2	4	40	60	100
DSC 2	24PMSG21	Inorganic Chemistry Practical-Practical II	0	0	6	1	3	40	60	100
DSC 3	24PMSG22	Physical Chemistry Practical-Practical III	0	0	6	1	3	40	60	100
			16	**-**	**12**	**-**	**22**	**-**	**-**	**-**

SEMESTER 3										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 7	24CMSG31	Organic photochemistry and Pericyclic reaction	4	0	0	2	4	40	60	100
DSC 8	24CMSG32	Solid State Chemistry	4	0	0	2	4	40	60	100
DSC 9	24CMSG33	Electrochemistry : Fundamentals and Its Applications	4	0	0	2	4	40	60	100
DSE 4 / IDC 4 / Minor 4	24DMSG31	DSE-4	4	0	0	2	4	40	60	100
DSE 5 / IDC 5 / Minor 5	24DMSG32	DSE-5	4	0	0	2	4	40	60	100
DSC 4	24PMSG31	Analytical Chemistry Practical - Practical IV	0	0	6	2	3	40	60	100
SI	24IMSG31	Internship	0	0	4	1	2	-	100	100
			20	**-**	**10**	**-**	**25**	**-**	**-**	**-**

SEMESTER 4										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 10	24CMSG41	Electro analytical and Separation Techniques	4	0	0	2	4	40	60	100
DSE 6 / IDC 6 / Minor 6	24DMSG41	DSE-6	4	0	0	2	4	40	60	100
IDC-1		IDC-1	2	0	0	1	2	40	60	100
RP	24RMSP41	Research Project	-	-	20	-	10	40	60	100
			10	**-**	**20**	**-**	**20**	-	-	-
		Overall Total	**66**	**0**	**48**		**90**			

DISCIPLINE SPECIFIC CORE COURSES

Category	Code	Course	L	T	P	O	C
DSC 1	24CMSG11	Organic Reaction Mechanism and Stereochemistry	4	0	0	2	4
DSC 2	24CMSG12	Concept in Inorganic Chemistry	4	0	0	2	4
DSC 3	24CMSG13	Advanced thermodynamics and kinetics					
DSC 1 (Lab)	24PMSG11	Organic Chemistry Practical-Practical I	0	0	6	1	3
DSC 4	24CMSG21	Organic chemistry and Molecular rearrangement	4	0	0	2	4
DSC 5	24CMSG22	Coordination Chemistry	4	0	0	2	4
DSC 6	24CMSG24	Quantum Chemistry & group theory	4	0	0	2	4
DSC 2 (Lab)	24PMSG21	Inorganic Chemistry Practical-Practical II	0	0	6	1	3
DSC 3(Lab)	24PMSG22	Physical Chemistry Practical-Practical III	0	0	6	1	3
DSC 7	24CMSG31	Organic photochemistry and Pericyclic reaction	4	0	0	2	4
DSC 8	24CMSG32	Solid State Chemistry	4	0	0	2	4
DSC 9	24CMSG33	Electrochemistry : Fundamentals and Its Applications	4	0	0	2	4
DSC 4 (Lab)	24PMSG31	Analytical Chemistry Practical - Practical IV	0	0	6	2	3
DSC 10	24CMSG41	Electro analytical and Separation Techniques	4	0	0	2	4

DISCIPLINE SPECIFIC ELECTIVE COURSES

Category	Code	Course	L	T	P	O	C
DSE 1	24DMSG11	Nuclear and Photochemistry	4	0	0	2	4
DSE 2	24DMSG12	Spectroscopic methods	4	0	0	2	4
DSE 3	24DMSG21	Chemistry of Natural Product	4	0	0	2	4

SUMMER INTERNSHIP

Category	Code	Course	L	T	P	O	C
SI	24IMSG31	Internship	0	0	4	1	2

RESEARCH PROJECT

Category	Code	Course	L	T	P	O	C
RP	24RMSP41	Research Project	-	-	20	-	10

SEMESTER I

24CMSG11 **ORGANIC REACTION MECHANISM AND STEREOCHEMISTRY**

L	T	P	O	C
4	0	0	2	4

Course Objectives:

- To understand the mechanism of various types of organic reactions and heterocyclic compounds.
- To correlate the principles of substitution, elimination addition reactions and heterocyclic compounds.
- To design new routes to synthesis organic and heterocyclic compounds.

UNIT – I Principles of Structure and Reactivity 12

Review of basic principles of structure and bonding, hybridisation, conjugation, Important properties of organic molecules: dipole moments, inductive effect (+I, -I), mesomeric effect, resonance effect, steric effect, aromaticity and anti-aromaticity, Huckel's rule, y-aromaticity, homo-aromaticity, neutral and charged aromatic systems (3, 4, 5, and 7- membered ring systems), annulenes and fused rings systems, hetero annulenes, aromaticity of heterocycles.

UNIT – II Stereochemistry 12

Stereochemistry: conformational analysis of acyclic and cyclic systems, effect of conformation on reactivity, elements of symmetry, chirality, molecules with more than one chiral center, projection formulae (i) Fischer (ii) Sawhorse (iii) Newman (iv) Flying Wedge, methods of resolution, specific rotation, optical purity and enantiomeric excess, and stereoselective reactions, optical activity in the absence of chiral carbon.

UNIT – III Nucleophilic Additions to Carbonyl Compounds 12

Nucleophilic addition to carbonyl compounds, Claisen-Schmidt condensation, directed aldol condensations, Claisen ester condensation, Dieckmann reaction, Stobbe condensations, Knoevenagel condensations, 1,4-conjugate additions (Michael addition), Robinson annulation, Wittig reactions, Mannich reactions.

UNIT – IV Aliphatic and Aromatic Nucleophilic Substitution 12

Nucleophilic substitution reactions, SN^1, SN^2, SN^i and neighbouring group mechanisms, nucleophilic substitutions at allylic, aliphatic and vinyl carbons, effect of substrate, nucleophile, leaving group, and medium, stereochemistry of nucleophilic substitution, ambident nucleophiles, aromatic nucleophilic substitutions, S_N Ar, S_N^1 and benzyne mechanisms, Sommelet-Hauser, Von Ritcher and Smiles rearrangement, Bucherer and Rosenmund reactions.

UNIT – V Aromatic and Aliphatic Electrophilic Substitution 12

Aromatic electrophilic substitution, the effect of leaving group, Friedel-Crafts alkylation, acylation and arylation, aliphatic substitution mechanisms, SE_2, SE_i and SE_1, addition-elimination and cyclic mechanisms, halogenations of ketones, aldehydes and carboxylic acids, aliphatic diazonium coupling, sulphonation, sulphenylation, acylation, Stork enamines, carbene and nitrene insertions, Kolbe-Schmidt reaction.

TOTAL: 60 h

Text Books:

1. Ernest L.Eliel, Stereochemistry of carbon compounds, Tata McGrawhill Edition, 2001.
2. J. March and M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th Edition, Wiley, 2013.
3. Peter Sykes, A Guidebook to Mechanism in Organic Chemistry, 6th Edition, Pearson Education Ltd., England, 2013.

Reference Books:

1. J. Clayden, N. Greeves, S.Warren and P. Wothers, Organic Chemistry, Oxford University Press, 2001.
2. M.B. Smith & J. March, March's Advanced Organic Chemistry, 5th Ed., John Wiley & Sons, New York, 2001.
3. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry, Part A and Part B, Kluwer Academic/Plenum Publishers, New York, 2004.

Web Sources:

1. https://archive.nptel.ac.in/courses/104/101/104101005/
2. https://www.organic-chemistry.org/
3. https://www.clutchprep.com/organic-chemistry

Course Outcomes (CO): At the end of this course, learners will be able to,

CO1:	Outline the concept of aromaticity in benzenoid, non-benzenoid and heterocyclic compounds.	**K2**
CO2:	Classify the various mechanism involved in various types of organic reactions with evidences.	**K2**
CO3:	Understand the applications of synthetically important reagents.	**K3**
CO4:	Compare the reactivity between aliphatic and aromatic compounds.	**K4**
CO5:	Explain the synthetic routes for organic and heterocyclic compounds	**K2**
CO6	Outline the principles aromatic nucleophilic substitution reaction	**K2**
CO7	Analyse and apply the different kind of intermediate in aromatic and aliphatic substitution reaction	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	2	3	2
CO2	3	3	3	3	3	-	-	2	3	3
CO3	3	3	3	2	3	-	2	3	2	2
CO4	3	3	3	3	2	2	-	2	2	3
CO5	3	3	2	2	3	2	2	3	2	2
CO6	3	3	2	2	3	2	-	3	2	2
CO7	3	3	2	2	3	-	2	3	2	2
Average	**3**	**3**	**2.6**	**2.4**	**2.6**	**2**	**2**	**2.4**	**2.4**	**2.4**

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**

L	T	P	O	C
4	0	0	2	4

24CMSG12 CONCEPTS OF INORGANIC CHEMISTRY

Course Objective:

- To understand the different kinds of chemical forces in molecules.
- To identify the nature of chemical bond in a given inorganic compound.
- To predict the nature and topology of inorganic compounds.

UNIT - 1: Atomic Structure and Periodic Table 12

Modern views on atomic structure: wave mechanical description of electron and orbitals, radial density functions and orbital energies, angular functions and orbital shapes. Effective nuclear charge - Slater rule and their uses: computation of and radii of atoms and ions. Modern periodic table: periodic properties, trends and the underlying reasons.

UNIT-2: Chemical Bonding 12

Hybridization: Derivation of wave functions for the following orbital hybridisation types: sp (BeH_2); sp^2 (BF_3); sp^3 (CH_4) considering only sigma bonding. Molecular Orbital Theory (LCAO-MO approach) for Electron deficient and Electron rich species. Molecular topologies: shared and lone pairs and Lewis structures, hybridization and geometry, VSEPR model, and Bent's rule. Recapitulation of hard soft acids and bases (HSAB) principle, Acid-bas strength and softness and hardness; Super acids and bases.

UNIT - 3: Crystallography 12

Principles: Miller indices, crystal lattices, and UNIT cells. X-ray diffraction: Bragg's law, powder method, single crystal diffraction, structure factor, and Fourier synthesis. Structure of sodium chloride, cesium chloride, fluorite, antifluorite, zinc blende, wurtzite, rutile, spinels, inverse spinels, and perovskite. Electron and neutron diffraction: basic principles and typical applications

UNIT-4: Organometallic Chemistry 12

Recapitulation of classification of organometallic compounds, electron counting and eighteen electron rules, Sixteen electron rule, Synthesis, structure and bonding of the following organometallic compounds: Alkyl and Aryl derivatives, Carbenes and Carbynes, Alkene complexes, Alkyne complexes, Allyl complexes, Cyclopentadiene complexes and Arene complexes (sandwich and half sandwich complexes).

UNIT-5: Bioinorganic Chemistry 12

Role of metal ions in biological processes, structure and properties of metalloproteins in electron transport processes, cytochromes, ferrodoxins and iron sulphur proteins, ion transport across membranes, Biological nitrogen fixation, PS-I, PS – II, Oxygen uptake proteins.

TOTAL: 60 h

Text Books:

1. J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
2. D. Banerjea, Coordination Chemistry, Tata McGraw Hill, 1993.
3. A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)

Reference Books:

1. Chakraburty, Soild State Chemistry, New Age International
2. G. L. Eichhron, Inorganic Biochemistry, Vol I and II, Elesevier
3. Progress Inorganic chemistry, Vol 18 and 38, J. J. Loppard, Wiley

Web Sources:

1. *https://onlinecourses.nptel.ac.in/noc22_cy02/preview*
2. *https://nptel.ac.in/courses/104101121*

Course Outcomes (CO): At the end of this course, learners will be able to

CO1:	Outline the basic principles of inorganic chemistry.	**K2**
CO2:	Understand the role of inorganic chemistry as it is related to the other areas of the discipline such as biochemistry, analytical, physical, etc.	**K2**
CO3:	Prove the theoretical problems and be able to apply the solutions to practical problems.	**K5**
CO4:	Analyse the crystalline structure of inorganic compounds	**K4**
CO5:	Explain the classification of organometallic compounds	**K5**
CO6	Outline the principles and synthesis of organometallic compounds	**K2**
CO7	Analyse and apply biological process of metalloproteins	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	-	-	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3
CO3	3	3	3	2	3	2	2	2	3	3
CO4	3	3	3	3	2	2	-	2	3	3
CO5	2	3	3	2	3	2	-	3	2	2
CO6	3	3	3	2	3	-	-	2	3	3
CO7	3	3	3	3	2	2	2	2	3	3
Average	**2.6**	**3**	**3**	**2.4**	**2.6**	**2**	**2**	**2.2**	**2.8**	**2.8**

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation

24CMSG13 **ADVANCED THERMODYNAMICS AND KINETICS**

L	T	P	O	C
4	0	0	2	4

Course Objective:

- To know quantum chemistry and classical thermodynamics in the evaluation of macroscopic properties.
- To understand the inter linking of quantum chemistry and statistical thermodynamics that leads to classical thermodynamics.
- To apply the concepts of statistical thermodynamics for the study of equilibrium reactions and reaction rates.

UNIT:1 Classical Thermodynamics 12

Review of laws of thermodynamics- Carnot cycle, Efficiency of heat engine, Entropy, entropy calculations – Free energy, criteria for spontaneity, Free energy as function of Temperature and Pressure. Chemical potential – Fugacity, determination of fugacity - Activity coefficient –partial molar quantities, partial molar volume, chemical potential, Gibbs-Duhem equation, experimental absolute entropies, determination, exceptions to third law, unattainability of absolute zero.

UNIT-II Irreversible Thermodynamics 12

Thermodynamic functions in terms of the partition function, internal energy, entropy, Helmholtz function, pressure, Gibbs function, residual entropy, equilibrium constant, isotope effects, average energies and equipartition principle, heat capacity of monoatomic gases, population inversion, negative Kelvin temperature, Einstein's and Debye's theories of heat capacities of solids, statistical basis of entropy of H_2 gas, ortho and para nuclear states, calculation of entropy in terms of ortho- para ratio, residual entropy of H_2 at 0 K.

UNIT – III Statistical Thermodynamics 12

Macro and micro states, ensembles (microcanonical and canonical), Maxwell Boltzmann statistics, Boltzmann- Planck equation, Fermi-Dirac and Bose-Einstein statistics, Comparison of three of statistics, negative absolute temperatures, partition function, evaluation of the partition function translational partition function, rotational partition function, vibrational partition function, electronic partition and nuclear partition function.

UNIT-IV Chemical Kinetics 12

Empirical Rate Laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants - Lindemann and Rice-Ramsperger- Kassel (RRK); unimolecular reactions; Kinetics of parallel – opposing reactions - chain reactions (hydrogen-halogen reactions). Catalysis-Homogeneous catalysis-heterogeneous catalysis-enzyme catalysis-Michaelis-Menton kinetics, - Autocatalysis.

UNIT V: Chemical and Phase Equilibria 12

Thermodynamic derivation of equilibrium constant K for reaction involving ideal and real gases – Thermodynamics of chemical reactions (reaction potential), Principal of Lechatlier – and Braun – chemical equilibria. Standard reaction free energy – free energy calculation from thermodynamical. Gibbs phase rule – its thermodynamic derivation application of phase rule to three component systems. Formation of one pair, two pairs and three pairs of partially miscible liquids – systems composed of two solids and a liquid.

Total 60 h

Text Books:

1. J. Rajaram and J.C. Kuriakose, 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.

Reference Books:

1. P. W. Atkins and Julio de Paula, Atkins' Physical Chemistry, 2018, International 11th Edition, Oxford University Press, UNITed Kingdom.

2. Ira N. Levine, Quantum Chemistry, 7 th Edition, 2014, Pearson Prentice Hall, London.

3. K. J. Laidler, Chemical Kinetics, 1987, 3 rd Edition, Harper & Row, New York.

Web Sources:

1. *https://nptel.ac.in/courses/104/103/104103112/*
2. *https://bit.ly/3tL3GdN*
3. *https://bit.ly/39IWesL*

Course Outcomes (CO): At the end of this course, learners will be able to

CO1:	Outline the basic principles of thermodynamic properties of ideal and real gases of a system.	**K2**
CO2:	Understand the student with the fundamental concepts of Irreversible thermodynamics	**K2**
CO3:	Classify the basic principles of statistical thermodynamics	**K4**
CO4:	Analyse kinetics of chain reactions using different theories of reaction rates	**K4**
CO5:	Understand the concepts of Chemical and Phase Equilibria.	**K2**
CO6	Outline the various principle and mechanism of collision theory	**K2**
CO7	Analyse and apply various reaction mechanism in chemical equilibira	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	-	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3
CO3	3	3	3	2	3	-	-	3	2	2
CO4	3	3	3	2	2	2	2	2	2	2
CO5	3	2	3	2	3	-	-	3	2	2
CO6	3	3	3	2	2	-	-	2	2	2
CO7	3	2	3	2	3	2	2	3	2	2
Average	**3**	**2.6**	**3**	**2.6**	**2.6**	**2**	**2**	**2.4**	**2.4**	**2.4**

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/Presentation

24PMSG11 **Organic Chemistry Practical - Practical I**

L	T	P	O	C
0	0	6	1	3

Course Objective:

- To know the techniques of separating organic compounds from the mixture.
- To learn the methods of crystallization and the method of purification.
- To provide practical experience in conducting organic reactions, understanding their mechanisms, and predicting the outcomes based on theoretical knowledge.

I. Identification of components in a two-component mixture and preparation of their derivatives.

1. Acid Substance and Neutral Substance
2. Basic Substance and Neutral Substance
3. Phenolic Substance and Neutral Substance
4. Acid Substance and Phenolic Substance
5. Phenolic Substance and Basic Substance

II. Determination of b.pt. /m.pt. for components and m.pt. for the derivatives.

III. Preparations:

1. p-Nitrobenzoic Acid from p-Nitrotoluene
2. Anthraquinone from Anthracene
3. Benzhydryl from Benzophenone
4. m-Nitroaniline from m-dinitrobenzene
5. 1,2,3,4-Tetrahydrocarbazole from Cyclohexanone
6. Methyl orange from Sulphanilic acid.
7. Iodobenzene from Aniline

TOTAL: 30h

Text Books:

1. N.S. Gnanapragasam, G. Ramamurthy, Organic Chemistry Lab Manual, S. Vishwanath Printers & Publishers Pvt. Ltd, Chennai. 2010.
2. Day & Underwood, Quantitative Analysis, Prentice Hall of India Pvt. Ltd, New Delhi. 6th Edition,2004
3. Vogel, I. *Practical organic chemistry*. 1974.

Reference Books:

1. Arthur I. Vogel, Elementary Practical Organic Chemistry (Part 1, 2 and 3), CBS Publishers and Distributors. New Delhi. 5th Edition, 1989.
2. J Leonard, B Lygo, G Procter, Advanced Practical Organic Chemistry, Stanley Thornes (Publishers) Ltd. 1st Indian Edition, 2004.
3. Leonard, John, Barry Lygo, and Garry Procter. *Advanced practical organic chemistry*. CRC press, 2013.

Web Sources:

1. https://www.masterorganicchemistry.com/
2. https://www.chemistryhelpcenter.org/organic-chemistry-resources/
3. Master Organic Chemistry - An Online Organic Chemistry Resource

Course outcomes: At the end of this course, learners will be able to:

CO1	Demonstrate the solubility nature of organic substances of different functional group.	**K2**
CO2	Learn the pilot separation of bi mixtures.	**K1**
CO3	Explain the systematic procedure organic substances analysis	**K4**
CO4	Learn two stage preparation involving molecular rearrangement oxidation.	**K1**
CO5	Test for the preparation involving nitration and bromination reaction	**K4**
CO6	Summarize the pilot separation of the mixture of acid, base and neutral organic compounds	**K2**
CO7	Inspect the concepts of boiling point and melting point of given organic compound	**K3**

Mapping of Program outcomes with course outcomes

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	2	2	2	3	3	3
CO2	3	3	3	3	3	-	-	3	3	3
CO3	3	3	3	2	3	-	2	3	3	3
CO4	3	3	3	3	2	2	2	2	3	3
CO5	2	3	3	3	3	-	-	3	2	2
CO6	3	3	3	3	2	2	2	2	3	3
CO7	2	3	3	3	3	-	2	3	2	2
Average	**2.8**	**2.8**	**3**	**2.6**	**2.6**	**2**	**2**	**2.8**	**2.8**	**2.8**

Assessment Methods:

CAT1	**CAT2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
			✓	✓

SEMESTER II

24CMSG21 ORGANIC CHEMISTRY AND MOLECULAR REARRANGEMENT

L	T	P	O	C
4	0	0	2	4

Course Objective:

- To study mechanisms of addition reactions, elimination reactions, oxidation and reduction reactions and reactions involving rearrangements.
- To understand the conformation of some important organic compounds.
- To understand potential rearrangements, chemists can predict the products of organic reactions.

UNIT–I Addition to carbon-carbon and carbon-hetero multiple bonds 12

Electrophilic, nucleophilic and neighbouring group participation mechanism-Addition of halogen and nitrosyl chloride to olefins. Hydration of olefins and acetylenes. Hydroboration, Hydroxylation, Michael addition, Robinson annulation reaction Diels Alder reaction,1,3-dipolar additions. Umpolung reactions and their application in organic synthesis.Carbenes and their addition to double bonds-Simmon Smith reaction, Mannich, Stobbe, Darzen, Wittig, Wittig – Horner, Tebbe and Benzoin reactions.

UNIT–II Elimination Reactions 12

E1, E2 and E1cB mechanism- E1, E2 and E1cB Spectrum—orientation of the double bond –Hoffmann and Saytzeff rules-competition. Typical elimination reactions – dehydration, dehydrohalogenation and dehalogenation. Stereochemistry of E2 eliminations in cyclohexane systems. Mechanism of pyrolytic elimination. Chugaev and Cope eliminations.

UNIT–III Molecular Rearrangements 12

A detailed study with suitable examples of the mechanism of the following rearrangements: Pinacol-pinacolone-Wagner Meerwein, Demjanov, dienone–phenone, Favorskii, Lossen, Baeyer–Villiger, Dakin Rearrangement, Wiitig, Hoffman-curtius, Beckmann rearrangements.

UNIT–IV Oxidation and Reduction 12

Mechanisms – study of the following oxidation reactions–oxidation of alcohols using chromium (Jones oxidation, Collins & Sarrettreagents, PCC&PDC) -use of DMS(Corey-Kim Oxidation), DMSO in oxidizing alcohols- Dess-Martin Oxidation- oxidation of alkene to carbonyl (OsO_4, $Pb(OAc)_4$,Ozonolysis) , SeO_2 and Sharpless Asymmetric epoxidatron. Reductions: selectivity in reduction of 4-T- Butyl cyclohexanone using select rides hydride reductions – synthetic importance of Clemmenson and Wolff- Kishner reductions- modifications of Wolff-Kishner reduction – Birch reduction, MPV reduction and Rosemand reduction.

UNIT–V Conformational Analysis 12

Conformation of some simple 1,2 disubstituted ethane derivatives. Conformational analysis of disubstituted cyclohexanes and their stereochemical features (geometric and optical isomerism by these derivatives). Conformation and reactivity of substituted cyclohexanols (oxidation and acylation), cyclohexanones (reduction) and cyclohexane-Application of conformational analysis. Analytical technique in Conformational analysis.

TOTAL: 60 h

Text Books:

1. R.O.C. Norman, Principles of Organic Synthesis, Chapmanand Hall, London. 2nd 1980.
2. Francis A. Carey, Richard J. Sundberg, Advanced Organic Chemistry-Part B Reactions and Synthesis, Plenum Press. 3rd Edition,1990.
3. Principles of Organic Synthesis" by Richard O.C. Norman and James M. Coxon. 2nd Edition.1999.

Reference Books:

1. S.M. Mukherjiand S. P. Singh, Organic Reaction Mechanism, Macmillan IndiaLtd.1990.
2. P.S. Kalsi, Textbook of Organic Chemistry, Macmillan IndiaLtd.1999.
3. Laue, Thomas, and Andreas Plagens. *Named organic reactions*. John Wiley & Sons, 2005.

Web Sources:

1. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(McMurry)/06%3A_An_Overview_of_Organic_Reactions/6.01%3A_Kinds_of_Organic_Reactions
2. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_I_ortes)/08%3A_Conformational_Analysis_of_Alkanes/8.02%3A_Conformational_Analysis
3. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/organic_chemistry-ii/01.types_of_organic_reactions/et/4784_et_et.pdf

Course Outcomes (CO): At the end of this course, learners will be able to:

CO1:	Learn the principle of addition reaction	**K2**
CO2:	Discuss the mechanism of familiar organic name reactions followed by addition mechanism	**K3**
CO3:	Learn the concepts of elimination reaction	**K2**
CO4:	Understand the detail mechanism of various types of molecular rearrangement	**K2**
CO5:	Interpret the various familiar oxidation reactions like oppenaur oxidation	**K2**
CO6	Understand the concept of different oxidation and reduction reagent in organic synthesis	**K2**
CO7	Summarize the concept of stereochemistry in di-substituted cyclo hydrocarbons	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	-	2	3	3
CO2	3	3	3	-	2	2	2	3	3	3
CO3	3	3	3	2	-	2	-	2	2	2
CO4	3	2	3	3	2	-	2	3	2	2
CO5	3	3	3	2	-	2	-	2	2	2
CO6	3	2	3	3	2	2	-	3	2	2
CO7	3	2	3	-	3	-	2	2	2	2
Average	**3**	**2.4**	**3**	**2.33**	**2.25**	**2**	**2**	**2.2**	**2.4**	**2.4**

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
			✓	✓

L	T	P	O	C
4	0	0	2	4

24CMSG22 **COORDINATION CHEMISTRY**

Course Objective:

- To learn about coordination chemistry, nomenclature and various theories, WernerTheory, valence bond theory, crystal field theory, Magnetic properties and splitting.
- To learn about reaction mechanism and f block elements.
- To explore the electronic properties of coordination complexes and their reactivity, including their roles in catalysis, redox reactions.

UNIT – I Coordination Chemistry 12

Introduction: Werner‘s theory and Sidgwick theory, EAN and formation of metal-metal bond in dimers, stability of complexes, determination of stability constants, Jobs method, stepwise stability constant, overall stability constant, factors affecting stability of coordination compounds, charge and size of central metal ion, chelate ring size, steric effects. Isomerism: linkage, ionization, hydrate, coordination, coordination position isomerism, geometrical and optical isomerism.

UNIT – II Theories of Coordination Chemistry 12

Valence bond theory hybridization, geometry, magnetism, drawbacks of VBT. Crystal field theory: crystal field effects, crystal field splitting in octahedral and tetrahedral geometries, high-spin and low-spin complexes, spectrochemical series, Jahn-Teller theorem, covalency in transition metal complexes, intensity of d-d transitions, spin-spin splitting, hyperfine splitting, MO Theory: metal orbitals and LGOs suitable for σ and π bonding in octahedral geometry, construction of qualitative MO energy level diagram for bonding in octahedral geometry.

UNIT – III Magnetic Properties and Splitting 12

Magnetic properties of tetrahedral and octahedral complexes-Gouy’s method, anomalous magnetic moment, thermal effects, spin and orbital contribution quenching, spin cross over rule, term symbols for equivalent and nonequivalent electrons, p2 - d2 splitting of terms in square planar, tetrahedral, octahedral fields, Orgel (d1 to Sd9 octahedral and tetrahedral complexes) and Tanabe Sugano diagrams(d1,d6 complexes and its applications), charge transition spectra of metal complexes.

UNIT – IV Reaction and Mechanism in Coordination chemistry 12

Ligand substitution reactions in octahedral, square planar complexes, labile and inert complexes (application of VBT, MOT), mechanism in Coordination chemistry, theories of trans effect and its application, Electron transfer reactions, inner sphere mechanism, outer sphere mechanism, Marcus theory and its applications, complementary and non - complementary electron transfer reactions, synthesis of coordination compounds using electron transfer reactions, metal assisted reactions, aldol condensation, ester hydrolysis.

UNIT – V Lanthanides and Actinides 12

Lanthanide and actinide series: Abundance and natural isotopes, occurrence, oxidation states, lanthanide contraction, similarity in properties, chemical properties of Ln(III)cations, magnetic properties, colour and electronic spectra of lanthanide compounds, separation of lanthanides, solvent extraction, ion exchange, chemical properties of Ln(III) metal ions, uranium-occurrence, metallurgy; chemical properties of hydrides, oxides, and halides, complexes of lanthanides and actinides.

Total: 60 hrs.

Text Books

1. Puri B. R, Sharma L. R. Kalia K. K "Principles of inorganic Chemistry" Milestone publishers, 31st edition, **2013.**
2. Porterfield, William W. Inorganic chemistry. Academic press, 2013.
3. F. A cotton G. Wilkinson and P. L. Gvas "Basic Inorganic Chemistry" John Wiley, 11th edition, **2009.**

Reference Books:

1. R. D. Madhan, "Modern Inorgnaic Chemistry" S. Chand & Co., 6th edition**2012**
2. James E. Huheey, Ellen, A. Keiter, Richard, L. Keiter, "Inorganic Chemistry" Pearson education (Singapore Pvt Limited) 9th edition,**2013.**
3. J. D.Lee, Concise Inorganic chemistry" Blackwell Science Limited (France) 9th edition 2013

Web Sources:

1. https://www.tutorialsduniya.com/notes/coordination-chemistry-lecture-notes-pdf/
2. https://www.alchemyst.co.uk/pdf/Inorganic/coordination_chem.pdf
3. Concise Inorganic Chemistry, 5th Ed - J. D. Lee - Google Books

Course Outcomes (CO): At the end of this course, learners will be able to:

CO1:	Learn the terms like covalence in transition metal complexes, spin states, hybridization, geometry, magnetism, and crystal field effects.	**K2**
CO2:	Understands the concepts behind coordination chemistry theories, including molecular orbital (MO) theory, Sidgwick theory, valence bond theory (VBT), crystal field theory (CFT), and Werner's theory	**K2**
CO3:	Analysis and differentiate between para-, dia-, ferro-, and antiferromagnetism magnetic properties of coordination complexes.	**K4**
CO4:	Understand how coordination compounds undergo ligand substitution, hydrolysis, a nation, and electron transfer reactions.	**K2**
CO5:	Describe the different theories, reaction and mechanism of coordination compounds.	**K4**
CO6	Understanding the abundance, analysis and preparation of lanthanide compounds	**K2**
CO7	Explain the abundance, analysis and preparation of actinide compounds	**K2**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	**PO6**	**PO7**	PSO1	PSO2	PSO3
CO1	3	-	3	2	2	2	-	2	3	3
CO2	3	3	3	-	2	2	-	3	3	3
CO3	1	3	3	2	-	2	2	2	2	2
CO4	3	-	3	3	2	2	-	2	2	2
CO5	3	2	2	-	3	-	2	2	2	2
CO6	3	2	2	-	3	2	-	2	2	2
CO7	3	2	2	-	3	2	-	2	2	2
Average	2.8	2.66	2.8	2.33	2.25	2	2	2.14	2.4	2.4

Assessment Methods:

CAT1	**CAT2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
			✓	✓

24CMSG23 **QUANTUM CHEMISTRY & GROUP THEORY**

L	T	P	O	C
4	0	0	2	4

Course Objective:

- To study fundamental aspects of classical mechanics, the harmonic oscillator, rigid rotor and Born –Oppenheimer approximation.
- To learn about the general aspects of group theory.
- To understand complex chemical phenomena and enhance their ability to conduct research in the field.

UNIT–I Quantum Chemistry-I **12**

Classicalmechanics-reasonforfailure-Basicprinciplesofquantummechanics.Atomic spectra, block body radiation, photoelectric effect-, Bohr's correspondence principle-De Broglie wave particle duality- Heisenberg uncertainty principle. Operator algebra, Linear and Hermitian operators. Eigen Values and Eigen Functions. Quantum mechanical postulates–Schrodinger equation–elementaryapplicationsofSchrodinger'sequation–theparticlein a box(one and three dimensional cases)

UNIT–II Quantum Chemistry-II **12**

The harmonic oscillator – the rigid rotor- the hydrogen atom – Schrodinger equation for hydrogen atom –un normalised and normalised wave equations-the solution- the origin of quantum numbers (Angular momentum and spin)-their physical significance. Helium atom and Pauli's exclusion principle.

UNIT–III Quantum Chemistry-III **12**

Approximation methods –Variation and Perturbation theorem, methods – application to hydrogen, helium atoms – R, S Coupling and term symbols for atoms. Born-Oppenheimer approximation – valence bond the ory for hydrogen molecule –LCAO-MO theory for di and poly atomic molecules-concept of hybridization –Huckel theory for conjugated molecules (ethylene, butadiene and benzene) – semi-empirical methods-Slater orbital and HF-SCF methods.

UNIT–IV Group theory-I **12**

Symmetry elements and symmetry operations – concept of Group and its properties, Group multiplication tables- Mathematical rules for the formation of a group, - Definition and classification of Point groups – Identification and determination – Matrix representations- Reducible and irreducible representations- Similarity transformation – Character table- Construction of Character table for C_{2V} and C_{3V} point group- Orthogonality theorem and its consequences- Mülliken symbols, reduction formula, direct sum and direct products. Determination of symmetry of hybrid orbitals

UNIT–V Group theory-II **12**

Determination of symmetry of hybrid orbitals-Symmetry of hybrid orbitals in non-linear molecules (H_2O, CH_4, XeF_4, BF_3, SF_6 and NH_3). Molecular vibrations- symmetry aspects of molecular vibrations -Direct product representation-Determination – IR and Raman activity of vibrational modes in non-linear molecules (H_2O, CH_4, XeF_4, BF_3, SF_6 and NH_3). SymmetryselectionrulesofinfraredandRamanSpectra.Selectionrulesforelectronic transitions. Symmetry of molecular orbitals and electronic states of HCHO. Selection rules for electronic transitions of HCHO.

TOTAL: 60h

Text Books:

1. R. Anantharaman, Fundamentals of Quantum chemistry, Macmillan India Limited 2001.
2. Ramakrishnan, M.S Gopinathan, Group Theory in Chemistry, Vishal Publications, New Delhi. 1988.
3. K. V.Raman, Group theory and its applications to Chemistry, Tata McGrawHill, New Delhi. 1990.

Reference Books:

1. D.A. McQuarrie, Quantum chemistry, University Science Books, Mil Valley, California. 1983.
2. T.N. Levine, Quantum Chemistry, Allyn and Bacon, Boston. 1983.
3. I.N. Levine, Quantum Chemistry, Prentice Hall India. 4th edition, 1994.

Web Sources:

1. https://chem.libretexts.org/Courses/Mount_Royal_University/Chem_1201/UNIT_1%3A_Quantum_Chemistry
2. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/13.applications_of_molecular_symmetry_and_group_theory/03.definition_of_group_and_its_characteristics/et/4842_et_et.pdf

Course Outcomes (CO): At the end of this course, learners will be able to:

CO1:	Learn the postulates of Quantum mechanics	**K2**
CO2:	Understand the basic principles of quantum mechanics	**K2**
CO3:	Discuss the Heisenberg uncertainty principle	**K4**
CO4:	Apply the approximation methods in quantum chemistry	**K3**
CO5:	Illustrate the anation, and electron transfer reactions.	**K2**
CO6	Apply and analysis the point groups simple molecule	**K3**
CO7	Explain the symmetry of non-linear molecules.	**K2**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	-	2	3	3
CO2	3	3	3	2	2	2	-	3	3	3
CO3	3	3	3	2	-	-	-	2	2	2
CO4	3	2	3	3	2	2	2	2	2	2
CO5	3	3	3	2	-	-	-	2	2	2
CO6	3	2	3	3	2	2	2	2	2	2
CO7	3	2	3	3	3	-	-	2	2	2
Average	3	2.4	3	2.4	2.25	2	2	2.2	2.4	2.4

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
			✓	✓

24PMSG21 **INORGANIC CHEMISTRY PRACTICAL – PRACTICAL II**

L	T	P	O	C
0	0	6	1	3

Course Objective:

- To learn the quantitative determination of compound by volumetric titration method.
- To learn the qualitative analysis of a given salt mixture.
- To develop the ability to document and present their experimental work effectively, including writing detailed lab reports.

I. Volumetric Estimations:

1. Estimation of Zinc
2. Estimation of Magnesium
3. Estimation of Calcium
4. Estimation of Nickel

II. Colorimetric analysis:

5. Estimation of iron
6. Estimation of nickel
7. Estimation of manganese
8. Estimation of copper.

III. Qualitative analysis:

9. Analysis of Salt mixture- I (W, Se, Pb, Cu)
10. Analysis of Salt mixture- II (Te, Th, Al, Fe)
11. Analysis of Salt mixture- III (Ti, Zr, Mn, Co)
12. Analysis of Salt mixture- IV (Ce, V, Ni, Zn)

TOTAL: 30h

Text Books:

1. Jeyavathana Samuel, Chemistry Practical Book, G.G. Printers, Chennai.2012.
2. Vickie. M. Williamson, M. Larry Peck, Lab manual for General Chemistry, Cengage Learning India Private Limited, New Delhi. 2009.
3. Theodore E. Brown, H. Eugene LeMay, Bruce E. Bursten, Catherine J. Murphy, Patrick Woodward, and Matthew E. Stoltzfus *The Central Science* 15th edition, published in 2022.

Reference Books:

1. V.V. Ramanujam, Inorganic Semimicro Qualitative Analysis, The National Publishing Company, Chennai. 3rd edition, 1974.
2. Vogel's "Textbook of Quantitative chemical Analysis", Pearson Education Ltd. 6th Edition, 2008.
3. Pass, Geoffrey. *Practical inorganic chemistry: preparations, reactions and instrumental methods*. Springer Science & Business Media, 2013.

Web Sources:

1. https://www.studocu.com/en-za/document/mangosuthu-university-of-technology/inorganic-chemistry-2/inorganic-chemistry-ii-practicals-guide/17752501.
2. Practical Physical/Inorganic Chemistry II | University of Cape Coast (ucc.edu.gh)
3. Practical Inorganic Chemistry | Mir Books (mirtitles.org)

Course outcomes: At the end of this course, learners will be able to:

CO1	Develop proficiency in the volumetric estimation of metal using complexometric titration techniques.	**K6**
CO2	Understand and apply colorimetric techniques to estimate iron content in various samples, interpreting absorbance data to determine concentrations.	**K2**
CO3	Develop expertise in the colorimetric estimation of copper, applying the Beer-Lambert law for precise quantification.	**K6**
CO4	Identify and qualitatively analyze the presence of W, Se, Pb, and Cu in salt mixtures, using systematic inorganic analysis methods.	**K1**
CO5	Accurately identify and qualitatively analyze the components of salt mixtures containing Ti, Zr, Mn, and Co, utilizing advanced analytical techniques.	**K1**

Mapping of Program outcomes with course outcomes

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	2	-	-	3	3	3
CO2	3	3	3	3	3	-	2	3	3	3
CO3	3	3	3	2	3	2	2	3	2	2
CO4	3	3	3	3	2	-	-	2	3	3
CO5	3	3	3	2	3	2	-	3	2	2
Average	3	2.8	3	2.6	2.6	-	2	2.8	2.6	2.6

Assessment Methods:

CAT1	**CAT2**	**Model Exam**	**End Semester Exams**	**Assignments**
		✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
✓	✓		✓	✓

24PMSG22 **PHYSICAL CHEMISTRY PRACTICAL – PRACTICAL I**

L	T	P	O	C
0	0	6	1	3

Course Objective:

- To understand and analyze the kinetic and thermodynamic. aspects of reactions.
- To learn the significance of potentiometric and conductometric titrations.
- To gain proficiency in logical deduction skills through written problems and laboratory work.

Non-Electrical experiments:

1. Determination of relative strength of the given 2 acids catalyzed by methyl acetate.
2. Determine the temperature coefficient & energy of activation of hydrolysis of methyl acetate.
3. Construction of Phase diagram for a simple binary system.
4. Determination of rate constant & order of reaction between $K_2S_2O_8$ & KI
5. Study of the primary salt effect on the Kinetics of ionic reactions & test the Bronsted relationship ($K_2S_2O_8$ + KI)
6. Determination of equilibrium constant of the reaction between I_2 + KI by Partition method.
7. Study of the adsorption of acetic acid by charcoal (Freundlich isotherm).

Electrical Experiments:

I. Potentiometric titrations:

1. Strong acid Vs Strong Base
2. Weak acid Vs Strong Base
3. Mixture of acid Vs Strong Base
4. Halides Vs AgNO3
5. Mixture of halides Vs AgNO3
6. Redox Titration

a. $FeSO_4$ Vs $K_2Cr_2O_7$ b. KI Vs $KMnO_4$

7. Determination of pKa of a weak acid using Henderson equation.

II. Conduct metric titrations:

1. Strong acid Vs Strong base.
2. Strong acid & weak acid Vs Strong base (Mixture of acids Vs Strong base)
3. Weak acid Vs Strong base.
4. Determination of cell constant and verification of Debye-Huckel Onsager equation for strong electrolyte.
5. Determination of dissociation constant of weak electrolyte by conductivity method.

TOTAL: 30h

Text Books:

1. P. S. Raghavan, B. Viswanathan, Practical Physical Chemistry, Viva books Private Limited, New Delhi. 2005.

2. B.D. Khosla and V.S. Garg, Senior Practical Physical Chemistry, R. Chand and Co., New Delhi. 1998.

3. Arthur M. Halpern and George C. McBane, Experimental Physical Chemistry, 2017

Reference Books:

1. Findary, T.A. Kitchner Practical physical chemistry, Longmans, Green and Co. 1997.
2. J.M. Wilson, K.J. Newcombe, A.R. Denko. R.M.W. richett, Experiments in Physical Chemistry, Pergamon Press. 2007.
3. Yadav, J. B. *Advanced Practical Physical Chemisty*. Krishna Prakashan Media, 2006.

Web Sources:

1. https://studylib.net/doc/6998505/laboratory-4-conductometric-titrations
2. https://www.unige.ch/asso-etud/aecb/rapports/3eme/chianalytique/titration_12.pdf
3. https://people.ok.ubc.ca/pphillips/DRAFT%20464%20Manual.pdf

Course outcomes: At the end of this course, learners will be able to:

CO1	Understand the student will be learning the concept of non-electrical experiments	**K2**
CO2	Learn to construct phase diagram	**K2**
CO3	Explain the concept distribution coefficient	**K3**
CO4	Analyses the hydrolyze of ester	**K4**
CO5	Analyze the weak acid& base and strong acid & base by potentiometric titration	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	3	2	2	2	-	3	3
CO2	3	3	3	3	3	-	-	3	3
CO3	3	3	3	2	3	-	2	3	2
CO4	3	3	3	3	2	2	-	2	3
CO5	3	3	3	3	3	2	-	3	2
Average	3	2.8	3	2.6	2.6	2	2	2.8	2.6

Assessment Method

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
		✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
✓	✓		✓	✓

DISCIPLINE SPECIFIC ELECTIVE

21DMSG11 NUCLEAR AND PHOTOCHEMISTRY

L	T	P	O	C
4	0	0	2	4

Course Objective

- To understand the Nuclear fission and nuclear fusion reaction and applications of tracers techniques.
- To study; the features of inorganic photochemistry like solar energy conversion and photo electrochemistry
- To know the importance of nuclear reactions in the modern world.

UNIT: 1 Nuclear Force and Electron Capture Detectors **12**

Nuclear Binding Energies, nuclear radii, spin and moments, nuclear structure, n/p ratios in stable and meta stable nuclei, nuclear forces, structure of the nucleus - Nuclear Models - liquid drop model - shell model – Radioactive decay- detection and determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M., Scintillation and Cherenkov counters.

UNIT: 2 Nuclear reactions **12**

Types of nuclear reactions, nuclear cross section, spallation, nuclear fission and fusion. Theory of fission-chain reaction, critical mass; nuclear reactors-fast breeder reactor, fuels used in nuclear reactors-fissile, fertile separation of isotopes, moderators, coolants. Nuclear fusion; nuclear reactors in India. Particle Accelerators: Cyclotron - synchrocyclotron.

UNIT 3 Tracer study 12

Preparations - principles underlying tracer technique - application of tracers in the study of reaction mechanism and in analytical chemistry - neutron activation analysis, isotope dilution analysis - radio chemical determination of age of geological specimen. Tracers as applied to industry and agriculture - radioactive tracer in the diagnosis and treatment in the field of medicine.

UNIT: 4 Photochemistry 12

Fundamentals of photochemistry – photochemical laws – emission of radiations – types of photo physical pathways – delayed fluorescence – basic instrumentation of steady-state and time resolved fluorometer – fluorescence emission, solvent and environmental effects, red-edge effects, effects of intermolecular photophysical processes on emission – static and dynamic quenching, Stern-Volmer equation – Jablonski diagram.

UNIT: 5 Photochemistry of Inorganic complexes **12**

Inorganic photochemistry – photoredox and isomerization process – Photo substitution reactions– photosensitization reactions – photochemistry in energy conversion, application of metal complexes in solar energy conversion; organometallic photochemistry –photochemical reactions in metal carbonyls; Photochemical techniques – flash photolysis – lasers in photochemistry;

TOTAL: 60h

Textbooks:

1. G.S. Manku, Inorganic Chemistry, TMG Co., 1984
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry- A Comprehensive Text, John Wiley and Sons, V Edition,1998
3. K.K.Rohatgi Mukherjee, Fundamentals Of Photochemistry, Wiley Eastern Ltd., 1978

Reference Books:

1. D.F. Shrivers, P.W. Atkins and C.H. Langfor, Inorganic Chemistry, CH Langford. 1990.
2. H.J. Arnikar, Essentials of Nuclear Chemistry, 4 th edn., NewAge International, New Delhi, 2007
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin

Weblink/ websources:

1.https://www.nou.ac.in/econtent/Msc%20chemistry%20paper%202/MSc%20Chemistry%20Paper-II%20UNIT-2.pdf

2.https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/

3.https://www.studocu.com/in/document/mahatma-gandhi-university/msc-chemistry/photochemistry-1-lecture-notes/44815992

Course Outcomes (CO): At the end of this course, learners will be able to:

CO1:	To learn what is cloud chamber and bubble chamber.	**K2**
CO2:	To know various reactions of nuclear fission and nuclear fusion.	**K3**
CO3:	To familiarize the nuclear reactors in India	**K3**
CO4:	To learn how radioactive tracer is used in diagnosis and treatment in the field of medicine.	**K3**
CO5:	To learn the concepts of solar energy conversion	**K4**
CO6	To understand the fundamental principles of photochemistry, including the interaction of light with matter and the absorption and emission of light by molecules.	**K3**
CO7	To identify the various photo physical processes, such as fluorescence, phosphorescence, and non-radioactive decay.	**K3**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	2	2	3	2
CO2	3	3	3	3	2	-	-	2	3	3
CO3	3	3	3	2	3	-	-	3	2	2
CO4	3	3	2	2	2	2	-	2	2	3
CO5	3	3	3	2	3	2	2	3	2	2
CO6	3	3	2	3	3	2	-	3	2	2
CO7	3	3	2	2	3	-	2	3	2	2
Average	**3**	**3**	**2.6**	**2.4**	**2.6**	**2**	**2**	**2.4**	**2.4**	**2.4**

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
			✓	✓

21DMSG12 **SPECTROSCOPIC METHODS**

L	T	P	O	C
4	0	0	2	4

Courses objective

- To learn the theory and application of various spectroscopic techniques, such as IR, NMR, UV-Vis and MS
- To understand the strengths and limitations of each spectroscopic techniques and choose appropriate methods for specific analytical problems.
- To communicate effectively about spectroscopic results, including written and oral presentation

UNIT-I Techniques of UV-Visible spectroscopy and Infrared Spectroscopy 12

Colorimetric analysis and UV-Visible spectroscopy: Beer Lambert's law, Principles of single and double beam instruments–applications for analysis of inorganic and organic samples. Infrared spectro photometric analysis–principle and instrumentation and molecular structure determination.

UNIT–II Raman Spectra 12

Raman Spectra–principle, basic instrumentation–structural analysis.

UNIT–III Nuclear Magnetic Resonance 12

Nuclear Magnetic Resonance–Principle, instrumentation structure determination,

NMR of ^{1}H, ^{13}C, ^{31}P, ^{19}F.

UNIT–III Electron Spin Resonance 12

Electron Spin Resonance–Principle, instrumentation, applications to coordination compounds.

UNIT-V Mass Spectrometry 12

Mass Spectrometry–Principle, basic instrumentation, fragmentation patterns –organic molecular structural determination.

TOTAL: 60

Text books:

1. D.A.Skoogand D.M.West, Fundamentals of Analytical Chemistry, IV Edition, Old Reinhord & Winston, Publication,1982.
2. B.K.Sharma,InstrumentalmethodsofChemicalanalysis,GoelPublishingHouse,4th Edition, 2005.
3. GurdeepR.Chatwal,ShamK.Anand,InstrumentalMethodsofChemicalAnalysis, Himalay Publ, 1979.

Reference books:

1. WillardMerrit,DeanandSettle,Instrumentalmethodsofanalysis,6th Edition,CBSPubl. 1986.
2. A.I.Vogel,TextbookofQualitativeInorganicAnalysis,ELBS,1976OldReinhord& Winston, Publication. 3rd Edition,1982.

Websites:

1. https://nptel.ac.in/courses/103/108/103108100/
2. https://nptel.ac.in/courses/115/103/115103030/

Web sources:

1. https://www.slideshare.net/Santachem/uv-visible-spectroscopy
2. https://www.slideshare.net/Preetichaudhary55/electron-spin-resonance-spectroscopy-145343647
3. https://www.slideshare.net/msakhan61/atomic-absorption-spectroscopy-aas-129450445

Course Outcomes (CO): At the end of this course, learners will be able to:

CO1:	Analyze the spectroscopic data to identify and characterize molecules	**K4**
CO2:	Apply spectroscopic methods to quantitative analysis	**K3**
CO3:	Choose appropriate spectroscopic techniques for specific analytical problems	**K3**
CO4:	Interpret spectroscopic results in the context of chemical structure and bonding	**K2**
CO5:	To understand the ESR spectra, properties of materials, including defects, impurities and surface properties .	**K2**
CO6	Analyze NMR spectra to determine the structure and properties of molecules	**K4**
CO7	Analyze mass spectra to determine the structure and properties of molecules	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	2	2	3	2
CO2	3	3	3	3	2	-	-	2	3	3
CO3	3	3	3	2	3	-	-	3	2	2
CO4	3	3	2	2	2	2	-	2	2	3
CO5	3	3	3	2	3	2	2	3	2	2
CO6	3	3	2	3	3	2	-	3	2	2
CO7	3	3	2	2	3	-	2	3	2	2
Average	**3**	**3**	**2.6**	**2.4**	**2.6**	**2**	**2**	**2.4**	**2.4**	**2.4**

Assessment Methods

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
			□	□

21DMSG21 **CHEMISTRY OF NATURAL PRODUCTS**

L	T	P	O	C
4	0	0	2	4

Courses objective

- To study the diversity and complexity of natural products, including their classification, structure and biosynthesis
- To learn about the isolation, purification and characterization of natural products
- To study chemical reactions and mechanism involved in the biosynthesis of natural products
- To understand the principles of natural products synthesis, including total synthesis and semi-synthesis

UNIT–I Alkaloids 12

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen hetero cyclicring, role of alkaloids in plants. Structure, stereochemistry, synthesis of the following: Ephedrine, Atropine, Quinine and Morphine

UNIT–II Steroids-I 12

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon, stereochemistry, isolation, structure determination and interconversions of steroids.

UNIT–II Steroids-II 12

Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone and bio synthesis of cholesterol

UNIT–IV Terpenoids 12

Terpenoids- Classification, Isoprenerule, Structural elucidation of chemical degradation and synthesis of camphor, Squalene, and Abetic acid.

UNIT–V Carbohydrates Prophyrins and Rotenoids 12

Carbohydrates –Oligosaccharides, trisaccharides glycosides. Structural Elucidation of Starch and cellulose, Primary concept. Porphyrin: Structure and synthesis of Haem and Chlorophyll. Rotenoids: Structure determination and synthesis of rotenone.

TOTAL : 60h

Text books:

1. R.O.C.Norman,ChapmanandHall,Principlesof OrganicSynthesis,London.1980.
2. E.S.Gould,StructureandmechanisminOrganicChemistry,HenryHoltand Co. New York. 1957.
3. FrancisA.CareyandRichardJ.Sundberg,AdvancedOrganicChemistry-Part B, 3rd Edition, 1990.
4. S.M.MukherjiandS.P.Singh,OrganicReactionMechanism,Macmillan India Ltd. 1990.

Reference books:

1. Michael.B.Smith,OrganicSynthesis,ElsevierInc. 3rd Edition,2010.
2. Mc.Murray,Advancedorganicchemistry,ThomsonPvt. Ltd.1998.

Websites:

1. https://www.intechopen.com/books/alkaloids-their-importance-in-nature-and-human-life/introductory-chapter-alkaloids-their-importance-in-nature-and-for-human-life

Course Outcomes (CO): At the end of this course, learners will be able to:

CO1:	To learn the general aspects of alkaloids in plants.	**K2**
CO2:	To know the structure, stereochemistry and synthesis of quinine and morphine.	**K3**
CO3:	To learn about the occurrence, nomenclature and basic skeleton of steroids.	**K3**
CO4:	To elucidate the structure and interconversion of steroids.	**K3**
CO5:	To understand the types of steroids.	**K4**
CO6	To learn about the terpenoids compound synthesis and applications	**K3**
CO7	To know the carbohydrate structure and synthesis and properties	**K3**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	2	3	2
CO2	3	3	3	3	3	-	-	2	3	3
CO3	3	3	3	2	3	-	2	3	2	2
CO4	3	3	3	3	2	2	-	2	2	3
CO5	3	3	2	2	3	2	2	3	2	2
CO6	3	3	2	2	3	2	-	3	2	2
CO7	3	3	2	2	3	-	2	3	2	2
Average	**3**	**3**	**2.6**	**2.4**	**2.6**	**2**	**2**	**2.4**	**2.4**	**2.4**

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/Presentation**
			✓	✓