GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

COURSE CURRICULUM

M.Sc. Organic Chemistry

Batch:2024-2025
Academic Year: 2024-25
Updated on: June, 2024

GSFC University
School of Science, Vigyan Bhavan, P. O. Fertilizernagar, Vadodara - 391750, Gujarat, India

VISION

- GSFCU strives to be the best compact boutique institution with a futuristic approach, encouraging student centric culture and sharpened focus on developing industry ready & employable students with all-round development.

MISSION

- Establish an institution, which promotes creativity and innovation.
- Develop unique quality standards for academic excellence and pedagogical innovations.
- Remain agile through a learning ecosystem with flexible processes & systems.
- Holistic growth for industry readiness.

No.	Programme Outcomes (POs)	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
PO1	Basic Knowledge: To impart knowledge regarding basic concepts of applied chemical sciences.	Cognitive domain	Apply
PO2	Interdisciplinary approach: To explain the relationships between chemical sciences, biological sciences, physical sciences and mathematical sciences.	Cognitive domain	Apply
PO3	Practical learning: To perform procedures as per laboratory standards in the areas of Chemical Sciences and to think analytically.	Cognitive domain	Create
PO4	Effective Communication and social Interaction: To communicate effectively in terms of reading, writing, speaking and delivering the view to others.	Cognitive domain	Evaluate
PO5	Ethics: To culminate and understand the moral values for any of the subjects with respect to good practices and humanity.	Cognitive domain	Create
PO6	Environment and Sustainability: To explain the importance of ecological balance along with conservation of natural resources for human well being.	Cognitive domain	Create

No.	Programme Specific Outcomes (PSOs)	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
PSO1	To prepare the students to understand the chemistry particularly organic and analytical chemistry related research and Industrial applications	Cognitive domain	Understan dEvaluate Create
PSO2	To make students expert in interpreting complex data related to chemistry problems and challenges.	Cognitive domain	Evaluate Analyse
PSO3	To provide knowledge needed to solve current and emerging technologies to students.	Cognitive domain	Apply Create
PSO4	To make students expert in communicating issues related to chemistry to a wide audience	Cognitive domain	Understan d Analyse
PSO5	To prepare students in solving complex social and ethical problems confronting the industry and the government.	Cognitive domain	Apply Create
PSO6	To expose students to the different processes used in industries and their applications in chemistry.	Cognitive domain	Apply Create

Mapping of POs & PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6
PSO1	1	1	3	3	3	1
PSO2	2	2	1	3	1	3
PSO3	3	3	3	1	3	3
PSO4	2	2	3	2	3	2
PSO5	2	2	3	2	3	2
PSO6	2	2	3	2	3	2
Avg.	2	2	3	2	3	2

1: Slight (Low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Definition of Credit:

1 Hour. Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
4 Hours Practical (P) per week	2 credit
2 Hours Practical (P) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
3 Hours Experiential learning	1 credit

Course code Definitions:

Lecture	L
Tutorial	T
Practical	P
Basic Science Courses	BSC
Engineering Science Courses	ESC
Humanities and Social Sciences including Management courses	HSMC
Professional core courses/Major (Core)	PCC
Professional Elective courses/Minor Stream	PEC
Open Elective courses	OEC
Laboratory course	LC
Mandatory courses	MC
Non-credit courses	NC
Project (Experiential learning)	PROJ
Experiential learning ex. Internship, Industrial Visit, Field visit, etc,	EL
Multidisciplinary courses	MDC
Ability Enhancement Course	AEC
Skill Enhancement Course	SCE
Value Added Courses	VAC

Structure of Postgraduate Programme:

Sr. No.	Category	Credit Breakup
1	Professional core courses -**Major (Core)**	120
2	Professional Elective courses relevant to chosen specialization/branch -**Minor Stream**	12
3	Project work, seminar and internship in industry or elsewhere	10
4	Mandatory Courses [Environmental Sciences, Induction Programme, Indian Constitution, Essence of Indian Knowledge Tradition]	(non-credit)
	Total	**114**

Table: Minimum Credit Requirement

S.No.	Broad Category of Course	Minimum Credit Requirement
		2-year PG
1	Major (Core) (50% of total credit)	120
2	Skill Enhancement Courses (SEC) (from major & Minor)	26
3	Internship and Dissertation	10
	Total	156

Category-wise Courses:

Professional Core Courses

(i) Number of Professional Core Courses:120
(ii) Credits: 92

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	MSCM111	Analytical Chemistry – I	I	3	4	0	7	3	2	0	5
2	MSCM112	Organic Chemistry - I	I	3	4	0	7	3	2	0	5
3	MSCM113	Physical Chemistry - I	I	3	4	0	7	3	2	0	5
4	MSCM114	Inorganic Chemistry -I	I	3	4	0	7	3	2	0	5
5	MSCM211	Analytical Chemistry – II	II	3	4	0	7	3	2	0	5
6	MSCM212	Organic Chemistry - II	II	3	4	0	7	3	2	0	5
7	MSCM213	Physical Chemistry - II	II	3	4	0	7	3	2	0	5
8	MSCM214	Inorganic Chemistry -II	II	3	4	0	7	3	2	0	5
9	MSCM311	Organic Chemistry – III	III	4	4	0	8	4	2	0	6
10	MSCM312	Organic Chemistry – IV	III	4	4	0	8	4	2	0	6
11	MSCM313	Organic Chemistry – V	III	4	4	0	8	4	2	0	6
12	MSCM411	Organic Chemistry – VI	IV	4	4	0	8	4	2	0	6
13	MSCM412	Organic Chemistry – VII	IV	4	4	0	8	4	2	0	6
14	MSCM413	Organic Chemistry – VIII	IV	4	4	0	8	4	2	0	6
15	MSCM106	Communication Skill - I	I	1	0	1	2	2	0	0	2
16	MSCM206	Communication Skill - II	II	1	0	1	2	2	0	0	2
17	MSCM307	Communication Skill - III	III	1	0	1	2	2	0	0	2
18	MSCM407	Communication Skill - IV	III	1	0	1	2	2	0	0	2
		Total		**60**	**56**	**04**	**120**	**64**	**28**	**0**	**92**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Project Work, Seminar And Internship In Industry Or Elsewhere

(i) Number of Project Work, Seminar And Internship In Industry Or Elsewhere:10
(ii) Credits:10

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	MSCM105	Internship – I	I	0	2	0	2	0	2	0	2
2.	MSCM205	Internship – II	II	0	2	0	2	0	2	0	2
3.	MSCM306	Internship – III	III	0	2	0	2	0	2	0	2
4.	MSCM309	Dissertation	III	0	2	0	2	0	2	0	2
5.	MSCM407	Dissertation	IV	0	2	0	2	0	2	0	2
				0	**10**	**0**	**10**	**0**	**10**	**0**	**10**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Ability Enhancement Courses

(i) Number of Ability Enhancement Courses:08
(ii) Credits:08

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	MSCM106	Communication Skill - I	I	1	0	1	2	2	0	0	2
2.	MSCM206	Communication Skill - II	II	1	0	1	2	2	0	0	2
3.	MSCM307	Communication Skill - III	III	1	0	1	2	2	0	0	2
4.	MSCM407	Communication Skill - IV	III	1	0	1	2	2	0	0	2
		Total		**04**	**0**	**04**	**08**	**08**	**0**	**0**	**08**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Skill Enhancement Compulsory/Elective Courses

(i) Number of Skill Enhancement Courses: 26
(ii) Credits: 26

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
Skill Enhancement Compulsory Courses											
1.	MSCM105	Internship – I	I	0	2	0	2	0	2	0	2

2.	MSCM107	Comprehensive Viva-I	I	0	2	0	2	0	2	0	2
3.	MSCM205	Internship – II	II	0	2	0	2	0	2	0	2
4.	MSCM206	Comprehensive Viva-II	II	0	2	0	2	0	2	0	2
5.	MSCM306	Internship – III	III	0	2	0	2	0	2	0	2
6.	MSCM308	Comprehensive Viva-III	III	0	2	0	2	0	2	0	2
7.	MSCM408	Dissertation	III	0	2	0	2	0	2	0	2
8.	MSCM408	Dissertation/Special Practical	III and IV	0	2	0	2	0	2	0	2
9.	MSCM409	Comprehensive Viva-IV	IV	0	2	0	2	0	2	0	2
Skill Enhancement Elective Courses											
9.	MSCM304/ 305	Computer application in Chemistry or Research Methodology	III	4	0	0	4	4	0	0	4
10.	MSCM406/ 415/404	Analysis and Characterization of Polymers / Organic Chemistry-IX/ Enviornmental Analytical Chemistry	IV	4	0	0	4	4	0	0	4
		Total		8	18	0	**26**	8	18	0	**26**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

About the Programme :

Science is the basic foundation of any technological and engineering creation. In view of the changing scenario at the national and international level in the field of Science and Technology, there is a great demand for basic sciences with considerable knowledge of its applications. GSFC University is committed to high academic standards. The M.Sc. Chemistry Program is designed for Four Semesters (Two Years) in such a way that a good basic foundation of subjects is laid and applications along with recent developments are covered. Students will also get theoretical and practical knowledge by undergoing industrial internship after every semester.

The more focused specialization course of organic and analytical chemistry is designed in the 2 year of M.Sc. Chemistry program to fulfill recent demands of industrial career. The M.Sc. Chemistry Program provides an opportunity to make a career in R&D, Industries and Academic Institutions. Opportunity for the placement may be provided by the Institute.

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Teaching Scheme
Semester – I M. Sc. Chemistry Program

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Ability Enhancement Compulsory Course															
1.	MSCM106	Communication Skills – I	1	0	1	2	1	0	1	2	20	10	20	50	00	50
	B. Skill Enhancement Courses															
2.	MSCM105	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
3.	MSCM107	Comprehensive Viva- I	0	0	2	2	0	0	2	2	0	0	0	0	0	50
	C. Core Course															
4.	MSCM111	Analytical Chemistry – I *(Basics of analytical chemistry)*	3	4	0	7	3	2	0	5	20	40	40	100	50	150
5.	MSCM112	Organic Chemistry – I *(Principles of Organic Chemistry)*	3	4	0	7	3	2	0	5	20	40	40	100	50	150
6.	MSCM113	Physical Chemistry – I *(Quantum & Polymer Chemistry)*	3	4	0	7	3	2	0	5	20	40	40	100	50	150
7.	MSCM114	Inorganic Chemistry – I (Coordination compounds & Organometallic Chemistry)	3	4	0	7	3	2	0	5	20	40	40	100	50	150
	C. Minor Course															
8.	CHE-2303 ISC	Introduction to Chemical Engineering and Safety in Chemical Industry	4	0	0	4	4	0	0	4	20	40	40	100	00	100

		Total	**17**	**18**	**03**	**38**	**17**	**10**	**03**	**30**						**850**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

COURSE CODE	COURSE NAME	SEMESTER
MSCM111	**Analytical Chemistry-I** *(Basics of Analytical Chemistry)*	**I**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	60	00	105	3	2	00	5

Course Pre- requisites	Basic B.Sc. Level Analytical Chemistry Concept
Course Category	Professional core course
Course focus	Skill Development
Rationale	This course offers a robust foundation in both classical and modern analytical techniques essential for accurate chemical analysis. It covers fundamental concepts like sampling, data handling, and laboratory practices, progressing to the statistical validation of analytical data. Students will gain practical skills in chromatography and advanced separation methods, preparing them for diverse analytical challenges in research and industry. This comprehensive approach ensures a thorough understanding of analytical chemistry principles and their applications.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Understand** the role and classification of analytical methods **Master** the assessment of analytical data **Learn** the principles, classifications, and applications of various chromatographic techniques. **Gain** expertise in advanced chromatographic methods **Explore** specialized separation techniques

Course Content (Theory)	Weightage	Contact

		hours
Unit 1: Fundamental of Analytical Chemistry Language of Analytical Chemistry, Analytical techniques, Selection of methods and instruments, Selecting an analytical method, Laboratory operations and practices, Handling of Glassware, Selecting and handing of reagents, Sample preparations, Laboratory notebooks, Safety in the analytical laboratory, Standardization and Calibration.	**20%**	**09**
Unit 2: Assessment of Analytical Data and Numerical Chemistry Analytical method validation: accuracy, precision, sensitivity, selectivity, robustness, ruggedness, scale of operation, analysis time, availability of equipment & cost, Errors, Significant figures, Tests, Numerical of statistical analysis .	**20%**	**09**
Unit 3: **Distillation:** Principles and Applications. **Solvent extraction:** Types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH and oxidation state, masking and salting out agents, techniques-batch and continuous extraction, applications. **Electrophoresis:** Two-dimensional gel electrophoresis, staining, zone electrophoresis, capillary electrophoresis, isoelectric focusing. **Centrifugation:** High speeds centrifuges, ultracentrifuge, sedimentation coefficients, density gradient, sedimentation equilibrium, analytical centrifugation	**20%**	**09**
Unit 4: Introduction to Techniques & Instrumentations: Spectroscopy, Chromatography and Thermal Analysis: Principles and Instrumentation and applications.	**20%**	**09**
Unit 5: Chromatography Differential migration rates, partition ratio, retention time, relation between partition ratio and retention time, capacity	**20%**	**09**

factor, selectivity factor. Plate theory and rate theory. Band broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column, types of columns, column efficiency, optimization column performance, selectivity factor, column resolution, distribution constant and applications of conventional column, advantages and limitations.		

List of Practical	**Weightage**	**Contact hours**
1. **Determination** of strength of a weak acid by conductometric titration	**12.5%**	4
2. **Determination** of equivalent conductance, degree of dissociation and dissociation constant of weak acid conductometrically	**12.5%**	4
3. **Determination** of strength of a weak acid by Potentiometric titration.	**12.5%**	4
4. **Determination** of λmax and concentration of given potassium permanganate solution using visible spectrometry	**12.5%**	4
5. **Determination** of Hardness of a given water sample by complexometric method.	**12.5%**	4
6. **Determination** of dissolved oxygen (DO) in a given water sample by Winkler's method.	**12.5%**	4
7. **Determination** of Chemical Oxygen Demand (COD) for a given polluted water sample.	**12.5%**	4
8. **Investigation** of adsorption of oxalic acid on charcoal.	**12.5%**	4

Instructional Method and Pedagogy: Utilizing models, PowerPoint, Presentations, chalk and board, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of the subject.

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**

After successful completion of the above course, students will be able to: CO1: Understand the role, classification, and selection analytical methods, along with laboratory practices and sam preparation. CO2: Learn to assess analytical data through statist methods, validate results, and minimize experimental error CO3: Grasp the principles, classifications, and application various chromatographic techniques. CO4: Gain expertise in Paper Chromatography (PC), H Performance Liquid Chromatography (HPLC), Chromatography (GC), and Ion Exchange Chromatogra (IEC). CO5:Explore solvent extraction, Gel Permea Chromatography (GPC), Affinity Chromatography, advanced techniques like LC/MS and electrophoresis.	Cognitive	Remember& Understand Remember & Analyse Understand Analyze Apply Apply

Learning Resources	
1.	Reference Books: 1. Douglas A. Skoog, Donald M. West, F. James, Fundamentals of Analytical Chemistry, 2. J W Robinson, Marcel Dekker, Undergraduate Instrumental Analysis, 6th Edition, Ch:1. 3. D. A. Skoog, F. J. Holler, T. A. Nieman, Principles of Instrumental Analysis, 5th Edition, Harcourt Asia Publisher 4. David Harvey, Modern Analytical Chemistry, McGraw-Hill Higher Education
2.	Journals & Periodicals: Analyst, Journal of Analytical Chemistry.
3.	Other Electronic Resources: Unacademy, NPTEL etc

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks

<table>
<tr><td>Theory:End Semester Marks</td><td>40 marks</td></tr>
<tr><td>Theory:Continuous Evaluation Component Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
<tr><td>Open Book Assignment</td><td>10 marks</td></tr>
<tr><td>Total</td><td>40 Marks</td></tr>
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<tr><td>Practical Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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<tr><td>Project/Industrial Internship Marks</td><td>
<table>
<tr><td>Quantity of the Project/Industrial in terms of Language, Presentation & format.</td><td>30 marks</td></tr>
<tr><td>Practical understanding of the subject on the Project/Industrial.</td><td>30 marks</td></tr>
<tr><td>Industry/Universitymentor's feedback on the Project/Industrial.</td><td>30 marks</td></tr>
<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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Mapping of PSOs& COs

	PSO1	PSO2	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	1	0	1	1	2
CO2	3	2	0	1	0	0	3
CO3	2	2	2	2	1	1	2
CO4	1	1	0	0	0	0	1
CO5	1	2	2	1	1	1	1

Mapping of POs& COs

	PO1	PO2	PO2	PO3	PO4	PO5	PO6
CO1	3	0	2	3	0	0	3
CO2	3	0	1	1	0	0	3
CO3	2	1	2	2	0	0	2
CO4	3	0	2	1	0	0	3
CO5	3	1	3	1	0	0	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM112	**Organic Chemistry I** *(Principles of Organic Chemistry)*	**I**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	60	00	105	3	2	0	5

Course Pre-requisites	Basic B.Sc. Level Inorganic Chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course covers essential concepts and reactions, starting with acidity, basicity, and aromaticity. It explores the nature and behavior of key intermediates like carbocations, carbanions, radicals, carbenes, and nitrenes. The course also explains nucleophilic and electrophilic substitution reactions, focusing on their mechanisms and factors that affect their reactivity. This knowledge helps students understand and predict organic reactions, crucial for advanced chemistry studies and applications.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Understand** the structure, reactivity of organic molecules, and concepts of aromaticity. 2: **Learn** about the generation, structure, stability, and reactivity of carbocations and carbanions, and their role in organic reactions. 3: **Study** the structure, generation, and reactions of carbenes, nitrenes, and radicals, including key rearrangement reactions. 4: **Explore** aliphatic and aromatic nucleophilic substitution mechanisms and factors influencing these reactions. 5: **Understand** aliphatic and aromatic electrophilic substitution mechanisms, including important name

	reactions and factors affecting reactivity.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Basic Organic chemistry & Aromaticity **Structure and reactivity:** Introduction to Acids and Bases, Structural effects on acidity and basicity of organic molecules, hydrogen bonding, resonance, inductive and field effects, hyper conjugation effects, steric effect, Bredt's rule. **Aromaticity:** Huckel's rule of aromaticity, benzenoid and non-benzenoid aromatic compounds, Tropones, Tropolones, Pyrilium cation, ferrocene. Alternant and nonalternant hydrocarbons, aromaticity of charged rings (3-8 membered), non-aromatic, antiaromatic and homo aromatic systems, Annulenes and hetero annulenes (10-18).	**20%**	**09**
Unit 2: Organic reactive intermediates & its reactions-I Reaction Intermediates: Generation, structure, stability, reactivity and detection of classical and non-classical carbocations, carbanions, free radicals, carbenes and nitrenes including nitrogen,phosphorous and sulfur ylides **Carbocation:** Generation, structure and stability of carbocations, Classical and non-classical carbocations, Neighboring group participation and rearrangements including Wagner-Meerwein, Pinacol-pinacolone, semi-pinacol rearrangement, C-C bond formation involving carbocations, Oxymercuration, halolactonisation. **Carbanion:** Generation, structure and stability of carbanions	**20%**	**09**
Unit 3: Organic reactive intermediates & its reactions-II **Carbenes and Nitrenes:** Structure of carbenes, generation of carbenes, addition and insertion reactions, rearrangement reactions of carbenes such as Wolff rearrangement, generation and reactions of ylid by carbenoid decomposition, Structure of nitrene, generation	**20%**	**09**

and reactions of nitrene and related electron deficient nitrogen intermediates, Curtius, Hoffmann, Schmidt, Beckmann rearrangement reactions. **Radicals:** Generation of radical intermediates and its (a) addition to alkenes, alkynes (inter & intramolecular) for C-C bond formation and Baldwin's rules (b) fragmentation and rearrangements.		
Unit 4: Organic reaction mechanisms-I **Aliphatic Nucleophilic Substitution** SN1, SN2, SET and SNi mechanism, NGP by pi and sigma bonds, classical and nonclassical carbocations, phenonium ions, norbornyl system, carbocation rearrangement in NGP, effect of structure, nucleophile, leaving group, factors affecting reactivity in SN reactions (e.g. solvent on rate of SN1 and SN2 reactions, ambident nucleophile and regioselectivity etc.) nucleophilic substitution at an allylic, trigonal and vinylic carbon **Aromatic Nucleophilic Substitution** ArSN1, ArSN2, aromatic nucleophilic substitution via benzynes, factors affecting ArSN reactions Some important name reactions involving nucleophilic substitution reactions: Sommelet hauser rearrangement, smiles rearrangement etc.	**20%**	**09**
Unit 5: Organic reaction mechanisms-II **Aliphatic Electrophilic Substitution:** Unimolecular and biomolecular mechanism, aliphatic diazo coupling **Aromatic Electrophilic Substitution:** Arenium ion mechanism, orientation and reactivity, energy profile diagram, steric effects and ortho/para ratios, ipso attack, orientation in other ring systems, naphthalene, anthracene, six and five membered heterocycles, diazonium coupling. Important reactions like Friedel crafts alkylation and acylation, Nitration, halogenation, formylation, chloromethylation, sulphonation. Some important name reactions involving electrophilic substitution reactions: Vilsmeier hack, Reimer tiemann,	**20%**	**09**

Fries rearrangement, diazonium coupling, bischker napieralski etc.		

List Of Practical	Weightage	Contact hours
1: To understand The concepts of stereochemistry	11%	4
2: Estimation of amount of glucose present in the unknown sample(D-glucose)	11%	4
3: Estimation of amount of glucose present in the unknown sample (cold drink)	11%	4
4: Preparation of urea-formaldehyde resin and determination of its saponification value	11%	4
5: Preparation of phenol-formaldehyde resin and determination of its saponification value	11%	4
6: Estimation of phenol	11%	4
7: Estimation of aniline	11%	4
8: Nitration of Salicylic acid	11%	4
9: Preparation of benzoquinone from hydroquinone	11%	4

Instructional Method and Pedagogy:

Utilizing models, PowerPoint, Presentations, chalk and board, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of the subject.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: analyze and predict the acidity, basicity, and aromaticity of organic molecules. CO2: To understand the generation, structure, stability, and reactions of carbocations and carbanions.	Cognitive	Understand Remember Understand

CO3: Students will gain knowledge about the generation and reactions of carbenes, nitrenes, and radicals, including key rearrangement reactions. CO4: Comprehend the mechanisms of aliphatic and aromatic nucleophilic substitutions and the factors influencing these reactions. CO5: explain the mechanisms of aliphatic and aromatic electrophilic substitutions and understand important name reactions and reactivity factors.		Apply Apply

Learning Resources	
1.	Reference Books: 1. Advanced Organic Chemistry –by J. March 6th EditionUndergraduate Instrumental Analysis, 6th Edition, J W Robinson, Marcel Dekker, Ch:1. 2. Advance Organic Chemistry (part A) –by A. Carey and R.J. Sundberg
2.	Journals & Periodicals: JACS, JOC etc
3.	Other Electronic Resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**
Theory:Mid semester Marks	20 marks
Theory:End Semester Marks	40 marks

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<tr><td>Practical Marks</td><td>
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<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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Mapping of PSOs& COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	0	0	0	0

CO2	3	1	2	2	2	0
CO3	3	1	1	2	1	0
CO4	2	0	0	1	1	0
CO5	3	2	1	1	1	2

Mapping of POs& COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	0	0	0	0
CO2	3	0	2	1	1	0
CO3	3	1	2	1	1	1
CO4	2	0	1	0	0	0
CO5	2	1	0	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM113	**Physical Chemistry I** *(Quantum & Polymer Chemistry)*	**I**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	60	00	105	3	2	0	5

Course Pre-requisites	Basic B.Sc. Level Physical Chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course in Quantum Chemistry provides a foundational understanding of the fundamental principles and theories that define the behavior of particles at the quantum level. It delves into the mathematical framework of quantum mechanics, including postulates, commutation relations, and various motion types (translational, rotational, vibrational). Additionally, it explores the application of quantum mechanics in chemical bonding, including molecular orbital theory and valence bond theory, along with the role of group theory in understanding molecular symmetry and properties. By integrating these concepts, the course equips students with the essential tools to analyze and predict the behavior of particles in molecular systems, offering a comprehensive foundation for advanced studies and research in chemistry and related field.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Understand** the foundational postulates of quantum chemistry and the commutation relations of various operators. **Explore** the translational and rotational motions of particles. **Study** the vibrational motion of particles and the quantum

	mechanics of hydrogen-like atoms, including wave function normalization and polynomial solutions. **Learn** approximate quantum mechanics methods. **Understand** the theories of chemical bonding and the application of group theory in quantum mechanics.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Postulates of quantum mechanics: Introduction to operator algebra. Postulates, Commutation relations: Commutative property; momentum operator; Hamiltonian operator; angular momentum operator; angular momentum operators and their commutation relations; shift operators and their commutation relations; the effect of shift operators on an eigenvalue of the angular momentum; some theorems and problems.	**20%**	**09**
Unit 2: Origin of quantization: Particle in a box Translational motion of a particle: Free particle; particle in a box with infinite potential barrier; quantization and quantum numbers; symmetry of the wave functions; use of the box model; cubical box and degeneracy; quantum mechanical tunneling and problems Rotational motion of a particle: Particle on a sphere; normalization of the wave functions; rotation of a diatomic molecule and problems. Valence bond and molecular orbital theories. Molecular orbitals of homonuclear and heteronuclear diatomic molecules. VSEPR. Molecular orbital and Valence bond approaches to polyatomic molecules. Hybrid orbitals.	**20%**	**09**
Unit 3: Polymer Chemistry-I Introduction: Background, Nomenclature, Classifications, Molecular Weight, Examples of Applications, Principles of Polymerization, Synthesis of Polymers: Step-Growth Polymerization	**20%**	**09**
Unit 4: Polymer Chemistry-II Radical Chain Polymerization, Controlled Radical Polymerization, Emulsion Polymerization, Ionic Chain Polymerization, Coordination Polymerization, Ring-Opening Polymerization, Copolymerization, Characterization of Polymers.	**20%**	**09**
Unit 5: Polymer Chemistry-III Determination of Molecular Weight (cont.), Frictional Properties of Polymers in Solution, Hydrodynamic Size, Chemical Composition, Polymer Processing, Phase Structure and Morphology of Bulk Polymers: Amorphous and Crystalline States, Viscoelasticity, Multicomponent Polymer Systems, Properties of Bulk Polymers.	**20%**	**09**

List Of Practical	Weightage	Contact hours
1: To determine the rate constant and activation energy of methyl acetate at different temperature	14%	4
2: To determine the dissociation constant Pk1 and Pk2 of given dibasic acid by pH metric.	14%	4
3: To determine solubility product (ksp) of given sparingly soluble salts (BaSO4) by conductivity water.	14%	4
4: Titrate copper (II) solution with EDTA spectrochemical	14%	4
5: To Determine concentration of protein in an unknown sample.	14%	4
6: To Determine critical micelle concentration of given surfactant using conductivity method.	14%	4
7: To study the reaction between persulphate and iodide to determine the rate constant	14%	4

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Physical Chemistry Studies.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1:** Students will be able to explain the postulates of quantum chemistry and discuss the commutation relations of operators such as momentum, Hamiltonian, and angular momentum. **CO2:** Students will demonstrate an understanding of the translational and rotational motion of particles. **CO3:** Students will be able to describe the vibrational motion of particles.	Cognitive	Remember Understand Apply Analyse

CO4: Students will apply perturbation theory and the variation theorem and analyze the treatment of degenerate levels. **CO5:** Students will evaluate molecular orbital and valence bond theories.		Apply

Learning Resources	
1.	Reference Books: 1.Bockris, J. O'M. and Reddy, A. K. N. (1998) Modern Electrochemistry, Vol. 2 A & B, Second Edition 2. Chakrabarty, D. K. (Reprint 2007), Adsorption and Catalysis by Solids, New Age International 3. Bond, G. C. (1974), Heterogeneous catalysis: Principles and applications Clarendon Press, Oxford 4. Atkins' Physical Chemistry, P. W. Atkins and De Paula, 8th edition (2010).R.C Mehrotra and A.Singh, Organometallic Chemistry- A unified Approach 5. Physical Chemistry, T. Engel and P. Reid, Pearson Education (2006)
2.	Journals: JACS, JPC A etc
3.	Other Electronic Resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

<table>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
<tr><td>Open Book Assignment</td><td>10 marks</td></tr>
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Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	0	0	1	1	0

CO2	3	1	0	1	0	0
CO3	3	1	1	0	0	0
CO4	2	0	0	0	0	0
CO5	3	2	2	1	1	1

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	1
CO2	2	1	0	0	0	0
CO3	2	2	1	1	0	0
CO4	1	0	1	1	0	0
CO5	2	2	2	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM114	**Inorganic Chemistry-I** *(Coordination compounds & Organometallic Chemistry)*	**I**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	60	00	105	3	2	0	5

Course Pre-requisites	Basic B.Sc. Level Inorganic Chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course offers a comprehensive exploration of various aspects of inorganic chemistry, including group theory, hydrogen and its compounds, the chemistry of non-transition elements, and bioinorganic chemistry. By understanding these topics, students will be able to analyze complex chemical systems and appreciate the fundamental role of inorganic chemistry in biological and environmental contexts.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Understand** the concepts of group theory in chemistry. **Explore** the relations between symmetry elements and symmetry operations. **Study** the classification, properties, and applications of hydrides and non-aqueous solutions. **Analyze** the synthesis, properties, and structures of halides, oxides, boranes, silicates, carbides, and sulfur-nitrogen compounds. **Explore** the role of metal ions in biological systems

Course Content (Theory)	Weightage	Contact hours

Unit 1: Transition Metal Chemistry Structure, bonding and properties of transition metal ligand complexes – ligand, coordination, geometry, coordination number, isomerism and optical isomerism, HSAB concept, thermodynamic stability, successive and overall stability constants, Irving-William series, chelate and macrocyclic effect. Magnetic Properties of Coordination Complexes	**20%**	**09**
Unit 2: Coordination Chemistry: I Theories of bonding: VBT, CFT and their limitations; d-orbital splitting in octahedral, JT-distorted octahedral, square planar, square pyramidal, trigonal bipyramidal, and tetrahedral complexes; CFSE for d1 to d10 systems, pairing energy, low-spin and high-spin complexes and magnetic properties; LFT, and molecular orbital (MO) theory of selected octahedral and tetrahedral complexes.	**20%**	**09**
Unit 3: Coordination Chemistry: II Electronic Spectra: UV-Vis, charge transfer, colors, intensities and origin of transitions, interpretation, term symbols and splitting of terms in free atoms, selection rules for electronic transitions, Orgel and Tanabe-Sugano diagram, calculation of Dq, B, C, Nephelauxetic ratio. Reaction mechanisms: substitution reactions in octahedral and square planar complexes, trans effect and its influence, water exchange, anation and base hydrolysis, stereochemistry, inner and outer sphere electron transfer mechanism.	**20%**	**09**
Unit 4: Organometallic Chemistry: I 18-electron rule, concept of hapticity; synthesis, structure and bonding of homo and heteroleptic metal-carbonyls, nitrosyls, alkyls, alkenes, allyl, alkynes, and arenes. Synthesis and reactivity of Fischer and Schrock carbenes, Monsanto process, Turn over number (TON), Turn over frequency (TOF).	**20%**	**09**
Unit 5: Organometallic Chemistry: II Electron counting schemes: polyhedral skeletal electron pair theory/Mingo's rule. Structure and Isolobal analogies.	**20%**	**09**

Metallocenes and bent-metallocenes. Fluxionality and dynamics in organometallic chemistry		

List Of Practical	Weightage	Contact hours
1: Preparation of Potassium dioxalatodiaqua chromate(II)	11%	**4**
2: Preparation of Tetrammine copper(II) sulphate	11%	**4**
3: Preparation of Sodium trioxalato ferrate(III)	11%	**4**
4: Preparation of Titrate copper (II) solution with EDTA spectrochemically	11%	**4**
5: Preparation of Potassium trioxalato chromate(III)	11%	**4**
6: Preparation of Hexammine nickel(II) chloride	11%	**4**
7: Preparation of Ammonium nickel(II) sulphate hexahydrate	11%	**4**
8: Preparation of Hexathiourea plumbus nitrate	11%	**4**
9: Preparation of Lead chromate	11%	**4**

Instructional Method and Pedagogy:

Utilizing models, PowerPoint, Presentations, chalk and board, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of the subject.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1: Understand** the concepts of group theory in chemistry. **CO2: Explore** the relations between symmetry elements and symmetry operations. **CO3: Study** the classification, properties, and applications of hydrides and non-aqueous solutions. **CO4: Analyze** the synthesis, properties, and structures of halides, oxides, boranes, silicates,	Cognitive	Understand Remember Apply Understand Apply

carbides, and sulfur-nitrogen compounds. **CO5: Explore** the role of metal ions in biological systems		

Learning Resources	
1.	Reference Books: 1.Bockris, J. O'M. and Reddy, A. K. N. (1998) Modern Electrochemistry, Vol. 2 A & B, Second Edition 2. Chakrabarty, D. K. (Reprint 2007), Adsorption and Catalysis by Solids, New Age International 3. Bond, G. C. (1974), Heterogeneous catalysis: Principles and applications Clarendon Press, Oxford 4. Atkins' Physical Chemistry, P. W. Atkins and De Paula, 8th edition (2010).R.C Mehrotra and A.Singh, Organometallic Chemistry- A unified Approach 5. Physical Chemistry, T. Engel and P. Reid, Pearson Education (2006)
2.	Journals: JACS, JPC A etc
3.	Other Electronic Resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

<table>
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Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	0	0	0	0	0
CO2	2	1	0	0	0	0
CO3	1	0	0	0	0	0
CO4	1	0	0	0	0	0
CO5	1	1	1	1	1	0

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6

CO1	3	0	0	1	0	0
CO2	3	0	0	1	0	0
CO3	3	0	1	1	0	0
CO4	3	0	1	1	0	0
CO5	3	0	3	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM106	Fundamentals of English	I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	00	00	30	2	0	0	2

Course Pre-requisites	Students should have basic knowledge of English language and grammar
Course Category	Compulsory Course
Course focus	Skill Development
Rationale	It enables humanity to experience the benefits of chemistry when we apply it in the exploitation of materials and energy.
Course Revision/ Approval Date:	14/03/2023
Course Objectives **(As per Blooms' Taxonomy)**	1 To emphasize the development of listening and reading skills among learners 2 To equip them with writing skills needed for academic as well as workplace context 3 To enable learners of Engineering and Technology develop their basic communication skills in English 4 To strengthen the fundamentals in English Language. 5 To build up the confidence to communicate with the world.

Course Content (Theory)	Weightage	Contact hours

Unit 1: Vocabulary Use of Dictionary Use of Words: Diminutives, Homonyms & Homophones, word formation, prefix-suffix, synonyms, antonyms, and standard abbreviations	25%	8
Unit 2: Writing Skills Types of the sentences, structures of the sentences, use of phrases and clauses, punctuation, comprehension, paragraph writing	25%	7
Unit 3: Spoken Skills Greetings, farewell and introduction, making an apology, accepting an apology, making an appointment, JAM, group discussion	25%	7
Unit 4: Communication Basics Definition of communication, Process of Communication, Principles of Communication, Functions of Communication, Barriers of Communication	25%	8

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		
CO1: At the end of the course, the students will be able to understand fundamentals of speaking English.	Understand, Remember, Create	Define, Classify, Describe & Demonstrate
CO2: At the end of the course, the students will be able to develop writing skills needed for academic as well as workplace context.	Create, Analyse, Apply	Classify, Describe & Demonstrate
CO3: At the end of the course, the students will be able to develop strong listening and reading skills.	Understand, Remember	Describe & Demonstrate

	, Evaluate	
CO4: At the end of the course, the students will be more confident about English communication skills.	Evaluate, Apply, Understand	Define, Describe & Demonstrate

Learning Resources	
1.	Reference Books: 1. Ramon & Prakash, Business Communication, Oxford. Sydney Greenbaum Oxford English Grammar, Oxford. 2. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill 3. Anjanee Sethi &Bhavana Adhikari, Business Communication, Tata McGraw Hill
2.	Journals
3.	Periodicals
4.	Other Electronic resources

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory:End Semester Marks	40 marks
Theory:Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Open Book Assignment: 10 marks **Total: 40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	0	3	3	2
CO2	1	1	1	0	3	3	1
CO3	1	1	1	0	3	2	2
CO4	1	1	1	0	3	3	3
CO5	1	1	1	0	3	3	1

Mapping of POs & COs

	PO1	PO2	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	3	0
CO2	3	3	3	3	2	3	0
CO3	3	2	3	3	2	2	0
CO4	3	1	3	3	3	3	0
CO5	3	2	2	3	2	2	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

Teaching Scheme
Semester – II M. Sc. Chemistry Program

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Ability Enhancement Compulsory Course															
1.	MSCM206	Communication Skills – II	1	0	1	2	1	0	1	2	20	10	20	50	00	50
	B. Skill Enhancement Courses															
2.	MSCM205	Internship	0	2	0	2	0	2	0	2	0	0	0	0	0	50
3.	MSCM207	Comprehensive Viva- II	0	0	2	2	0	0	2	2	0	0	0	0	0	50
	B. Core Course															
4.	MSCM211	Analytical Chemistry – II *(Electroanalytical Techniques & Fundamentals of spectroscopy)*	3	4	0	7	3	2	0	5	20	40	40	100	50	150
5.	MSCM212	Organic Chemistry – II *(Organic Synthesis-I & Stereochemistry)*	3	4	0	7	3	2	0	5	20	40	40	100	50	150
6.	MSCM213	Physical Chemistry – II *(Advanced Chemical Thermodynamics and Kinetics)*	3	4	0	7	3	2	0	5	20	40	40	100	50	150
7.	MSCM214	Inorganic Chemistry – II *(Group theory, p block elements & Bio-inorganic Chemistry)*	3	4	0	7	4	2	0	5	20	40	40	100	50	150
	B. Minor Course															

8.	CHE-2302 ISC	Introduction to Commercially Relevant Chemical Products and Respective Indian Chemical Industries	4	0	0	0	4	0	0	4	20	40	40	100	00	100
		Total	**17**	**18**	**03**	**38**	**17**	**10**	**03**	**30**						**850**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

COURSE CODE	COURSE NAME	SEMESTER
MSCM211	**Analytical Chemistry – II** *(Electroanalytical Techniques and Advanced Instrumental Methods)*	**II**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	60	0	105	3	2	0	5

Course Pre-requisites	Basic B.Sc. Level Analytical Chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	The course on Electroanalytical Techniques and Advanced Instrumental Methods of Analysis aims to provide students with a comprehensive understanding of various analytical techniques used in the chemical and pharmaceutical industries. By understanding the principles, instrumentation, and applications of these techniques, students will be better equipped to analyze and interpret experimental data, leading to improved problem-solving skills and scientific literacy.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Analyze** various electroanalytical techniques and their applications. **Evaluate** thermal methods and their applications in drug analysis. **Apply** principles of molecular spectroscopy to solve numerical problem **Interpret** IR spectra for qualitative and quantitative analysis. **Create** analysis reports using advanced spectroscopic

	techniques.

Course Content (Theory)	Weightage	Contact hours
Unit1: Electroanalytical Techniques Potentiometry, ion selective electrodes and their applications (solid state, precipitate, liquid-liquid enzyme and gas sensing electrodes), ion selective field effect transistors, biocatalytic membrane electrodes and enzymes based biosensors. Polarography- Ilkovic equation, derivation starting with Cottrell equation, effect of complex formation on the polarographic waves. Electrogravimetry: Introduction, principle, instrumentation, factors affecting the nature of the deposit, applications. Coulometry: Introduction, principle, instrumentation, coulometry at controlled potential and controlled current.	**20%**	**09**
Unit 2: Thermal methods Introduction, recapitulation of types of thermal methods, comparison between TGA and DTA. Differential Scanning Calorimetry – Principle, comparison of DTA and DSC, Instrumentation, block diagram, nature of DSC curve, factors affecting curves (Sample size, sample shape, pressure). Determination of heat of reaction, specific heat, percentage crystallinity, magnetic transition, oxidative stability, Applications-Analysis of drug analysis.	**20%**	**09**
Unit 3: Titrimetric Analyses General principle and classification, Volumetric and gravimetric, titrimetric methods and calculation, Requirements of reaction in titrimetric, Endpoint detection Acid-base, redox, precipitation, and complexation reactions, Dissociation of acids and bases in aqueous and non-aqueous media **Fundamentals of spectroscopy and Components of optical instruments** Recapitulation of basic concepts, electromagnetic spectrum, sources, detectors. Sample containers, laser as source of radiation, fibre optics, Introduction of Fourier Transform. Molecular Spectroscopy-Ultraviolet and Visible Spectroscopy (Numericals). Derivation of BeerLambert's Law and its	**20%**	**09**

limitations, factors affecting molecular spectroscopy-temperature, solvent and effect of substituents on charge transfer bands. Applications of Ultraviolet and Visible spectroscopy: Simultaneous spectroscopy, derivative spectroscopy.		
Unit 4: UV-VIS and IR Spectroscopy Infrared Absorption Spectroscopy: Instrumentation sources, sample handling, transducers dispersive, non - dispersive instrument. FTIR and its advantages, applications of IR: Qualitative with emphasis on "Finger Print" region, Quantitative analysis, Advantages and Limitations of IR., Introduction and basic principles of diffuse reflectance spectroscopy and attenuated total reflectance Spectroscopy.	**20%**	**09**
Unit 5: **Atomic Absorption Spectroscopy:** methods, instrumentation of AAS, spectral interference, standard addition and internal standard, method of analysis **Mass spectrometry:** recapitulation, instrumentation, ion source for molecular studies, electron impact, filed ionization, field absorption, chemical ionization and fast atom bombardment sources. Mass analyzer: Quadrupole, time of flight and ion trap. Applications. **Mossbauer Spectroscopy:** Theory, Instrumentation, Applications - isomer shift, nuclear quadruple coupling and hyperfine interaction, Problems related to Mossbauer Spectroscopy.	**20%**	**09**

List Of Practical	Weightage	Contact hours
1: Estimation of quinine by fluorimetry.	10%	4
2: To prepare TLC plates, and identify unknown compounds in the given mixture and also to calculate the R f values of unknown compounds	10%	4
3: Column chromatographic separation and estimation	10%	4
4:Determination of concentration of Fe +3 (as 8-hydroxy quinolone)	10%	4

and Ni +2 (as Ni-DMG) mixture by solvent.		
5:Determine % purity of given sample of boric acid by Conductivity method.	10%	4
6:Estimation of detergents by coulometry.	10%	4
7:Estimation of ferrous ion by potentiometric titration.	10%	4
8: Assay of folic acid.	10%	4
9: Determination of salt concentration by ion exchange method.	10%	4
10: Separation of pigments from Given sample.	10%	4

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Analytical studies.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO 1: **Analyze** electroanalytical techniques and determine their applications in chemical analysis. CO 2: **Evaluate** thermal analysis methods and utilize them in drug analysis. CO 3: **Apply** molecular spectroscopy principles to solve numerical problems effectively. CO 4: **Interpret** IR spectra to conduct qualitative and quantitative analyses. CO 5: **Create** detailed analysis reports using advanced spectroscopic techniques.	Cognitive	Understand Apply Apply Remember Apply

Learning Resources	
1.	Textbook: 1. Modern Analytical Chemistry, D. Harvey , McGraw Hill,

	2000 2. Principles of Instrumental Analysis : Douglas Skoog, Pearson 3. Introduction to Instrumental Analysis: Robert Brown.
2.	Reference books : 1. Instrumental Method of Analysis : H. H. Willard, L. L. Merritt & J.A. Dean 2. Instrumental Methods of Chemical Analysis, B.K. Sharma, Goel Pub's House)
3.	Journal: Royal Society of Chemistry, Analyst etc.
4.	Periodicals: Chemistry Today
5.	Other Electronic resources: Unacademy NPTEL etc.

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
<tr><td>Theory: Mid semester Marks</td><td>20 marks</td></tr>
<tr><td>Theory: End Semester Marks</td><td>40 marks</td></tr>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
<tr><td>Open Book Assignment</td><td>10 marks</td></tr>
<tr><td>Total</td><td>40 Marks</td></tr>
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<tr><td>Practical Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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</table>

Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	1	1	1
CO2	2	1	1	1	1	0
CO3	2	1	1	1	2	1
CO4	2	1	1	1	0	1
CO5	2	2	1	1	2	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	2	2	1	0
CO2	3	0	2	2	1	0
CO3	3	0	2	2	1	0
CO4	3	1	2	2	2	0
CO5	3	0	3	1	2	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM212	**Organic Chemistry – II** *(Organic Synthesis-I & Stereochemistry)*	**II**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	60	0	105	3	0	2	5

Course Pre-requisites	Basic B.Sc. Level Organic Chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course aims to provide a detailed understanding of advanced organic synthesis techniques, focusing on various reagents and their applications in oxidation, reduction, rearrangements, stereochemistry, and elimination/addition reactions. Through the structured units, students will gain a comprehensive grasp of both theoretical concepts and practical applications, enabling them to solve complex organic synthesis problems. Each unit is designed to build upon the students' existing knowledge, promoting critical thinking and application of advanced organic chemistry concepts.
Course Revision/ Approval Date:	18/06/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: **Analyze** the mechanisms and applications of oxidation reagents in organic synthesis. **Evaluate** reduction reagents and their applications in organic synthesis. **Interpret** mechanisms and applications of molecular rearrangements involving different reactive intermediates. **Apply** stereochemical principles to predict and analyze stereoisomerism and reaction outcomes.

	Create mechanistic pathways for elimination and addition reactions in organic synthesis.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Oxidation Reagents in Organic Synthesis Oxidation Reagents: CrO3, MnO2, SeO2, Pb(OAc)4, HIO4, DMSO, HgO, K3Fe(CN)6, DDQ, Dess-Martin periodinane, Peracid;CrO3, PDC, PCC, KMnO4, MnO2, Swern, SeO2, Pb (OAc)4, Pd-C, OsO4, mCPBA, O3, NaIO4, HIO4	**20%**	**09**
Unit 2: Reduction Reagents in Organic Synthesis Boranes and hydroboration reactions, R3SiH, Bu3SnH, MPV, H2/Pd-C, Willkinsons, NaCNBH3, NH2NH2, DIBAL, Al(O-tBu)3, Al(O-iPr)3 **Some Miscellaneous Reagents in Organic Synthesis:** Trimethylsilylhalide, LDA, Wilkinson catalyst, alkyl lithium, Grignard reagent, Gilman reagent, PTC, NBS, DCC.	**20%**	**09**
Unit 3: **Reactive Intermediates in Molecular Rearrangements**: Molecular Rearrangement involving Non-Classical Carbocation: Neighbouring group participation by π(pi) and σ(sigma) bonds. **Molecular Rearrangement involving Carbocation:** Wagner-Meerwein, Pinacol-Pinacolone, Demjanov and Beckmann Rearrangement. **Molecular Rearrangement involving Carbanion:** Favorskii, Benzil-Benzilic Acid, Stevens and Sommelet-Hauser Rearrangement. **Molecular Rearrangement involving Free radical:** Riemer-Tiemann, Fries Rearrangement **Molecular Rearrangement involving Nitrene:** Curtius, Schmidt, Lossen and Hoffmann Rearrangement **Molecular Rearrangement involving Carbene:** Wolf Rearrangement [Emphasizing on Various Techniques for Determination of Mechanism]	**20%**	**09**
Unit 4: Stereochemistry	**20%**	**09**

Stereochemical principles, enantiomeric relationship, diastereomeric relationship, R and S, E and Z nomenclature in C, N, S, P containing compounds, Prochiral relationship, stereospecific and stereoselective reactions, optical activity in biphenyls, spiranes, allenes and helical structures. Conformational analysis of cyclic and acyclic compounds. Concept of Chirality, Chirality and Symmetry, Sawhorse, Newman and Fischer Projections, Interconversion of Projection formula, Elements of Chirality including Chiral centre, Chiral axis, Chiral plane and Helicity, CIP Nomenclature, Molecules with more than one Chiral centre, Total number of Stereoisomer in such molecules, Enantiomeric and Diastereomeric Relationship, Chirogenicity and Stereogenecity, Pseudochirality, Topicity and Prostereoisomerism, Determination of Topic relationship between Homomorphic ligands in Intact Molecules, Concept of stereoselective and stereospecific reactions, Optical Purity.		
Unit 5: Elimination and Addition Reactions **Elimination Reactions:** Mechanisms and Orientation, E1, E1cb, E2 spectrum, Effects of Changes in Substrate, Base, Leaving Group and Medium on Reactivity, Hoffman and Saytzef eliminations, Bredt's Rule, Pyrolytic Eliminations- Cope and Chugaev eliminations. **Addition reactions:** Mechanisms, Orientation and Reactivity, Markonikoff and anti-Markonikoff additions, Reactions including Hydro-Halo, Hydro-Hydroxy, Hydro-Alkoxy, Dihydro, Dihydroxy, dihalo, ozonolysis, Woodward-Prevost Hydroxylation.	**20%**	**09**

List Of Practical	Weightage	Contact hours
1:Organic Spotting: Qualitative Analysis of Tertiary Mixture-1	10%	4
2:Organic Spotting: Qualitative Analysis of Tertiary Mixture-2	10%	4
3:Organic Spotting: Qualitative Analysis of Tertiary Mixture**-3**	10%	4

4:Organic Spotting: Qualitative Analysis of Tertiary Mixture-4	10%	4
5:Organic Spotting: Qualitative Analysis of Tertiary Mixture-5	10%	4
6:Organic Spotting: Qualitative Analysis of Tertiary Mixture-6	10%	4
7:Organic Spotting: Qualitative Analysis of Tertiary Mixture-7	10%	4
8:Organic Spotting: Qualitative Analysis of Tertiary Mixture-8	10%	4
9:Organic Spotting: Qualitative Analysis of Tertiary Mixture-9	10%	4
10: Organic Spotting: Qualitative Analysis of Tertiary Mixture-10	10%	4

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Organic studies.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO 1: Analyze** the mechanisms and applications of oxidation reagents in organic synthesis. **CO 2: Evaluate** reduction reagents and their applications in organic synthesis. **CO 3: Interpret** mechanisms and applications of molecular rearrangements involving different reactive intermediates.	Cognitive	Understand Understand Understand Apply Apply

CO 4: Apply stereochemical principles to predict and analyze stereoisomerism and reaction outcomes. **CO 5: Create** mechanistic pathways for elimination and addition reactions in organic synthesis.		

Learning Resources	
1.	Textbook: Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford) Modern Synthetic reactions- H.O. HouseOrganic Chemistry, Stanley H. Pine Organic Synthesis – M.B. Smith.
2.	Reference books: Advanced Organic Chemistry (part A & B)– A. Care y and R.J. Sundberg Stereochemistry conformations and mechanism by P.S. Kalsi. Introduction to spectroscopy – D.l. Pavia, G.M. Lampman, G.S. Kriz, 3rd Edition.
3.	Journal: JACS, JOC, Org Lett etc.
4.	Periodicals: Chemistry Today.
5.	Other Electronic resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Open Book Assignment: 10 marks **Total: 40 Marks**

Practical Marks	

Attendance	05 marks
Practical Exam	20 marks
Viva	10 marks
Journal	10 marks
Discipline	05 marks
Total	**50 Marks**

Project/ Industrial Internship Marks	

Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
Practical understanding of the subject on the Project/Industrial.	30 marks
Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
Attendance	10 marks
Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	0	0	0	0
CO2	3	1	2	2	2	0
CO3	3	1	1	2	1	0
CO4	2	0	0	1	1	0
CO5	3	2	1	1	1	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6

CO1	3	0	0	0	0	0
CO2	3	0	2	1	1	0
CO3	3	1	2	1	1	1
CO4	3	0	1	0	0	0
CO5	3	1	0	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM213	**Physical Chemistry – II** (Advanced Chemical Thermodynamics and Kinetics)	**II**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	60	0	105	3	0	2	5

Course Pre-requisites	Basic B.Sc. Level Physical Chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course is designed to provide a comprehensive understanding of the principles and applications of thermodynamics, statistical thermodynamics, electrochemistry, surface chemistry, and chemical kinetics. Through these units, students will gain both theoretical knowledge and practical skills, enabling them to analyze complex chemical systems and processes. Each unit is structured to build upon students' prior knowledge, enhancing their cognitive abilities and preparing them for advanced studies or professional applications in chemistry.
Course Revision/ Approval Date:	18/06/2024
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: **Analyze** the principles and applications of classical thermodynamics **Evaluate** the significance thermodynamic properties. **Apply** electrochemical principles to solve problems. **Interpret** the concepts of surface properties and their thermodynamic implications. **Create** mechanistic pathways for chemical reactions.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Classical Thermodynamics Review of Classical Thermodynamics, laws of thermodynamics, Concept of entropy, Properties of Gibbs free energy, Phase equilibrium of one and two component system, Mixtures, Chemical equilibrium, Molecular Interactions: Dipole moment, Electrical polarization, Charge-dipole, Dipole-dipole and Dipole-induced dipole interaction, Dispersion interaction. Transport Phenomena: Diffusion (Ficks laws)	**20%**	**09**
Unit 2: Statistical Thermodynamics-I Introduction to statistical thermodynamics: Concept of ensembles, partition functions and distributions, microcanonical, canonical and grand canonical ensembles, canonical and grand canonical partition functions, Boltzmann, Fermi-Dirac and Bose-Einstein distributions.	**20%**	**09**
Unit 3: Statistical Thermodynamics-II Partition function and its significance, Translational, Rotational, Vibrational and Electronic partition functions and their evaluation, Thermodynamic properties in terms of partition functions, Internal energy, Molar heat capacity, Entropy and free energy functions, Translational, rotation and vibrational entropies of ideal mono atomic gases, Sackur Tetrode equation, Numericals.	**20%**	**09**
Unit 4: Chemical kinetics-I Chemical kinetics and its scope, rate of reaction, factors influencing the rate of a reaction, measurements of reaction rates, differential and integral rate laws, rate laws and equilibrium constants for elementary reactions, temperature dependence of rate constants, Arrhenius equation, concept of activation energy, determination of reaction mechanisms; collision and transition state theories of rate constants; Unimolecular reactions, bimolecular reaction dynamics: Potential energy surface, Transition state theory.	**20%**	**09**

Unit 5: Chemical kinetics-II Advanced topics in chemical kinetics: Introduction to photochemistry, Kinetics of multicomponent systems: Combustion and Atmospheric chemistry. Introduction to solution phase reaction dynamics: Cage effect, Diffusion controlled reactions, Polar solvation.	**20%**	**09**

List of Practical	Weightage	Contact hours
1: To determine the percentage composition of a given acid mixture containing a strong acid (HCl) and a weak acid (CH3COOH) pH metric method.	10%	4
2: -To determine equivalent conductance, degree of dissociation and dissociation constant of weak acid conductometrically.	15%	4
3: To determine the percentage composition of a given acid mixture containing a strong acid (HCI) and a weak acid (CH3COOH) conductometrically.	15%	4
4:To determine the viscosity average molecular weight of given polymer (polystyrene) by viscosity method.	15%	4
5: To study the adsorption of oxalic acid on charcoal.	15%	4
6: To determine the composition of a given liquid mixture by viscometric method.	15%	4
7:To determine the ƛmax and concentration of given unknown potassium permanganate (KMnO4) using visible spectroscopy technique.	15%	4

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Physical Chemistry Studies.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain

After successful completion of the above course, students will be able to: **CO1: Analyze** the principles and applications of classical thermodynamics **CO2: Evaluate** the significance thermodynamic properties. **CO3: Apply** electrochemical principles to solve problems. **CO4: Interpret** the concepts of surface properties and their thermodynamic implications. **CO5: Create** mechanistic pathways for chemical reactions.	Cognitive	Understand Evaluate Understand Knowledge Understand

Learning Resources	
1.	**Textbooks:** 4. Thermodynamics for Chemists, Samuel Glasstone, Litton Educational Publishing Inc., Affiliated East-West Press Pvt. Ltd. 5. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House, Merrut 6. Physical Chemistry, B. K. Sharma, Goel Publishing House, Merrut. 4. Principles of Physical Chemistry, B.R. Puri, L. R. Sharma and Madan S. Pathania, Visual Publishing Co. 5.Atkins' Physical Chemistry, P. W. Atkins and De Paula, 8 th edition(2010) 6.Physical Chemistry, T. Engel and P. Reid, Pearson Education (2006) 7. M. C. Gupta, (1990) Statistical Thermodynamics, Second edition, New Age International Publications, New Delhi
2.	**Reference books :** 1. Physical Chemistry a Molecular approach, D. Mcquarie and J. Simon (University Science) 2000. 2. Physical Chemistry for Biological Sciences by Raymond Chang(Universal Books), 2000. 3. T. Engel and P. Reid, (2007) Thermodynamics: Statistical

	Thermodynamics and Kinetics, First Edition, Pearson Education, Noida.
3.	Journal: JPC C, JPC A, Langmuir etc
4.	Periodicals: Chemistry Today
5.	Other Electronic resources: Unacademy NPTEL etc.

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<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	1	1	1
CO2	2	1	0	0	0	0
CO3	2	2	1	1	0	0
CO4	1	0	1	1	0	0
CO5	2	2	2	1	1	0

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	0	1	1	0
CO2	3	1	0	1	0	0
CO3	3	1	1	0	0	0
CO4	2	0	0	0	0	0
CO5	3	2	2	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM214	**Inorganic Chemistry – II** *(Group theory, p block elements & Bio-inorganic Chemistry)*	**II**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	0	2	6

Course Pre-requisites	Basic B.Sc. Level Inorganic Chemistry Concept.
Course Category	Core Professional
Course focus	Employability
Rationale	This course aims to provide a deep understanding of transition metal chemistry, coordination chemistry, and organometallic chemistry, emphasizing the structure, bonding, properties, and reactivity of transition metal complexes and organometallic compounds. Through a combination of theoretical principles and practical applications, students will develop analytical and problem-solving skills essential for research and industrial applications in inorganic chemistry.
Course Revision/ Approval Date:	14/3/2020

Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Analyze** the structure, bonding, and properties of transition metal ligand complexes. **Evaluate** theories of bonding in coordination complexes and their applications. **Interpret** electronic spectra and reaction mechanisms of coordination complexes. **Apply** the 18-electron rule and electron counting schemes in organometallic chemistry. **Create** reaction pathways and catalytic mechanisms in organometallic complexes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Group theory in Chemistry Concepts of symmetry in molecule:- Symmetry elements, symmetry operations, definitions and theorems in group theory, examples of groups, subgroups and classes, Molecular Point groups :-Identification and classification, notation of point groups, Matrix representation of symmetry operations, Types of matrices, matrix notations for symmetry elements : E, C_n, i, s, Sn. Matrix representation of point groups : product and square rule, inverse rule, matrices for C_3v, C_4v etc.,	**20%**	**09**
Unit 2: Symmetry and Group theory: II Construction of character tables :-rules, reducible and irreducible representations, character of a representation, Properties of a irreducible representations, orthogonality theorem, character tables for C_2v, C_3v, C_4v, D_nh, uses of character tables. General relations symmetry elements and symmetry operations, symmetry elements and optical isomerism, symmetry point groups, classes of symmetry operations, classification of molecular point groups.	**20%**	**09**
Unit 3: Hydrogen and its compounds Theory: Hydrides: Classification, electron deficient, electron	**20%**	**09**

precise and electron rich hydrides. PH3 SbH3, AsH3. Selenides, Tellurides. Alkali and alkaline earth metals: solutions in non-aqueous Media, Applications of crown ethers in extraction of alkali and alkaline earth metals.		
Unit 4: Bioinorganic Chemistry-I Metal ions in Biological Systems: Essential and trace metals. Na^+/K^+ Pump, Role of metals ions in biological processes, Transport and Storage of Dioxygen	**20%**	**09**
Unit 5: Bioinorganic Chemistry-II Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper. Electron Transfer in Biology Structure and function of metalloproteins in electron transport processes cytochromes and ion-sulphur proteins, synthetic models.	**20%**	**09**

List Of Practical	Weightage	Contact hours
1: Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering radicals.(Mixture-1)	**12%**	**4**
2:Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering radicals.(Mixture-2)	**12%**	**4**
3:Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering radicals.(Mixture-3)	**12%**	**4**
4:Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering radicals.(Mixture-4)	**12%**	**4**
5:Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering radicals.(Mixture-5)	**12%**	**4**
6:Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering	**12%**	**4**

radicals.(Mixture-6)		
7:Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering radicals.(Mixture-7)	**12%**	**4**
8:Qualitative Analysis: Inorganic Spotting of mixture containing 3 Cations And 3 Anions And interfering radicals.(Mixture-8)	**12%**	**4**
9: Some others preparation based on Syllabus.	**4%**	**4**

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Physical Chemistry Studies.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Subdomain
After successful completion of the above course, students will be able to: CO1: **Analyze** the structure, bonding, and properties of transition metal ligand complexes. CO2: **Evaluate** theories of bonding in coordination complexes and their applications. CO3: **Interpret** electronic spectra and reaction mechanisms of coordination complexes. CO4: **Apply** the 18-electron rule and electron counting schemes in organometallic chemistry. CO5: **Create** reaction pathways and catalytic mechanisms in organometallic complexes.	Cognitive	**Understand** **Understand** **Evaluate** **Understand** **Apply**

Learning Resources	
1.	**Textbook:** Chemical Applications of Group Theory, Third Edn., Author - F. A. Cotton(Wiley, New York)

	Group Theory and its Chemical Applications, P.K. Bhattarchrya Inorganic Chemistry : Shriver & Atkins (4th edition 2003, Oxford)
2.	**Reference books :** Concise Inorganic Chemistry, J. D. Lee, Fourth Edn.(Chapman and Hall) Inorganic chemistry: principle of structures and reactivity, Huheey, Keiter, Keiter, Medhi, Pearson Education, Fourth Edn.(2007) Organometallic Chemistry-A Unified Approach: R. C. Mehrotra & A. Singh.
3.	Journal: Coordination Chemistry Review, Journal of Coordination Chemistry.
4.	Periodicals: Chemistry Today.
5.	Other Electronic resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Open Book Assignment: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks

	Discipline	05 marks
	Total	**50 Marks**
Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	0	0	0	0	0
CO2	2	1	0	0	0	0
CO3	1	0	0	0	0	0
CO4	1	0	0	0	0	0
CO5	1	1	1	1	1	0

Mapping of POs & COs

	PO1	PO2	PO2	PO3	PO4	PO5

CO1	3	0	0	1	0	0
CO2	3	0	0	1	0	0
CO3	3	0	1	1	0	0
CO4	3	0	1	1	0	0
CO5	3	0	3	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE MSCM206	COURSE NAME Communication Skills II	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	00	00	30	30	00	00	2

Course Pre-requisites	Basic Knowledge of English Grammar & communication Basic English Grammar & Intermediate communication skills
Course Category	Mandatory Course
Course focus	Communicational Skills and Ability Enhancement
Rationale	It enables humanity to experience the benefits of chemistry when we apply it in the exploitation of materials and energy.
Course Revision/ Approval Date:	14/03/2023
Course Objectives **(As per Blooms' Taxonomy)**	1 To emphasize the development of listening and reading skills among learners 2 To equip them with writing skills needed for academic as well as workplace context 3 To enable learners of Engineering and Technology develop their basic communication skills in English 4 To strengthen the fundamentals in English Language. 5 To build up the confidence to communicate with the world.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Communicative Skills Verbal & Non-verbal, Communication, Effective Communication Style & Structure, Strategies of Effective	**25%**	7

Communication		
Unit 2: Listening Skills Definition, Types of Listening, Characteristics of the Listeners, Traits of a Good Listener, Barriers to Effective Listening	**25%**	8
Unit 3: Reading Skills Definitions Types of Reading, Techniques of Effective Reading, Skimming, Scanning, Reading Tasks (Critical & Inferential)	**25%**	7
Unit 4: Speaking Skills Speech Drills Pronunciation and accent Stress and Intonation, Introducing self, Interview Skills, Public Speaking	**25%**	8

Instructional Method and Pedagogy:

Classroom Lecture, Case Studies, Quizzes, Presentations, Role Play, Expert Lecture (Consultant)

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: To emphasize the development of listening and reading skills among learners	Understand, Analyse, Remember	Define, Classify & Demonstrate
CO2: To equip them with writing skills needed for academic as well as workplace context	Analyse, Apply, Understand	Classify, Describe & Demonstrate
CO3: To enable learners of Engineering and Technology to develop their basic communication skills in English	Understand, remember	Define, Describe & Demonstrate
CO4: To strengthen the fundamentals in English Language.	Remember, Analyse	Define Describe
CO5: To build up the confidence to communicate with the world.	Understand, Apply	Define, Classify, Describe & Demonstrate

Learning Resources

1.	Textbook
2.	Reference books 1. Ramon & Prakash, Business Communication, Oxford. Sydney Greenbaum Oxford English Grammar, Oxford. 2. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill 3. Anjanee Sethi & Bhavana Adhikari, Business Communication, Tata McGraw Hill
3.	Journal

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	10 marks
MCQs	10 marks
Skill enhancement activities / case study	10 marks
Presentation/ miscellaneous activities	10 marks
Total	**20 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	0	3	3	2
CO2	1	1	1	0	3	3	1
CO3	1	1	1	0	3	2	2
CO4	1	1	1	0	3	3	3
CO5	1	1	1	0	3	3	1

Mapping of POs & COs

	PO1	PO2	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	3	0
CO2	3	3	3	3	2	3	0
CO3	3	2	3	3	2	2	0
CO4	3	1	3	3	3	3	0
CO5	3	2	2	3	2	2	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

Teaching Scheme
Semester – III M. Sc. Organic Chemistry

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Skill Enhancement Courses															
1.	MSCM308	Comprehensive Viva-III	1	1	0	2	1	1	0	2	0	0	0	0	0	50
2.	MSCM306	Internship-III	0	1	1	2	0	1	1	2	0	0	0	0	0	50
3.	MSM309	Dissertation	0	1	1	2	0	1	1	2	0	0	0	0	0	50
	B. Core Course															
4.	MSCM311	Organic Chemistry – III *(Organic Spectroscopy)*	4	2	0	6	4	2	0	6	20	40	40	100	50	150
5.	MSCM312	Organic Chemistry – IV *(Photochemistry & Pericyclic Chemistry)*	4	2	0	6	4	2	0	6	20	40	40	100	50	150
6.	MSCM313	Organic Chemistry – V *(Heterocyclic & Supramolecular Chemistry)*	4	2	0	6	4	2	0	6	20	40	40	100	50	150
	C. Minor Course															
7.	CHE-2306 ISC	Advanced Spectroscopy and Training on Analytical Instruments	2	0	0	2	2	0	0	2	20	10	20	50	00	50

8.	CHE-2305 ISC	Intellectual property Rights (IPR), Literature Searches & Topics in R&D, Green Analytical Chemistry, Introduction to Basic Finance for Business	4	0	0	4	4	0	0	4	20	40	40	100	00	100
		Total	**19**	**09**	**04**	**30**	**17**	**9**	**4**	**22**						**750**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

COURSE CODE	COURSE NAME	SEMESTER
MSCM311	**Organic Chemistry –III** *(Organic Spectroscopy)*	**III**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	0	2	6

Course Pre-requisites	Basic B.Sc. Level Organic Chemistry Concept
Course Category	Core Professional
Course focus	Employability/ Entrepreneurship/ Skill development
Rationale	This course is designed to provide a comprehensive understanding of modern spectroscopic techniques essential for organic compound analysis. Students will learn theoretical principles, instrumentation, and practical applications of these techniques, equipping them with advanced analytical skills necessary for organic compound characterization and structure elucidation.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Analyze** the principles and applications of UV spectroscopy, including Woodward-Fieser rules. **Evaluate** proton NMR spectra for chemical shifts and spin interactions. **Interpret** carbon-13 NMR spectra for chemical shifts and coupling constants. **Apply** principles of mass spectrometry to determine molecular weight and fragmentation patterns. **Create** interpretations of ESR spectra and hyperfine

	coupling constants

Course Content (Theory)	Weightage	Contact hours
Unit 1: **UV Spectroscopy:** Theory and principles of electronic transition and UV absorption, chromophores and auxochromes, Woodward-Fieser rules for dienes and enones, characteristic absorptions in alkenes and alkynes, alcohols, ethers, amines, carbonyl compounds. Effects of conjugation. Characteristic absorptions in aromatic compounds. Factors affecting the position and intensity of UV bands – effect of conjugation, steric factor, pH, and solvent polarity. Calculation of absorption maxima for above classes of compounds by Woodward-Fieser rules (using Woodward-Fieser tables for values for substituents) **Infrared Spectroscopy:** Theory and principles, molecular vibrations and calculations of vibrational frequencies. Detailed study of vibrational frequencies of carbonyl compounds, aldehydes, ketones, esters, amides, acids, acid halides, anhydrides, lactones, lactams and conjugated carbonyl compounds. Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT IR. IR of gaseous, solids and polymeric materials.	**20%**	**12**
Unit 2: NMR Spectroscopy Proton resonance condition, aspects of PMR spectra – number of signals, chemical shifts, factors affecting chemical shifts (Electronegativity, H-bonding, Anisotropy effects), shielding and deshielding, diamagnetic anisotropy, peak area and integration, splitting of the signals – spin-spin coupling, coupling constants – vicinal, geminal, long range and virtual couplings, Pople notation and spin assignments, chemical shift equivalence and magnetic equivalence, first order and second order spectra, complex PMR spectra, simplification of the PMR spectra – high resolution spectra, use of shift reagents, spin-spin decoupling-double resonance, proton exchange, deuterium exchange, Nuclear Overhauser Effect. Use of PMR spectra in differentiation of	**20%**	**12**

stereoisomers.		
Unit 3: 13C-NMR Spectroscopy Difficulties and solution for recording 13C-NMR spectra, recording of 13CNMR spectra – scale, solvents, solvent signals and their positions, multiplicity, 13C-1H coupling constant – proton coupled and decoupled 13C spectra, broadband decoupling, off resonance technique. Chemical shifts in 13C spectra – chemical shift calculation for alkanes, alkenes and alkynes, chemical shift calculation in internal and terminal substituted compounds, aromatic compounds. Use of 13C spectra I differentiating stereoisomers, Nuclear Overhauser Effect. 13c - Dept Spectra – Differentiation In Primary, Secondary And Tertiary Carbons By Dept – 45, Dept – 90, Dept – 135 Spectra. 2d Nmr Spectroscopy: Theory And Principles Of 2d Nmr Spectroscopy, Interpretation Of 1h-1h Cosy, 1h-13c Hetcor, Hmqc, Hmbc, Inadequate Spectra. NMR studies of nuclel other than proton- 19F and 31 P.	**20%**	**12**
Unit 4: Mass Spectroscopy Theory and principles of mass spectroscopy, Instrumentation, low and high resolution mass spectra, Ionization techniques – Electron Impact (EI) ionization, Chemical Ionization (CI), Field Desorption (FD), Fast Ion Bombardment (FAB), Electronspray Ionization (ESI) and Matrix Assisted Laser Desorption/Ionization (MALDI). Determination of molecular weight and molecular formula, nitrogen rule, detection of molecular ion peak, metastable ion peak. Fragmentations – rules governing the fragmentations, McLafferty rearrangement. Interpretation of mass spectra of different class of compounds – saturated and unsaturated hydrocarbons, aromatic hydrocarbons, alcohols, ethers, ketones, aldehydes, carboxylic acids, amines, amides, compounds containing halogens.	**20%**	**12**
Unit 5: Electron Spin Resonance Spectroscopy basic principles, Zero field splitting and kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement	**20%**	**12**

techniques, applications**.** **Interpretation and Application of organic compounds**		

Sr. No.	List Of Practical	Weightage	Contact Hrs
1	To prepare TLC plates, and identify unknown compounds in the given mixture and also to calculate the R_f values of unknown compounds.	**12.5%**	**4 hr**
2	Synthesis of 1, 4-dihydropyridine derivative via Hantzsch reaction.	**12.5%**	**4 hr**
3	Synthesis of 3,4-dihydropyrimidin-2(1H)-ones derivatives via biginelli reaction.	**12.5%**	**4 hr**
4	Performing an experiment involving the fluorescence spectroscopy of a Hantzsch product and biginelli product.	**12.5%**	**4 hr**
5	Performing an experiment involving the UV VIS spectroscopy of a Hantzsch product and biginelli product.	**12.5%**	**4 hr**
6	Preparation of Resacetophenone (**2,4 dihydroxy acetophenone)** and its characterization by IR	**12.5%**	**4 hr**
7	Synthesis of 2,4,5 triphenyl imidazole.	**12.5%**	**4 hr**
8	Monitering of organic synthesis via TLC	**12.5%**	**4 hr**

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Physical Chemistry Studies.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1: Analyze** the principles and applications of	Remember and	Define, Describe

UV spectroscopy, including Woodward-Fieser rules. **CO2: Evaluate** proton NMR spectra for chemical shifts and spin interactions. **CO3: Interpret** carbon-13 NMR spectra for chemical shifts and coupling constants. **CO4: Apply** principles of mass spectrometry to determine molecular weight and fragmentation patterns. **CO5: Create** interpretations of ESR spectra and hyperfine coupling constants	understand Remember and understand Remember and understand Analysis & Apply	Define, Describe,Apply Define, Describe,Apply Define Define , Describe

Learning Resources	
1.	Reference books : 1.March's Advanced Organic Chemistry, Jerry March, sixth edition, 2007, JohnWiley and sons. 2.Advanced Organic Chemistry: Reaction Mechanisms, R. Bruckner, Academic Press (2002). Textbook: 1.Organic Chemistry –by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)Principles of Instrumental Analysis - Skoog, Holler and Nieman, 5th Edition, Ch: 1.
2.	Journals: JACS, JOC etc. Periodicals: Chemistry Today
3.	Other Electronic Resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

<table>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
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<tr><td>Practical Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
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<tr><td>Project/ Industrial Internship Marks</td><td>
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</table>

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6

CO1	2	0	1	1	0	0
CO2	3	1	2	2	2	0
CO3	3	1	1	2	1	0
CO4	2	0	0	1	1	0
CO5	3	2	1	1	1	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	0	1
CO2	3	0	2	1	1	0
CO3	3	1	2	1	1	1
CO4	2	0	1	0	0	0
CO5	2	1	0	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	**COURSE NAME**	**SEMESTER**
MSCM312	**Organic Chemistry –IV** *(Photochemistry & Pericyclic Chemistry)*	**III**

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	0	2	6

Course Pre-requisites	Basic B.Sc. Level Organic/Analytical Chemistry Concept
Course Category	Core Professional

Course Focus	Employability
Rationale	This course delves into the fascinating realm of photochemistry and pericyclic reactions. Students will gain a profound understanding of the interaction of electromagnetic radiation with matter, the mechanisms of photochemical reactions, and the principles governing pericyclic reactions. The course emphasizes theoretical foundations and practical applications in organic chemistry, preparing students for advanced research and industrial applications.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Analyze** the mechanisms and quantum yield of photochemical reactions. **Evaluate** intramolecular reactions of under photochemical conditions. **Interpret** various photochemical reactions of aromatic compounds **Apply** molecular orbital symmetry and Woodward-Hoffmann rules to predict pericyclic reactions. **Create** mechanistic pathways for sigmatropic rearrangements.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit 1: Interaction of electromagnetic radiation with matter, types of excitations,fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. Classification, rate constants and life times of reactive energy states – determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions –photo-disssociation, gas-phase photolysis.	**20%**	**12**

Unit 2: Photochemistry of Alkenes Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1, 4- and 1, 5-dienes. **Photochemistry of Carbonyl Compounds** Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, b ,g − unsaturated and a ,b − unsaturated compounds. Cyclohexadienones. Intermolecular cyloaddition reaction – dimerisations and oxetane formation.	**20%**	**12**
Unit 3: Photochemistry of Aromatic Compounds Isomerisations, additions and substitutions **Miscellaneous Photochemical Reactions:** Photo-Fries reaction of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions, Photochemistry formation of smog. Photodegradation of polymers. Photochemistry of vision.	**20%**	**12**
Unit 4: Pericyclic Reactions Introduction, symmetry in linear conjugated pi systems, symmetry in allyl and 2,4 pentadienyl systems, excited states, types of pericyclic reactions, Classification of pericyclic reactions; thermal and photochemical reactions. Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadience, 1,3,5- hexatriene and allyl system, Woodward- Hoffmann correlation diagrams. FMO and PMO approach. Three approaches: Evidence for the concertedness of bond making and breaking Symmetry-Allowed and Symmetry-Forbidden Reactions – The Woodward- Hoffmann Rules-Class by Class The generalised Woodward- Hoffmann Rule Explanations for Woodward-Hoffmann Rules The Aromatic Transition structures [Huckel and Mobius] Frontier Orbitals Correlation Diagrams, FMO and PMO approach. **Electrocyclic reactions**- conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. **Cycloaddition reactions**: Supra and antra facial additions, 4n and 4n+2 systems, 2+2 additions of ketenes. Diels- Alder reactions, 1, 3-Dipolar	**20%**	**12**

cycloaddition and cheletropic reactions, ene reaction, retro-Diels-Alder reaction, regioselectivity, peri selectivity, torquoselectivity		
Unit 5: **Sigmatropic rearrangements**- suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5 – sigmatropic rearrangements, claisen, cope and aza-cope rearrangements. Fluxional tautomerism, Ene reaction. **Chiroptical Properties Of Organic Compounds:**	**20%**	**12**

Sr. No.	List Of Practical	Weightage	Contact Hrs
1	To prepare TLC plates, and identify unknown compounds in the given mixture and also to calculate the R_f values of unknown compounds.	**12.5%**	**4 hr**
2	Synthesis of 1, 4-dihydropyridine derivative via Hantzsch reaction.	**12.5%**	**4 hr**
3	Synthesis of 3,4-dihydropyrimidin-2(1H)-ones derivatives via biginelli reaction.	**12.5%**	**4 hr**
4	Performing an experiment involving the fluorescence spectroscopy of a Hantzsch product and biginelli product.	**12.5%**	**4 hr**
5	Performing an experiment involving the UV VIS spectroscopy of a Hantzsch product and biginelli product.	**12.5%**	**4 hr**
6	Preparation of Resacetophenone (**2,4 dihydroxy acetophenone)** and its characterization by IR	**12.5%**	**4 hr**
7	Synthesis of 2,4,5 triphenyl imidazole.	**12.5%**	**4 hr**
8	Monitering of organic synthesis via TLC	**12.5%**	**4 hr**

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Physical Chemistry Studies.

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: **CO1: Analyze** the mechanisms and quantum yield of photochemical reactions. **CO2: Evaluate** intramolecular reactions of under photochemical conditions. **CO3: Interpret** various photochemical reactions of aromatic compounds **CO4: Apply** molecular orbital symmetry and Woodward-Hoffmann rules to predict pericyclic reactions. **CO5: Create** mechanistic pathways for sigmatropic rearrangements.	Remember and understand Remember and understand Remember and understand Analysis & Apply	Define, Describe Define, Describe,Apply Define, Describe,Apply Define Define , Describe

Learning Resources	
1.	Reference Books: 1.March's Advanced Organic Chemistry, Jerry March, sixth edition, 2007, JohnWiley and sons. 2Advanced Organic Chemistry: Reaction Mechanisms, R. Bruckner, Academic Press (2002). Textbook: 1.Organic Chemistry –by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)Principles of Instrumental Analysis - Skoog, Holler and Nieman, 5th Edition, Ch: 1.
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Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	1	1	0
CO2	2	2	2	1	1	0
CO3	3	1	1	2	1	0
CO4	3	1	1	2	1	0
CO5	3	2	1	1	1	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	0	0
CO2	3	2	1	0	0	0
CO3	3	1	2	1	1	1
CO4	3	1	2	1	1	1

CO5	2	1	0	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
MSCM313	**Organic Chemistry –V** *(Heterocyclic & Supramolecular Chemistry)*	**III**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	0	2	6

Course Pre-requisites	Basic B.Sc. Level Organic chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course focuses on the comprehensive study of heterocyclic chemistry, supramolecular organic chemistry, and the synthesis of bioactive compounds like pheromones and plant hormones. Students will explore the nomenclature, synthesis, and reactions of various heterocyclic systems, as well as the principles and applications of supramolecular chemistry and the synthesis of biologically active molecules.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: **Understanding** of various nomenclature systems of heterocyclic compounds **Evaluate** the synthesis and reactions of heterocyclic systems. **Interpret** the synthesis and reactions of nitrogen/oxygen/sulfur-containing heterocycles. **Apply** knowledge of supramolecular chemistry. **Create** synthesis pathways for pheromones and bioactive compounds.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Nomenclature of fused heterocycles Nomenclature of heterocyclic compounds of bicyclic/tricyclic (5-6 Membered) fused heterocycles (up to three hetero atoms). (Common, systematic (Hantzsch-Widman) and replacement nomenclature) Reactions and Synthesis of Indoles, Benzo[b]thiophenes and Benzo[b]furans and Related compounds, Review of 1, 3 and 1, 2-azoles	**20%**	**12**
Unit 2: Reactions and Synthesis of Bicyclic heterocycles Quinolines and Isoquinolines, Reactions and Synthesis of Bicyclic heterocyclic systems containing two or more nitrogen atoms: Cinnolines, quinazolines, quinoxalines, phthalazines and pteridines. **Small ring heterocycles:** Synthesis and reactions of aziridines, oxiranes, thiiranes, and diazirines	**20%**	**12**
Unit 3: Reactions and Synthesis of Six membered heterocycles containing nitrogen: Pyridines, Diazines, triazines and tetrazines. **Reactions and Synthesis of Oxygen & Sulfur containing heterocycles:** Pyryliums, 2-and 4-pyrones, Benzopyryliums and benzopyrones and Advance molecules. Synthesis and reactions of thiazines and dithiin derivatives	**20%**	**12**
Unit 4: Supramolecular Organic Chemistry Introduction, host-guest interactions, classification of host-guest compounds, intermolecular forces, nature of supramolecular interactions, molecular recognition, chiral discrimination, molecular receptors and design principles, template effect, biomimetic chemistry, cryptands, cyclodextrins, calixarenes, catenanes and rotaxanes, molecular capsules, molecular self-assembly.	**20%**	**12**

Unit 5: Pheromones Introduction and applications, total synthesis of 3,11-dimethyl-2- nonacosanone and its 29-hydroxy derivative, grandisol, exobravicomine, frontaline and juvenile hormone. Introduction to plant hormones: structure determination and synthesis of auxins. Prostaglandins: Introduction. Occurance, nomenclature, classification and physiological effects, synthesis of PGE2 and PGF2, biosynthesis and biological importance.	**20%**	**12**

Instructional Method and Pedagogy:

Utilizing models, PowerPoint, Presentations, chalk and board, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of the subject.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: Understanding of various nomenclature systems of heterocyclic compounds	Remember and understand	Define, Describe
CO2: Evaluate the synthesis and reactions of heterocyclic systems.	Remember and understand	Define, Describe
CO3: Interpret the synthesis and reactions of nitrogen/oxygen/sulfur-containing heterocycles.	Remember and understand	Define, Describe,Apply
CO4: Apply knowledge of supramolecular chemistry.	Analysis & Apply	Define
CO5: Create synthesis pathways for pheromones and bioactive compounds.		Define , Apply

Learning Resources	
1.	Reference Books: 1. March's Advanced Organic Chemistry, Jerry March, sixth edition, 2007, JohnWiley and sons. 2. Advanced Organic Chemistry: Reaction Mechanisms, R. Bruckner, Academic Press (2002). Textbook: 1.Organic Chemistry –by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)Principles of Instrumental Analysis - Skoog, Holler and Nieman, 5th Edition, Ch: 1.
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Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Open Book Assignment: 10 marks **Total: 40 Marks**

Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**
Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1
CO2	3	1	1	1	1	1
CO3	3	2	1	1	1	1
CO4	2	2	1	1	1	0
CO5	3	2	1	1	1	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	0	0
CO2	3	1	0	1	1	1
CO3	3	2	0	1	1	1
CO4	3	2	0	1	1	0
CO5	2	1	0	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

Teaching Scheme
Semester – IV M. Sc. Organic Chemistry

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Skill Enhancement Courses															
1.	MSCM409	Comprehensive Viva-IV	1	1	0	2	1	1	0	2	0	0	0	0	0	50
2.	MSCM408	Dissertation	0	4	0	4	0	4	0	4	0	0	0	0	0	100
	B. Core Course															
3.	MSCM411	Organic Chemistry – VI *(Disconnection Approach)*	4	0	0	4	4	0	0	4	20	40	40	100	00	100
4.	MSCM412	Organic Chemistry – VII *(Advanced Organic Synthesis)*	4	0	0	4	4	0	0	4	20	40	40	100	00	100
5.	MSCM413	Organic Chemistry – VIII *(Natural Products)*	4	0	0	4	4	0	0	4	20	40	40	100	00	100
	B. Minor Course															
6.	CHE-2301 ISC	Sustainable and Green Chemistry, Industrial Important processes and Synthetic Methodologies for Advanced Materials and Modern Topics in Chemistry	4	0	0	4	4	0	0	4	20	40	40	100	00	100
7.	CHE-2304 ISC	Quality Management and Regulatory Dimensions in Chemical Industry, Environmental & Effluent Treatment Topics, CRM & Product Stewardship	4	0	0	4	4	0	0	4	20	40	40	100	00	100

		Total	**21**	**05**	**00**	**26**	**21**	**01**	**01**	**26**						**650**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

COURSE CODE MSCM411	COURSE NAME Organic Chemistry – VI *(Disconnection Approach)*	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
60	60	0	120	4	2	0	6

Course Pre-requisites	Basic B.Sc. Level Organic chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course in organic synthesis provides comprehensive insights into disconnection strategies, protecting groups, and advanced synthesis techniques. By exploring various methods to create complex organic molecules, students will gain a deeper understanding of how to apply these concepts to real-world chemical synthesis challenges.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1 Understand and apply disconnection strategies to synthesize various organic molecules, including alcohols, olefins, ketones, and acids. 2 Apply disconnection principles to synthesize β-hydroxy carbonyl compounds, diols, and dicarbonyl

	compounds, and utilize pericyclic reactions in organic synthesis. 3 Learn the synthesis of heterocycles, small ring compounds, and the use of ketenes and radicals in organic synthesis. 4 Understand the role and application of protecting groups in organic synthesis and the strategy for protecting and de-protecting various organic functional groups. 5 Explore the synthesis of complex organic molecules such as mesoporphyrin, cephalosporin C, and coenzyme A, and study their structural and functional aspects.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction and definition of disconnection Various terminology used in disconnection. One and two group disconnection, disconnection and synthesis of alcohols, olefins, simple ketones, acids and its derivatives, disconnections in 1,3- dioxygenated skeletons, preparation of β-hydroxy carbonyl compounds, α,β- unsaturated carbonyl compounds, 1,3-dicarbonyls, 1,5- dicarbonyls and use of Mannich reaction	**20%**	**12**
Unit 2: Two group disconnection Disconnection and synthesis of β-hydroxy carbonyl compounds, 1, 2-diols, 1,4 and 1,6- dicarbonyl compounds. Pericyclic reactions..: Disconnections based on Diels-Alder reaction and its use in organic synthesis	**20%**	**12**

Functional group analysis: Strategy of saturated hydrocarbon synthesis, functional group addition to intermediates.		
Unit 3: Disconnection and synthesis of acyclic and cyclic hetero compounds Synthesis of ethers, amines, nitrogen and oxygen containing five and six membered heterocycles. **Synthesis of small ring compounds** : Special method for small rings preparations, synthesis of 3 and 4 membered ring compounds. Use of ketenes in organic synthesis, Radical reactions in organic synthesis.	**20%**	**12**
Unit 4: Protecting groups Protection of organic functional groups, protecting reagents and removal of protecting groups. Protection and de-protection of hydroxyl, amino, carboxyl,ketone and aldehyde functions as illustrated in the synthesis of polypeptide and polynucleotide, enamines, Umpolung in organic synthesis Retrosynthesis. Umploung of reactivity: Umpolung of carbonyl group, synthesis based on umpolung of carbonyl group – synthesis of 1,2, and 1,3 diketones, cyclic ketones etc	**20%**	**12**
Unit 5: Synthesis of some complex molecules Synthesis of Mesoporhyrin – IX, Cephalosporin C and Coenzyme A. atropine and camphor.	**20%**	**12**

List Of Practical	**Weightage**	**Contact hours**
1. Nitration of Benzophenone	11%	4

2. Synthesis of 1,2,3,4-Tetrahydrocarbazole	11%	4
3. Synthesis of Dibenzalacetone from Benzaldehyde	11%	4
4. Synthesis of Benzoic acid from Toluene	11%	4
5. Synthesis of Phthalimide from Phthalic acid	11%	4
6. To separate a mixture of amino acids by Thin Layer Chromatography (TLC) and identify the test amino acids by measuring their Rf values.	11%	4
7. Synthesis of phthalein dye	11%	4
8. Synthesis of benzophenone Oxime	11%	4
9. Preparation of Schiff Base	11%	4

Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of Physical Chemistry Studies.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Subdomain
After successful completion of the above course, students will be able to: CO1: Students will be able to apply disconnection strategies to synthesize and analyze various organic molecules. CO2: Students will demonstrate the ability to	Remember and understand	Define, Describe Define,

use disconnection principles to synthesize complex organic compounds, including β-hydroxy carbonyl compounds and diols. CO3: Students will synthesize and analyze heterocycles and small ring compounds using advanced organic synthesis techniques. CO4: Students will understand and apply protecting group strategies in organic synthesis and synthesis of complex molecules. CO5: Students will synthesize and analyze complex organic molecules and understand their structural and functional aspects.	Remember and understand Remember and understand Analysis & Apply	Describe,Apply Define, Describe Define Define , Describe

Learning Resources	
1.	Reference Books: 1. Organic Spectroscopy: Principles And Applications, Jag Mohan, Alpha ScienceInternational Ltd., 30-Mar-2004. 2.Natural products chemistry and applications, Sujata V. Bhat, B.A. Nagasampagi and S. Meenakshi, Narosa Publishing House, 2011. Textbook: 1. Nelson, D. L, and Cox, M. M, (2008) Lehninger principles of Biochemistry 5thEdition, W. H. Freeman and Company, NY., USA. 2.Spectrometric Identification of Organic compounds, R.M. Silverstein and others, John Wiley and Sons Inc., 5th ed., 1991.
2.	Journals: JACS, JOC, ORG LETT. ETC. Periodicals: Chemistry Today
3.	Other Electronic Resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**

<table>
<tr><td>Theory: Mid semester Marks</td><td>20 marks</td></tr>
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<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
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<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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</td></tr>
</table>

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	1	1	1
CO2	3	1	1	1	1	1
CO3	3	1	1	1	1	1
CO4	2	1	1	1	0	0
CO5	2	2	1	1	0	0

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	1
CO2	3	2	1	1	1	1
CO3	3	2	1	1	1	1
CO4	3	2	1	1	1	1
CO5	2	2	2	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE MSCM412	COURSE NAME **Organic Chemistry –VII** *(Advanced Organic Synthesis)*	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	4	0	8	4	2	0	6

Course Pre-requisites	Basic B.Sc. Level Organic chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course provides an in-depth exploration of classical stereochemistry and asymmetric synthesis, focusing on the classification and reactivity of medium and fused ring compounds, the role of chiral auxiliaries and catalysts, and the significance of asymmetric synthesis in organic reactions and naming transformations. Through hands-on analysis and application, students will gain expertise in stereoselectivity and asymmetric synthesis techniques.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1 To understand the classification of point groups, conformational analysis of medium rings, and the stereochemistry of fused and bridged ring compounds. 2 To explore the use of chiral auxiliaries, reagents, and

	catalysts in asymmetric synthesis techniques. 3 To analyze chemo-, regio-, and stereoselectivities in asymmetric synthesis and understand the application of various reagents and catalysts. 4 To study the role of asymmetric naming reactions and the mechanisms behind various organic rearrangements. 5 To understand the application and role of organic reagents in asymmetric synthesis, including the techniques and methods used.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Classical Stereochemistry Classification of point groups based on symmetry elements with examples (nonmathematical treatment). Conformational analysis of medium rings: Eight to ten membered rings and their unusual properties, I-strain, transannular reactions. Stereochemistry of fused ring and bridged ring compounds: decalins, hydrindanes, perhydroanthracenes, steroids, and Bredt's rule. Anancomeric systems, Effect of conformation on reactivity of cyclohexane derivatives in the following reactions (including mechanism): electrophilic addition, elimination, molecular rearrangements, reduction of cyclohexanones (with LiAlH4, selectride and MPV reduction) and oxidation of cyclohexanols.	**20%**	**12**
Unit 2: Asymmetric synthesis use of chiral auxiliaries. Chiral reagents and catalyst,asymmetric hydrogenataion,asymmetric epoxidation and asymmetric dihydroxylation	**20%**	**12**
Unit 3: Asymmetric synthesis Chemo-, Regio- and Stereoselectivities • Introduction and classification of asymmetric synthesis • Cram's chelated and Prelog's rules, and Felkin-Anh model• Diastereoselectivity in	**20%**	**12**

the aldol reaction• Use of BINOLs, BINAPs, CBS, IPCBH2, IPC2BH and 9-BBN in asymmetric reactions• MPV reduction and Sharpless epoxidation		
Unit 4: Asymmetric Naming reactions & Rearrangements	**20%**	**12**
Unit 5: organic reagents for asymmetric synthesis	**20%**	**12**

List Of Practical	Weightage	Contact hours
10. Nitration of Benzophenone	11%	4
11. Synthesis of 1,2,3,4-Tetrahydrocarbazole	11%	4
12. Synthesis of Dibenzalacetone from Benzaldehyde	11%	4
13. Synthesis of Benzoic acid from Toluene	11%	4
14. Synthesis of Phthalimide from Phthalic acid	11%	4
15. To separate a mixture of amino acids by Thin Layer Chromatography (TLC) and identify the test amino acids by measuring their Rf values.	11%	4
16. Synthesis of phthalein dye	11%	4
17. Synthesis of benzophenone Oxime	11%	4
18. Preparation of Schiff Base	11%	4

Instructional Method and Pedagogy:

PPT, Video,ChalkBoard, QUIZ , Assignment

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**
After successful completion of the above course, students will be able to: CO1: Students will demonstrate knowledge of point group classification, conformational analysis, and stereochemistry of fused and bridged ring compounds. CO2: Students will be able to apply asymmetric synthesis techniques using chiral auxiliaries, reagents, and catalysts. CO3: Students will exhibit an understanding of chemo-, regio-, and stereoselectivity in asymmetric synthesis, as well as the role of specific reagents and catalysts. CO4: Students will analyze and explain asymmetric naming reactions and organic rearrangements. CO5: Students will demonstrate the application of organic reagents in asymmetric synthesis techniques.	Remember and understand Remember and understand Remember and understand Analysis & Apply	Define, Describe Define, Describe,Apply Define, Describe Define Define , describe

Learning Resources

1.	Reference Books: 1. Voet, D. and J. G. Voet (2004) Biochemistry, 3rd Edition, John Wiley &sons, Inc. USA. 2. Heterocyclic chemistry, 3rd edition, Thomas L. Gilchrist, Pearson Education, 2007. Textbook: 1. Nelson, D. L, and Cox, M. M, (2008) Lehninger principles of Biochemistry 5thEdition, W. H. Freeman and Company, NY., USA. 2. Stryer, Lubert; Biochemistry; W. H. Freeman publishers.
2.	Journals: JACS, JOC, ORG LETT. ETC. Periodicals: Chemistry Today
3.	Other Electronic Resources: Unacademy NPTEL etc.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Open Book Assignment: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks

	Discipline	05 marks
	Total	**50 Marks**
Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	1	1	1
CO2	2	1	1	1	0	0
CO3	2	1	1	1	1	1
CO4	2	1	1	1	1	1
CO5	2	2	1	1	0	0

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	1
CO2	3	1	1	1	1	1
CO3	3	2	1	1	1	1
CO4	3	2	1	1	1	1
CO5	2	2	2	1	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	**COURSE NAME**	**SEMESTER**
MSCM413	**Organic Chemistry –VIII** *(Chemistry of Natural Products)*	**IV**

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**

60	60	00	120	4	2	00	6

Course Pre-requisites	Basic B.Sc. Level Organic chemistry Concept
Course Category	Core Professional
Course focus	Employability
Rationale	This course offers an in-depth exploration of natural products, plant hormones, vitamins, steroids, alkaloids, terpenoids, carotenoids, and enzymes. By understanding their classification, structure, synthesis, biological importance, and enzymatic mechanisms, students will gain a comprehensive grasp of these complex biochemical compounds and their role in biological systems.
Course Revision/ Approval Date:	18/06/2024
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1 Understand the classification, isolation methods, and structure determination techniques for natural products, including carbohydrates and natural pigments. 2 Analyze the structure and synthesis of plant hormones, prostaglandins, and vitamins, and understand their biological importance and functions. 3 Examine the structural identification and synthesis of cholesterol, ergosterol, steroid hormones, and alkaloids, along with their biogenesis. 4 Explore the structure and synthesis of terpenoids and carotenoids, and understand their biogenesis and molecular rearrangements. 5 Analyze enzyme nomenclature, classes, types of reactions, and the factors affecting enzyme kinetics, including enzyme action mechanisms.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction of Natural Products Classification, source and methods of isolation of natural products, General methods for the structure determination of natural products. **Carbohydrates:** Introduction to naturally occurring sugars: Deoxysugars, aminosugars, branched sugars. Structure elucidation of lactose and D glucosamine (synthesis not expected). Structural features and applications of inositol, starch, cellulose, chitin and heparin. **Natural pigments:** General structural features, occurrence, biological importance and applications of: carotenoids, anthocyanins, quinones, flavones, pterins and porphyrins (chlorophyll). Structure elucidation of βcarotene and Cyanin (with synthesis). Synthesis of ubiquinone from 3, 4, 5trimethoxyacetophenone.	**20%**	**12**
Unit 2: **Introduction to plant hormones:** structure determination and synthesis of auxins. Prostaglandins: Introduction. Occurance, nomenclature, classification and physiological effects, synthesis of PGE2 and PGF2, biosynthesis and biological importance. Natural pigments: General structural features, occurrence, biological importance and applications of: carotenoids, anthocyanins, quinones, flavones, pterins and porphyrins (chlorophyll). **Vitamins** Classification, sources and biological importance of vitamin B1,B2,B6, folic acid, B12,C,D1,E (α-tocopherol) ,K1,K2 ,H (β- biotin), Structure and synthesis of Vitamin A1, Vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), Vitamin B6 (Pyridoxine) and Folic acid, α-Tocopherol, Biotin (Vitamin H). Synthesis of Vitamin C	**20%**	**12**
Unit 3: Steroids Introductions, structural identification and synthesis of Cholesterol, Ergosterol; Steroid Hormones: Introduction, classification Androgens: structural identification and	**20%**	**12**

Androsterone, synthesis of Testosterone, Oestrogens: Introductions and total synthesis of Oestrone; Gestrogens: synthesis of Progesterone from cholesterol and Stigmasterol. synthesis of Cortisone, and Chemistry of bile acids. Biogenesis of Steroids. **Alkaloids** Introduction of Opium alkaloids, Structure and synthesis of Morphine, Rearrangement in opium alkaloids, synthesis of Reserpine and Tylophorine. Biogenesis of Alkaloids, Structure and synthesis of Cinchonine, (-)-Cocaine, Structure and synthesis of Tropine, Synthesis of 2-ethylpyridine, tropinic acid, tropinone and tropilidine from tropine, Synthesis of pimelic acid from tropinic acid.		
Unit 4: Terpenoids and Carotenoids Structure and synthesis of bicyclic sesquiterpenoids Eudesmol and Cadinene, structure and synthesis of ß-Carotene, synthesis of Caryophyllene and (-) Khusimone, Cedrene and Cedrol, molecular rearrangement of Caryophyllene and Logifolene. Biogenesis of Terpenoids and Carotenoids.	**20%**	**12**
Unit 5: Chemistry of enzymes Introduction, nomenclature, classes and general types of reactions catalyzed by enzymes. Properties of enzymes: a) enzyme efficiency/ catalytic power b) enzyme specificity; Fischer's 'lock and key' and Koshland 'induced fit' hypothesis. Concept and identification of active site. Factors affecting enzyme kinetics: Substrate concentration, enzyme concentration, temperature, pH, product concentration etc. Reversible and irreversible inhibition. Mechanism of enzyme action: transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Mechanism of chymotrypsin catalyzed hydrolysis of a peptide bond.	**20%**	**12**

List Of Practical	**Weightage**	**Contact hours**
19. Nitration of Benzophenone	11%	4

20. Synthesis of 1,2,3,4-Tetrahydrocarbazole	11%	4
21. Synthesis of Dibenzalacetone from Benzaldehyde	11%	4
22. Synthesis of Benzoic acid from Toluene	11%	4
23. Synthesis of Phthalimide from Phthalic acid	11%	4
24. To separate a mixture of amino acids by Thin Layer Chromatography (TLC) and identify the test amino acids by measuring their Rf values.	11%	4
25. Synthesis of phthalein dye	11%	4
26. Synthesis of benzophenone Oxime	11%	4
27. Preparation of Schiff Base	11%	4

Instructional Method and Pedagogy:

PPT, Video,ChalkBoard, QUIZ, Discussion(D),Student seminars, Case study

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1:To understand the classification, methods of isolation, and structure determination of	Remember and understand Analysis & Apply	Define, Describe Define, Describe,Apply Define, Describe,Apply

natural products, including carbohydrates and natural pigments. CO2:To analyze the structure, synthesis, and biological importance of plant hormones, prostaglandins, and vitamins. CO3:To explore the structural identification, synthesis, and biogenesis of steroids and alkaloids. CO4: To examine the structure, synthesis, and biogenesis of terpenoids and carotenoids. CO5: To understand enzyme nomenclature, types of reactions, kinetics, and mechanisms of enzyme action.	Remember and understand Remember and understand	Define Define , Describe

Learning Resources	
1	Reference Books: 1. Organic Spectroscopy: Principles And Applications, Jag Mohan, Alpha ScienceInternational Ltd., 30-Mar-2004. 2.Natural products chemistry and applications, Sujata V. Bhat, B.A. Nagasampagi and S. Meenakshi, Narosa Publishing House, 2011. Textbook: 1. Nelson, D. L, and Cox, M. M, (2008) Lehninger principles of Biochemistry 5thEdition, W. H. Freeman and Company, NY., USA. 2.Spectrometric Identification of Organic compounds, R.M. Silverstein and others, John Wiley and Sons Inc., 5th ed., 1991.
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		Marks

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	1	1	0
CO2	2	1	1	0	0	0
CO3	2	0	1	1	0	0
CO4	2	1	1	1	0	0
CO5	3	2	1	1	1	1

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	0	0
CO2	3	1	1	1	0	0
CO3	2	1	1	1	0	1
CO4	3	1	1	1	1	1
CO5	3	2	1	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None