



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. (Advanced Organic Chemistry) Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC02AOC01	Organic Spectroscopy	4-0-1	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1: Proficiency in interpreting IR, NMR, MS, and UV-Vis spectra.

CLO2: Ability to identify functional groups and deduce molecular structures.

CLO3: Understanding of spectroscopic principles and instrumentation.

CLO4: Skill in integrating data from multiple spectroscopic techniques.

CLO5: Preparedness for careers in organic chemistry research, analytical chemistry, pharmaceuticals, and related fields, with a strong foundation in spectroscopic methods.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	UV-Visible, Infrared, and Raman Spectroscopy Introduction of Spectroscopy, a region of electromagnetic radiation, and the contributions of Indian scientists C. V. Raman and C. N. R. Rao in spectroscopic techniques UV-Vis Spectroscopy: Introduction, Beer-Lambert's law, instrumentation, fundamentals of electronic transitions, chromophores and auxochromes, Woodward-Fieser rules, Effect of conjugation. IR Spectroscopy: Introduction, Principle of IR spectroscopy, Instrumentation, fundamental modes of vibrations, types of vibrations, condition for IR absorption, selection rules, condition for IR absorption. Raman Spectroscopy: Discovery of the Raman effect, scattering phenomena, elastic and inelastic scattering, Stokes and anti-Stokes shifts, instrumentation and applications, comparison between IR and Raman spectroscopy	Classroom Lectures, Seminars, Problem-Based Learning, Research-Oriented Learning, Self-Directed Learning	CLO1, CLO2, CLO3, CLO5
II	Nuclear Magnetic Resonance ¹H NMR: Introduction, principles, magnetic and non-magnetic nuclei, instrumentation, Shielding and deshielding effects, chemical shift, Origin of Chemical shift and spin-spin coupling, Pulse sequence, relaxation processes, peak area and proton ratio, anisotropic effect, coupling constant, simplification of the complex PMR spectra, Nuclear Overhauser effect, applications to simple structural problems ¹³C NMR: basic concepts, and instrumental issues, Chemical shifts (aliphatic, olefinic, alkyne, aromatic, heteroaromatic, and carbonyl carbons), substituents' effects on chemical shift, ¹³C-¹H coupling constant,	Classroom Lectures, Seminars, Problem-Based Learning, Research-Oriented Learning,	CLO1, CLO2, CLO3, CLO5



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	proton-coupled and decoupled ^{13}C spectra, DEPT spectra		
III	Mass Spectrometry General principle and theory, Methods of ionisation, Importance of HRMS, Rules of fragmentation, Recognition of the molecular ion peak, McLafferty rearrangements and retro-Diels-Alder process, metastable ions on peaks, the nitrogen rule, Ortho effect, Application of Mass spectrometer in structure elucidation and molecular weight determination.	Classroom Lectures, Seminars, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Self-Directed Learning	CLO1, CLO3, CLO5
IV	Structural Elucidation of Organic Compounds Problems based on UV-Vis, IR, ^1H NMR, ^{13}C NMR, Mass	Classroom Lectures, Problem-Based Learning, Collaborative Learning, Self-Directed Learning	CLO4, CLO5

- **(*) Learning Pedagogies/Methods**

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Classroom Lecture (CL)
- (b) Seminars (Student-led and Faculty-moderated)
- (c) Case-Based Learning (CBL)
- (d) Micro-Projects/Mini Research Tasks
- (e) Industrial Visit/Field Visit/Institutional Visit
- (f) Problem-Based Learning (PBL)
- (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (j) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (k) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (l) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (m) Inquiry-Based Learning
- (n) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment

a. Internal Formative assessment (30 Marks)

- (a) Quiz
- (b) Seminar
- (c) Assignment
- (d) Group Task
- (e) Attendance

b. Internal Summative Assessment (20 Marks)

Mid-term tests



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(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/Analyse & above (A)	
I	CLO1, CLO2	30	1	3	6	10
II	CLO3	30	1	6	7	14
III	CLO4	30	1	4	7	12
IV	CLO5	30	2	2	10	14
		120	05	15	30	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity, and Group tasks	50%
2	End-Semester Examination	Written Exam	50%

(C) CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	-	3	-	2	2	-	-	-	-	-	3	-
CLO2	-	3	-	2	3	-	-	-	-	-	-	-
CLO3	-	3	-	2	2	-	-	-	-	-	-	-
CLO4	-	3	-	2	2	-	-	-	-	-	-	-
CLO5	3	3	1	3	3	-	-	1	-	-	1	3

Values to the CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Elementary Organic Spectroscopy	Y. R. Sharma	5 th edition, 2013	S. Chand & Company
2	Introduction to Spectroscopy	Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan	4 th edition, 2009	Thomson Brooks/Cole publisher



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3	Spectroscopic Identification of Organic Compounds	R. M. Silverstein, G. C. Bassler	8 th edition, 2014	Wiley
4	Organic Spectroscopy	William Kemp	3 rd edition, 2022	Bloomsbury Publishing
5	Organic Chemistry	Jonathan Clayden, Nick Greeves, Stuart Warren	2 nd edition, 2001	Oxford Publication

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Course: Fundamentals of Spectroscopy	http://www.digimat.in/nptel/courses/video/104106122/L01.html
2	SWAYAM Online Course: Fundamentals of Spectroscopy	https://onlinecourses.nptel.ac.in/noc26_cy33/preview
3	e-PG Pathshala (INFLIBNET): P12: Organic Spectroscopy	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
4	National Digital Library (IIT Kharagpur) Introduction to Organic Spectroscopy by Libretexts	http://www.ndl.gov.in/he_document/libretexts/libretexts/IN__L__1_C_B__3_U_o_I_S__915_I_t_O_S__1109_1110?e=0 organic%20spectroscopy



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M.Sc. (Advanced Organic Chemistry) Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC02AOC02	Name Reactions and Reagents in Organic Chemistry	4-0-1	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1: Critically analyze and predict the mechanistic pathways of C-C and C-Heteroatom bond formations, specifically assessing the role of reactive intermediates and stereochemical control.

CLO2: Evaluate and understand appropriate oxidizing and reducing agents (including specialized reagents like IBX, L-Selectride, and Wilkinson's catalyst) to formulate chemo- and regio-selective transformations.

CLO3: Analyze and solve structural problems by evaluating the driving forces of molecular rearrangements and identify reactions.

CLO4: Justify and apply the industrial utility of modern coupling reactions (Suzuki, Heck, Click Chemistry) and name reactions to design efficient, high-yield synthetic protocols for drug intermediates.

CLO5: Synthesize and defend advanced laboratory strategies and research-oriented methodologies, integrating the contributions of Indian scientists and asymmetric catalysis into modern organic synthesis.

Unit	Course Content	Learning Pedagogies*	CO(s)
I	Name Reaction in Organic Synthesis – I Aldol reaction, Michael Addition, Mannich reaction, Robinson Annulation, Henry reaction, contribution of Indian scientist V. K. Singh in asymmetric Henry reaction (Singh's catalyst), Baeyer-Villiger Oxidation, Stork Enamine reaction, Wittig reaction and its modification, Peterson olefination, Shapiro and Bamford Steven's reaction, Julia Olefination, Vilsmeier-Heck reaction, Mitsunobu reaction, Brown's Hydroboration, Applications of hindered boron reagents, Carbonylation of organoboranes, Stobbe condensation, K. Venkataraman's contribution in flavone synthesis (Baker-Venkataraman Rearrangement)	Classroom Lecture, Seminars, Case-Based Learning, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Self-Directed Learning	CLO1, CLO3, CLO4, CLO5
II	Name Reaction in Organic Synthesis – II Stille coupling, Suzuki coupling, Sonogashira coupling, Heck reaction, Negishi coupling, Buchwald-Hartwig amination, Mukaiyama esterification, Yamaguchi esterification, Ritter reaction, Nazarov cyclisation, Ugi reaction, Strecker synthesis, Click reactions, Tiffeneau-Demjanov rearrangement	Classroom Lecture, Seminars, Case-Based Learning, Problem-Based Learning, Research-Oriented Learning,	CLO1, CLO3, CLO4, CLO5



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		Collaborative Learning, Self-Directed Learning	
III	Oxidation Reagent (a) Oxidation of alcohol: Jones reagent, Swern oxidation, Collins reagent, Fetizon's reagent, PCC, PDC, modification of PDC by S. Chandrasekaran, IBX, Activated MnO ₂ , Etard reaction, DMSO (b) Oxidative cleavage of Carbon-Carbon double bonds: KMnO ₄ , OsO ₄ , Ozonolysis (c) Oxidations using SeO ₂ , PhSeBr. (d) Selective cleavages at functional groups: HIO ₄ , Pb(OAc) ₄	Classroom Lecture, Seminars, Case-Based Learning, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Self-Directed Learning	CLO2, CLO3, CLO5
IV	Reduction Reagent (a) Catalytic Hydrogenation (b) Reduction of nitriles, oximes and nitro compounds (c) Reduction of acids and Esters (d) Reduction with metal hydride: Sodium cyanoborohydride, Diborane, L- & K-Selectrides, LiBH ₄ , DIBAL-H (e) Birch reduction, Luche reagent, Wolf-Kishner reduction, Clemmenson reduction, Wilkinson catalyst, TBTH.	Classroom Lecture, Seminars, Case-Based Learning, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Self-Directed Learning	CLO2, CLO3, CLO5

- (*) Learning Pedagogies/Methods**

- (o) Classroom Lecture (CL)
- (p) Seminars (Student-led and Faculty-moderated)
- (q) Case-Based Learning (CBL)
- (r) Micro-Projects/Mini Research Tasks
- (s) Industrial Visit/Field Visit/Institutional Visit
- (t) Problem-Based Learning (PBL)
- (u) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (v) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (w) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (x) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (y) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (z) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (aa) Inquiry-Based Learning
- (bb) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- Assessment Methodologies**

- (D) Internal Assessment**

- a. Internal Formative assessment (30 Marks)**

- (f) Quiz
- (g) Seminar
- (h) Assignment
- (i) Group Task



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(j) Attendance

b. Internal Summative Assessment (20 Marks)

Mid-term test

(E) Weightage of Learning Efforts for Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Analyse & above (A)	
I	CLO1, CLO3, CLO4, CLO5	15	1	4	9	14
II	CLO1, CLO3, CLO4, CLO5	15	1	4	7	12
III	CLO2, CLO3, CLO5	15	2	4	7	13
IV	CLO2, CLO3, CLO5	15	1	3	7	11
		60	05	15	30	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity, and group tasks	50
2	End-Semester Examination	Written Exam	50

• CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	2	1	3	3	-	2	1	1	-	-	2	-
CLO2	3	1	3	2	1	2	1	1	2	2	2	1
CLO3	2	1	3	3	1	1	-	1	-	-	1	-
CLO4	3	1	2	2	1	2	2	2	2	3	3	3
CLO5	3	2	2	3	2	3	3	3	2	2	3	2

- Values to CLO-PLO matrix are assigned by **judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-



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M.Sc. (Advanced Organic Chemistry) Semester-II

• **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Volume / Year	Publisher
1	Advanced Organic Chemistry, Part - A: Structure and Mechanisms	F.A. Carey, R. J. Sundberg	5th Ed. / 2007	Kluwer Academic/ Plenum Publishers, Springer, 5th ed. (2008)
2	Text book of Organic Chemistry Vol. I & II	I. L. Finar	6th Ed. / 2002	Pearson Education India, 6 th ed. (2002)
3	Organic Chemistry	R. T. Morrison, R. N. Boyd	7th Ed. / 2010	Pearson Pub., 7th ed. (2010)
4	Advanced Organic Chemistry: Reaction Mechanism and Structure	Jerry March, John	8th Ed. / 2020	Wiley, 4 th ed. (2006)

• **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL (Principles of Organic Synthesis)	http://www.nptel.ac.in
2	SWAYAM (Organic Chemistry – II)	http://www.swayam.gov.in
3	e-PG Pathshala (INFLIBNET) (Reagents in Organic Synthesis)	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
4	National Digital Library (IIT Kharagpur) (Advanced Chemical Research Repository)	NDLI: Browse



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M.Sc. (Advanced Organic Chemistry) Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSE	P2TNC02AOC03	Molecular Orbital Theory and Pericyclic Reaction	4-0-1	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1: Explain the concepts of Molecular Orbital Theory and perform energy calculations for cyclic and acyclic systems, including charge densities and reactivity indices.

CLO2: Apply FMO, PMO, and Woodward–Hoffmann rules to predict the feasibility and stereochemical outcomes of pericyclic reactions such as electrocyclic reactions, cycloadditions, and sigmatropic shifts.

CLO3: Analyze various pericyclic reaction mechanisms (electrocyclic, cycloaddition, sigmatropic, and cheletropic) using orbital symmetry principles.

CLO4: Differentiate between suprafacial and antarafacial processes in pericyclic reactions and explain stereochemical consequences in [i,j] and [1,j] sigmatropic rearrangements.

CLO5: Interpret photochemical reaction pathways using Jablonski diagrams and evaluate mechanisms of photochemical processes such as Norrish reactions, Paternò–Büchi reaction, and di- π -methane rearrangement.

CLO6: Predict product formation and reaction feasibility in both thermal and photochemical conditions using MO theory, symmetry considerations, and mechanistic understanding.

Unit	Course Content	Learning Pedagogies*	CO(s)
I	Molecular Orbital Theory Introduction, Construction of π -Molecular Orbitals of Ethylene and 1, 3-Butadiene, Symmetry in π -Molecular Orbital, Filling of Electrons in π -Molecular Orbitals in Conjugated Polyenes, Construction of Molecular Orbitals of Conjugated Ions and Radicals, Frontier Molecular Orbitals, Excited States, Symmetries in Carbon-Carbon Sigma Bond	Seminars, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Experiential Learning, Self-Directed Learning	CLO1, CLO2
II	Pericyclic Reactions – I Orbital symmetry, selection rules (FMO and PMO approach, Woodward-Hofmann rules), Electrocyclic reaction (1,3-butadiene-cyclobutene and 1,3,5-hexatriene-cyclohexadiene systems), cycloaddition: [2+2], [2+4] and [6+2] systems; stereoselectivity of the reactions, heterocycloaddition reactions, 1,3-dipolar cycloaddition, Suprafacial and antarafacial interactions. Stereochemical aspects in supra–supra, antara-supra and antara-antara, Diels-Alder reaction, Ene reaction, Woodward-Hoffmann selection rules	Classroom Lecture, Seminars, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning	CLO2, CLO3, CLO4, CLO6



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M.Sc. (Advanced Organic Chemistry) Semester-II

	for cycloaddition reaction		
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III	Pericyclic Reactions – II Sigmatropic reactions: [1,j] and [i,j] shifts. Suprafacial and antarafacial shifts, Selection rules for [i, j] shifts. Cope, degenerate Cope and Claisen rearrangements, Explanation for the mechanism of sigmatropic reactions: 1) symmetry properties of HOMO 2) Huckel-Mobius aromatic and antiaromatic transition state method, chelotropic reactions and explanation of mechanism by FMO theory, group transfer reaction given by diimide	Classroom Lecture, Seminars, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning	CLO2, CLO3, CLO4, CLO6
IV	Photochemistry Basic principles, Jablonski diagram; photochemistry of olefinic compounds, cis-trans isomerization; photochemistry of carbonyl compounds (Norrish type-I and type-II reactions), Paterno-Buchi reaction, Photorearrangement reactions: di- π methane rearrangement, rearrangement of cyclohexadienes, Barton reaction; photo-Fries reaction, reactions and synthetic applications of singlet oxygen, Hoffman-Löffler rearrangement.	Classroom Lecture, Seminars, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning	CLO5, CLO6

• (*) Learning Pedagogies/Methods

- (cc) Classroom Lecture (CL)
- (dd) Seminars (Student-led and Faculty-moderated)
- (ee) Case-Based Learning (CBL)
- (ff) Micro-Projects/Mini Research Tasks
- (gg) Industrial Visit/Field Visit/Institutional Visit
- (hh) Problem-Based Learning (PBL)
- (ii) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (jj) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (kk) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (ll) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (mm) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (nn) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (oo) Inquiry-Based Learning
- (pp) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(F) Internal Assessment

a. Internal Formative assessment (30 Marks)

- (k) Quiz
- (l) Seminar



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M.Sc. (Advanced Organic Chemistry) Semester-II

(m) Assignment

(n) Group Task

(o) Attendance

b. Internal Summative Assessment (20 Marks)

Mid-term test

(G) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Analyse & above (A)	
I	CLO1, CLO2	15	1	3	7	11
II	CLO2, CLO3, CLO4, CLO6	15	1	4	8	13
III	CLO2, CLO3, CLO4, CLO6	15	1	4	8	13
IV	CLO5, CLO6	15	2	4	7	13
		60	5	15	30	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity and Group Task	50
2	End-Semester Examination	Written Exam	50

• CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	1	2	2	2	–	–	1	–	1
CLO2	3	1	3	3	2	–	–	1	–	1
CLO3	3	1	3	3	1	–	–	1	–	1
CLO4	3	1	3	3	1	–	–	1	–	1
CLO5	3	1	2	2	2	–	–	1	–	1
CLO6	3	1	3	3	2	1	–	1	–	1

Values to CLO-PLO matrix are assigned by Judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:



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Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Advanced Organic Chemistry Part A and B	F. A. Carey and R. J. Sundberg	5 th Edition, 2007	Springer India Pvt. Ltd.
2	Molecular Orbitals and Organic Chemical Reaction	I. Fleming	Student Edition, 2009	Wiley
3	Advanced Organic Chemistry, Part - A: Structure and Mechanisms	F.A. Carey, R. J. Sundberg	5 th edition, 2008	Kluwer Academic/ Plenum Publishers, Springer
4	Text book of Organic Chemistry Vol. I & II	I. L. Finar	6 th edition, 2002	Pearson Education India
5	Organic Chemistry	R. T. Morrison, R. N. Boyd	7 th edition, 2010	Pearson Pub.

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Courses: Pericyclic Reactions and Photochemistry	https://onlinecourses.nptel.ac.in/noc25_cy29/preview
2	SWAYAM: Pericyclic Reactions and Photochemistry	https://www.youtube.com/watch?v=wTxx4t93ZsE
3	e-PG Pathshala (INFLIBNET): Pericyclic Reactions and Photochemistry	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
4	National Digital Library (IIT Kharagpur)	http://ndl.iitkgp.ac.in/he_document/cec/cec/6eUirFnomUo_PLNspmbLKJ8JSR7XCZOhfcm9N-vnNnR?e=5 pericyclic%20reaction



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M.Sc. (Advanced Organic Chemistry) Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC02AOC04	Organic Preparation and Ore-Alloy Analysis	0-8-0	120	04

• Course Learning Outcomes (CLOs)

After successful completion of this course, students will be able to:

CLO1: Perform and optimize qualitative and quantitative analysis of inorganic/industrial samples using standard laboratory methods and appropriate instrumentation.

CLO2: Design and synthesize organic compounds through established laboratory procedures and validate suitable purification techniques such as recrystallization and chromatography.

CLO3: Characterize and critically interpret synthesized compounds using analytical and spectroscopic methods correlating structural features with experimental observations.

CLO4: Analyze experimental data systematically and draw scientifically valid conclusions based on laboratory results.

CLO5: Demonstrate safe laboratory practices, proper handling of chemicals, and responsible waste disposal in accordance with standard safety protocols.

CLO6: Communicate experimental procedures and findings effectively through well-organized laboratory records and scientific reports.

Unit	Course Content	Learning Pedagogies*	CO(s)
	Ore-Alloy Analysis 1. Analysis of Hematite 1) Acid insoluble residue 2) Iron as Fe_2O_3 3) Iron by redox method (volumetrically) 2. To analyze the given sample of Pyrolusite 1) Acid insoluble residue 2) Iron as Iron oxide 3) Mn by using EDTA 4) MnO_2 oxalic acid method/Iodometric method 3. To determine the amount of Al and Fe in the given sample of Bauxite ore 1) Al as Al_2O_3 2) Fe as Fe_2O_3 Alloys analysis	Experimental Learning, Problem-Based Learning, Collaborative Learning, Inquiry-Based Learning, Reflective Practices, ICT-Enabled Learning, Micro-Projects/Mini Research Tasks,	CLO1, CLO2, CLO3, CLO4, CLO5, CLO6



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1. Analysis of German silver 2. Analysis of Bronze 3. Analysis of Brass 4. Analysis of Steel 5. Miscellaneous	Research-Oriented Learning, Self-Directed Learning	
Organic Chemistry: 1) Preparation of aromatic aldehydes by Vilsmeier-Haack reaction 2) Preparation of 3-formylindole by the Vilsmeier-Haack reaction 3) Preparation of <i>p</i> -chloronitrobenzene by Sandmeyer reaction 4) Preparation of <i>p</i> -Iodonitrobenzene by Sandmeyer reaction 5) Pechmann Condensation (Coumarin synthesis) 6) Aldol condensation (Chalcone) 7) Fischer indole synthesis 8) Preparation of Benzanilide by Beckmann rearrangement 9) Preparation of pyrazolone 10) Synthesis of flavone		

- (*) Learning Pedagogies/Methods**

- (qq) Seminars (Student-led and Faculty-moderated)
- (rr) Case-Based Learning (CBL)
- (ss) Micro-Projects/Mini Research Tasks
- (tt) Industrial Visit/Field Visit/Institutional Visit
- (uu) Problem-Based Learning (PBL)
- (vv) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (ww) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (xx) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (yy) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (zz) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (aaa) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (bbb) Flipped Classroom Approach
- (ccc) Inquiry-Based Learning
- (ddd) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- Assessment Methodologies**

- (H) Internal Assessment**

- a. Internal Formative assessment (30 Marks)**

- (p) Journal Evolution
 - (q) Method of Working
 - (r) Attendance

- b. Internal Summative Assessment (20 Marks)**

- (a) Mid-Term Examination
 - (b) Viva-voce



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(I) Weightage of Learning Efforts for Assessment

Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
		Remember (R) 10	Understanding (U) 20	Analyse & above (A) 70	
CLO1, CLO2, CLO3, CLO4, CLO5, CLO6	120	5	10	35	50
	120	5	10	35	50

• CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	1	3	-	2	3	2	2	1	1	1	1	-
CLO2	3	1	3	2	-	2	2	1	3	2	2	1
CLO3	1	3	2	3	2	2	1	2	1	1	2	-
CLO4	1	2	2	3	3	3	2	2	2	1	2	-
CLO5	2	-	-	1	-	2	2	1	3	3	2	2
CLO6	-	-	-	2	2	2	2	3	2	1	2	2

- Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Journal Evaluation, Method of working, Attendance, Mid-Term Examination, Viva-voce	50
2	End-Semester Examination	Practical Exam	50

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Volume / year	Publisher
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1	Qualitative Chemical Semimicro Analysis	V. N. Alexeyev	2003 (Reprint)	Mir Publishers, Moscow
2	Vogel's Qualitative Inorganic Analysis	G. Svehla	7 th Ed. / 2012	Pearson Education
3	Vogel's Textbook of Practical Organic Chemistry	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell	5 th Ed. / 1989	Pearson Education
4	Practical Organic Chemistry	O. P. Agarwal	31 st Ed. / 2014	Goel Publishing House
5	Advanced Practical Organic Chemistry	N. K. Vishnoi	3 rd Ed. / 2009	Vikas Publishing House
6	Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis	V. K. Ahluwalia, Renu Aggarwal	2000 (Reprint)	Universities Press

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	National Programme on Technology Enhanced Learning (NPTEL) Lab Workshop (Experimental Organic Chemistry)	https://nptel.ac.in
2	SWAYAM Lab Procedures (Laboratory Techniques in Organic Chemistry)	https://vlab.amrita.edu/index.php?sub=2
3	Virtual Labs (MHRD) Organic Chemistry Virtual Lab	https://oc-amrt.vlabs.ac.in/
4	Royal Society of Chemistry (RSC Education) Practical Chemistry Collection	https://edu.rsc.org/resources/practical
5	MIT Open Course Ware Laboratory Chemistry	https://ocw.mit.edu/courses/5-310-laboratory-chemistry-fall-2019/b45b441482cb2fe3bfa5afe515c23622/MIT5_310F19_Lab2.pdf



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Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC02AOC05	Industrial Product Analysis	0-8-0	120	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1: Apply fundamental principles of physical and analytical chemistry to perform quantitative and qualitative analysis using techniques such as spectrophotometry, titrimetry, and electrochemical methods.

CLO2: Analyse experimental data to determine physicochemical parameters such as reaction kinetics, solubility, viscosity, and thermodynamic properties of chemical systems.

CLO3: Evaluate the composition and purity of chemical and pharmaceutical samples using standard laboratory techniques, including iodimetry, COD determination, and other analytical methods.

CLO4: Demonstrate proficiency in laboratory skills by designing, conducting, and interpreting experiments related to polymers, surfactants, and reaction mechanisms with proper safety practices.

CLO5: Develop and prepare pharmaceutical formulations (e.g., solutions, emulsions, suspensions, ointments) and assess their stability, solubility, and drug-excipient interactions.

Course Content	Learning Pedagogies*	CLO(s)
Physical and Analytical Chemistry: 1. To verify Beer-Lambert's law for potassium permanganate solution and hence to determine the molar extinction coefficient and an unknown concentration of the given sample spectrophotometrically. 2. To determine the solubility of calcium oxalate in the presence of KCl. (Ionic strength effect). 3. Analysis of Pharmaceutical tablets. 4. To estimate the amount of D-glucose in the given solution colorimetrically. 5. To determine the acid value of the given oil. 6. To determine the zero-shear viscosity (η_0) of a polymer solution at different temperatures. 7. To titrate pH metrically a dibasic acid solution against alkali and calculate the first and second neutralisation of the acid. 8. To determine the decomposition kinetics of a polymer	Experiential Learning, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Self-Directed Learning, Reflective Learning	CLO1 to CLO5



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by TGA using the iso-conversional method. 9. To determine the relative strength of HCl and H₂SO₄ by studying the hydrolysis of methyl acetate. 10. Determination of the CMC of the given surfactant by drop weight methods. 11. To determine the percentage purity of glucose by iodimetry. 12. Determination of acid value of polyester resin. 13. To determine the epoxy equivalent weight of the given epoxy resin. 14. To determine the chemical oxygen demand (COD) in a given water sample. 15. Extraction of caffeine from dry tea leaves and its quantitative determination. 16. To determine the pK_a. Pharmaceutical formulation (Any five) 1) Preparation of weak Iodine solution. 2) Preparation of Paracetamol Suspension. 3) Preparation of Castor Oil Emulsion. 4) Preparation of Simple Syrup IP. 5) Preparation of Lemon Syrup. 6) Preparation of Methyl Salicylate Ointment. 7) Determination of solubility of Paracetamol in water, 0.1 N HCl, 0.1 N NaOH, Phosphate buffer pH 6.8 and 7.4.		
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• (*) Learning Pedagogies/Methods

Notes:

(3) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(4) Acronyms/abbreviations of the terms can be placed in the above table.

(eee) Classroom Lecture (CL)

(fff) Seminars (Student-led and Faculty-moderated)

(ggg) Case-Based Learning (CBL)

(hhh) Micro-Projects/Mini Research Tasks

(iii) Industrial Visit/Field Visit/Institutional Visit

(jjj) Problem-Based Learning (PBL)

(kkk) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)

(lll) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)

(mmm) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)

(nnn) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)

(ooo) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

(ppp) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)

(qqq) Inquiry-Based Learning

(rrr) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)



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• Assessment Methodologies

(J) Internal Assessment

a. Internal Formative assessment (30 Marks)

- (s) Journal Evaluation
- (t) Method of Working
- (u) Attendance

b. Internal Summative Assessment (20 Marks)

- (a) Mid-term Examination
- (b) Viva-Voce

(K) Weightage of Learning Efforts for External Assessment

Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
		Remember (R)	Understanding (U)	Application/Analyse & above (A)	
CLO1, CLO2, CLO3, CLO4, CLO5	120	5	15	30	50
	120	5	15	30	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Journal Evaluation, Method of Working, Attendance, Mid-term Examination, Viva-Voce	50
2	End-Semester Examination	Practical Exam, Viva-Voce	50

(L) CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	-	-	-	2	-	-	3	3	3	-	2	-
CLO2	-	-	-	-	-	-	3	3	3	-	2	-
CLO3	1	-	-	-	-	-	3	3	3	-	2	-
CLO4	-	-	-	2	-	-	3	3	3	3	2	-
CLO5	3	-	-	3	-	-	3	1	3	2	2	-

Values to the CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2



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Low	1
No correlation	-

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Experiments in Physical Chemistry	J. M. Wilson, R. J. Newcombe, A. R. Denaro	2 nd edition, 1968	Elsevier
2	A Laboratory Manual of Experiments in Physical Chemistry	D. Brennan, C. F. H. Tipper	1975	McGraw-Hill
3	Experimental Physical Chemistry	R. C. Das, B. Behera	1983	McGraw-Hill
4	Advanced Physico-Chemical Experiments	J. Rose	1964	London: Pitman
5	Vogel's Textbook of Quantitative Chemical Analysis	G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney	5 th edition, 1989	ELBS Publication

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	3D Chemistry Models	https://www.labster.com/3d
2	Virtual Chemistry	https://virtualchemlabs.com/
3	Amrita Vishwa Vidyapeetham	https://vlab.amrita.edu/?sub=2
4	Virtual Lab an Initiative of Ministry of Education	https://ea-dei.vlabs.ac.in/



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Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC02AOC06	Polymer Chemistry	2-0-1	60	02

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1: Critically explain fundamental concepts of polymer science including oligomers, monomers, polymers, functionality, repeating units, and degree of polymerization, along with bonding and nomenclature of polymers.

CLO2: Analyze and classify polymers and differentiate between various types of polymerization processes, including bulk, solution, suspension, and emulsion polymerization, with emphasis on their mechanisms and kinetics free radical, ionic, and condensation.

CLO3: Evaluate and correlate the physical and chemical properties of polymers, including mechanical, thermal, electrical, optical, and chemical properties, and relate them to polymer structure and composition.

CLO4: Apply and formulate the molecular weight concepts such as number average, weight average molecular weight, degree of polymerization, polydispersity, and their practical significance in polymer applications.

CLO5: Evaluate and compare different experimental techniques for molecular weight determination, including end group analysis, colligative methods (cryoscopy and ebullioscopy), osmometry, viscometry, light scattering, ultracentrifugation, and gel permeation chromatography (GPC).

Unit	Course Content	Learning Pedagogies*	CO(s)
I	Introduction of Polymer Science: Basic concepts: Oligomer, Monomer, Polymer, Polymerisation and Functionality, Repeating unit, Degree of polymerisation, Bonding in polymers, Notation and nomenclature of polymers, Classification of polymers, Types of polymerisations, Properties of polymers: mechanical, chemical, thermal, electrical and optical Techniques of Polymerization: Bulk, solution, suspension, and emulsion polymerization, Salient features of different polymerization techniques, Kinetics of polymerization (free radical, ionic, condensation, emulsion polymerization)	Classroom Lecture, Seminars, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Self-Directed Learning	CLO1, CLO2, CLO3
II	Molecular Weight Determination Techniques: Molecular Weight Concepts and Measurement of Molecular Weights Number average and weight average molecular weights, Molecular weight and degree of polymerization, Polydispersity and molecular weight distribution in polymers, Practical significance of polymer molecular	Classroom Lecture, Seminars, Problem-Based Learning, Research-Oriented Learning, Collaborative Learning, Self-	CLO4, CLO5



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weight, Measurement of molecular weight: End group analysis, Colligative property methods, Freezing point depression (Cryoscopy), Boiling point elevation (Ebullioscopy), Membrane osmometry, Vapour phase osmometry, Viscometry, Dilute solution viscosity, Light scattering, Ultracentrifugation and Gel permeation chromatography (GPC).	Directed Learning	
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• (*) Learning Pedagogies/Methods

- (sss) Classroom Lecture (CL)
- (ttt) Seminars (Student-led and Faculty-moderated)
- (uuu) Case-Based Learning (CBL)
- (vvv) Micro-Projects/Mini Research Tasks
- (www) Industrial Visit/Field Visit/Institutional Visit
- (xxx) Problem-Based Learning (PBL)
- (yyy) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (zzz) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (aaaa) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (bbbb) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (cccc) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (dddd) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (eeee) Inquiry-Based Learning
- (ffff) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(M) Internal Assessment

a. Internal Formative assessment (30 Marks)

- (v) Quiz
- (w) Seminar
- (x) Assignment
- (y) Group Task
- (z) Attendance

b. Internal Summative Assessment (20 Marks)

Mid-term test

(N) Weightage of Learning Efforts for Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Analyse & above (A)	
I	CLO1, CLO2, CLO3	30	1	3	8	12
II	CLO4, CLO5	30	1	4	8	13
		60	2	7	16	25



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• Assessment and Evaluation

Sr.No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity and Group task	25%
2	End-Semester Examination	Written Exam	25%

(O)CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	2	1	1	3	-	-	-	2	1	1	2	-
CLO2	2	1	2	3	1	-	-	1	1	2	2	-
CLO3	2	2	1	3	1	-	-	1	2	3	2	1
CLO4	1	2	-	3	3	1	1	1	1	1	2	-
CLO5	-	3	-	3	3	2	-	1	2	1	2	-

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Polymer Science and Technology	Joel R. Fried	3 rd edition 2014	Prentice Hall (Pearson Education)
2	Introduction to Polymer Science and Chemistry: A Problem-Solving Approach	Manas Chanda	2 nd edition 2013	CRC Press (Taylor & Francis Group)
3	Principles of Polymerization	George Odian	4 th edition 2004	Wiley-Interscience
4	Textbook of Polymer Science	Fred W. Billmeyer Jr.	3 rd edition 2007	Wiley India
5	Fundamentals of Polymer Science: An Introductory Text	Michael M. Coleman, Paul C. Painter	2 nd edition 2008	DEStech Publications

• Online Resources (Open Source)

Sr.No.	Description of Resource(s)	Weblink
1	NPTEL- Polymer Science	https://nptel.ac.in/courses/104105124
2	SWAYAM- Polymer Chemistry	https://onlinecourses.nptel.ac.in/noc25_cy56/preview
3	e-PG Pathshala (INFLIBNET)- Polymer Chemistry	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
4	National Digital Library (IIT Kharagpur)- Polymer Chemistry	https://onlinecourses.nptel.ac.in/noc26_ch29/preview



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