For 2-Year PG Programme
(Scheme B-1)
With Major Practicum Component

CHEMISTRY-CORE (THEORY) SYLLABUS

M.Sc. I Semester

Part A: Introduction				
Program: 2-Year PG		**Class-M.Sc.**	**Semester-I**	**Session: 2025-26**
Subject– Chemistry				
1	**Course Code**	**CC-11 (T)**		
2	**Course Title**	**Advanced Organic Chemistry**		
3	**Course Type**	**CORE Course**		
4	**Pre-requisite**	**To study this course, students must have Chemistry as one of the subjects in B.Sc. Degree Course.**		
5	**Course Learning Outcomes (CLO)**	**Upon successful completion of this Course, learners will be able to:** ➢ Understand the traditional insight of Aromaticity and contributions of Acharya Prafulla Chandra Ray (Father of Indian Chemistry). ➢ Explain the concept of aromaticity and differentiate between aromatic, antiaromatic, nonaromatic, and homoaromatic compounds using structural features and spectroscopic data. ➢ Apply the PMO approach to interpret aromatic character in systems like annulenes, metallocenes, and crown ether complexes. ➢ Demonstrate the mechanisms of major condensation reactions such as Aldol, Claisen, Mannich, Perkin, and Stobbe, etc. highlighting the role of enolate intermediates. ➢ Assess the stability and reactivity of Free radicals and describe their behavior in reactions like allylic halogenation, Sandmeyer, and Hunsdiecker transformations. ➢ Interpret reaction mechanisms through energy diagrams, transition states, and isotope effects; relate structural effects to reactivity using Hammett and Taft correlations. ➢ Classify pericyclic reactions and predict their stereochemical outcomes based on orbital symmetry principles and the Woodward–Hoffmann rules. ➢ Describe the mechanisms and applications of photochemical reactions such as Paterno–Büchi, di-π methane rearrangement, and photo-Fries rearrangement in organic synthesis.		
6	**Credit Value**	**Theory–06**		

7	Total Marks	Maximum Marks: Total 100 University Exam (UE)-60, CCE-40	Minimum Passing Marks: 40

Part B-Content of the Course

Total No. of Lectures-Tutorials-Practical (L-06 hours per week):
L-T-P: 90-0-0 (Total Hours)

Unit	Topic	No. of Lectures
1	**Indian Knowledge system and its relevance to Aromaticity:** Concept of Aromaticity – Traditional Insight Chemistry of natural aromatic compounds: Eugenol (from cloves), Thymol (from ajwain), Curcumin (from turmeric) and Vanillin (from vanilla). Contributions of Acharya Prafulla Chandra Ray (The Father of Indian Chemistry) in Organic Chemistry. **Aromaticity:** Concept of aromaticity, Aromaticity in benzenoid and non–benzenoid compounds, Antiaromatic compounds, Nonaromatic compounds, Homoaromatic compounds, PMO approach, Annulenes, Metallocenes, Crown ether complexes and cryptates. ***Keywords***: Aromatic Compounds, PMO Approach, Benzenoid and Non-Benzenoid Systems, Annulenes and Metallocenes ***Activities***: 1. Poster Making to illustrate aromatic, antiaromatic, and nonaromatic compounds with examples. 2. Building 3D molecular models of benzenoid and non-benzenoid aromatic compounds using model kits/ software. 3. Organize a debate on "The Role of Aromatic Compounds in Traditional Medicine *vs.* Modern Chemistry."	15
2	**Free radical reactions:** Structure, stability and geometry, and properties of Free radicals. Free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance, reactivity for aliphatic and aromatic substrates at a bridgehead, reactivity in the attacking radicals, the effect of solvent on the reactivity. **Name Reactions:** Birch Reduction, Nef reaction, Bouveault-Blanc reaction, Chichibabin, Mannich reaction, Meerwein-Ponndorf-Verley reduction, Oppherneur oxidation, Curtius reaction, Claisen Schmidt reaction,	15

	Sharpless-epoxidation, Pechmann reaction. Aldol Condensation, Knoevenagel reaction, Mannich reaction, Benzoin condensation, Perkin reaction, Sandmeyer's and Hunsdiecker reaction. ***Keywords***: Free Radical Substitution, Stability of Radicals, Organic Reactions ***Activities***: 1. Creating Reaction Mechanism Posters for free radical substitutions and name reactions. 2. Demonstration/simulation (virtually or in-lab) of simple free radical halogenation or oxidation reactions. 3. Students can create short explanatory videos explaining the mechanism and real-life application of name reactions.	
3	**Reaction Mechanism: Structure and Reactivity** Types of reaction mechanisms, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Curtin–Hammett Principle. Potential energy diagrams, transition states and intermediates, methods of determining the mechanism, and isotope effects. Generation, structure, stability and reactivity of carbocations, carbanions, Free radicals, carbenes and nitrenes. Effect of structure on reactivity–resonance and field effects, quantitative treatment. The Hammett equation and linear free energy relationships, substituent and reaction constants, Taft equation. ***Keywords***: Reaction Pathways, Thermodynamic and Kinetic Control, Reactive Intermediates, Linear Free Energy Correlations ***Activities***: 1. Creation of reaction Pathway posters showing intermediates, transition states, and activation energy for various organic reactions. 2. Building of flowcharts or concept maps illustrating various reaction intermediates (carbocations, free radicals, carbenes, etc.), including their generation and stability. 3. Students can play roles as key scientists (e.g., Hammett, Taft, Curtin, and Hammett) and explain their contributions.	20
4	**Pericyclic Reactions**: Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reaction. Woodward-Hoffmann correlation diagrams. FMO and PMO approach.	20

	Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 system. 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, 3,3- and 5,5-sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements, Ene reaction and Fluxional tautomerism. ***Keywords***: Orbital Symmetry, Electrocyclic Reactions, Cycloadditions, Sigmatropic Rearrangements, Woodward-Hoffmann Rules ***Activities***: 1. Ask the students to prepare animations and short videos showing conrotatory and disrotatory motions in electrocyclic reactions. 2. Preparation of flowcharts to classify pericyclic reactions: electrocyclic, cycloaddition, and sigmatropic rearrangements with examples.	
5	**Photochemical Reactions:** Photochemistry of alkenes and aromatic compounds, Paterno–Buchi reaction, di-pi methane rearrangement, Photo-Fries rearrangement, Barton reaction, Photochemical formation of smog, Photodegradation of polymers and Photochemistry of vision. ***Keywords***: Photoreduction, Photo rearrangements, Photocycloadditions, Smog Formation, Photodegradation ***Activities***: 1. Students can create visual flowcharts summarizing different photochemical reactions (e.g., Paterno–Buchi, Barton, di-π-methane rearrangement). 2. Poster making to explain the photochemistry of vision, involving rhodopsin, retinal isomerization, and its role in biological light sensing.	20

Part C: Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

Books

1. Ray, Prafulla Chandra, A History of Hindu Chemistry, Asian Educational Services, New Delhi.
2. Sivarajan, V.V., Balachandran, I., Ayurvedic Drugs and Their Plant Sources, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

3. March, J. Advanced Organic Chemistry: Reactions, Mechanisms and Structure. John Wiley.
4. Sykes, Peter. A Guidebook to Mechanism in Organic Chemistry. Orient Longman.
5. Mukherji, S.M. and Singh, S.P. Reaction Mechanism in Organic Chemistry. Macmillan.
6. Carey, F.A. and Sundberg, R.J. Advanced Organic Chemistry, Part A and B. Plenum.
7. Kalsi, P.S. Organic Reactions and Their Mechanisms. New Age International.
8. Coxon, J. and Holtom, B. Organic Photochemistry. Cambridge University Press.
9. Dupuoy, C.H. and Chapman, O.L. Molecular Reactions and Photochemistry. Prentice Hall.
10. Kagan, J. Organic Photochemistry. Academic Press.
11. Kundall, R.P. and Gilbert, A. Photochemistry. Thomson Nelson.
12. Clayden J., Greevs N., and Warren S., Organic Chemistry, Oxford Publ.
13. Carey, F.A., Sundberg, R.J., Advanced Organic Chemistry, Parts A and B, Plenum.
14. Carruthers, W., Coldham, I., Modern methods of organic synthesis, Cambridge University Press.
15. Warren, S., Organic Synthesis: The Disconnection Approach, John Wiley & Sons.
16. Jagdamba Singh, L. D. S. Yadav Organic Chemistry, Pragati Prakashan.

Suggested equivalent online courses and Web Sources:

- https://archive.nptel.ac.in/course.html
- https://ugcmoocs.inflibnet.ac.in/index.php/courses/moocs
- https://swayam.gov.in/explorer

Assessment and Reference

Maximum Marks: 100
Internal Assessment (CCE): 40
External Assessment (UE): 60

Internal Assessment

	Continuous and Cumulative Evaluation (CCE) Methods will be based on following defined components:	Marks
a.	Class Tests	
b.	Presentation/Assignment/ Quiz/ Group Discussion	
c.	Appropriate weightage of attendance in the Class	
	Total	40

External Assessment

	Theory Paper as per University Examination	
	Total	60
	Grand Total	100

For 2-Year PG Programme
(Scheme B-1)
With Major Practicum Component

CHEMISTRY-CORE (THEORY) SYLLABUS
M.Sc. I Semester

Part A- Introduction				
Program: 2-Year PG		**Class-M.Sc.**	**Semester-I**	**Session: 2025-26**
Subject– Chemistry				
1	**Course Code**	**CC-12 (T)**		
2	**Course Title**	**Advanced Inorganic Chemistry**		
3	**Course Type**	**CORE Course**		
4	**Pre-requisite**	**To study this course, students must have Chemistry as one of the subjects in B. Sc. Degree Course.**		
5	**Course Learning Outcomes (CLO)**	**Upon successful completion of this Course, learners will be able to:** ➢ Relate ancient Indian knowledge of metal complexes (bhasmas) to modern metal-ligand chemistry. ➢ Understand the connection between traditional colour changes, electronic transitions, and the Ayurvedic concept of 'Rasa'. ➢ Analyze and interpret the electronic spectra of transition metal complexes using Orgel and Tanabe-Sugano diagrams, understanding d-orbital transitions and selection rules for electronic spectroscopy. ➢ Apply the concepts of crystal field theory, including calculations of 10 Dq, B, and β parameters, and evaluate the intensity of various types of electronic transitions. ➢ Understand and explain the bonding and stereochemistry of main group compounds, utilizing the Bent rule and Walsh diagrams, and exploring hybridization energetics and dπ-pπ bonding. ➢ Evaluate the stability and formation constants of metal-ligand complexes in solution, including stepwise and overall formation constants, and understand the chelate effect and its thermodynamic origin. ➢ Identify and classify metal-cluster compounds, including higher boranes, carboranes, and metallo-carboranes, while calculating bond order and understanding the magnetic behavior and STYX number of these clusters. ➢ Study and apply the bonding and structural elucidation of metal π-complexes, including metal carbonyls, transition metal nitrosyls, dinitrogen complexes, and tertiary phosphine ligands, with a focus on their vibrational spectra and important reactions.		
6	**Credit Value**	**Theory–06**		

7	Total Marks	Maximum Marks: Total 100 University Exam (UE)-60, CCE-40	Minimum Passing Marks: 40

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (L-06 hours per week):
L-T-P: 90-0-0 (Total Hours)

Unit	Topic	No. of Lectures
1	**Indian Knowledge System and its relationship with Electronic Spectral Studies of Transition Metal Complexes:** Ancient Indian texts such as Rasaratna Samuccaya and Rasashastra describing preparation and medicinal use of metal complexes (bhasmas), reflecting an empirical grasp of metal-ligand interactions. The colour changes of metal salts and their complexes in dyeing and purification processes, demonstrating practical knowledge related to electronic transitions and ligand field effects. The Ayurvedic concept of 'Rasa' metaphorically aligning with the changes in molecular energy states and interactions observed in spectroscopic ground states and electronic transitions. **Electronic Spectral Studies of Transition Metal Complexes:** Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), Selection rule for electronic spectroscopy. Intensity of various types of electronic transitions. Calculations of 10Dq, B and β parameters, and charge transfer spectra. Franck-Condon principle and Applications (No. of transitions, and energy orders). Charge transfer (CT) mechanism; Ligand to Metal and Metal to Ligand Charge Transfer Bands. Effect of Solvent Polarity on CT Spectra. ***Keywords***: Electronic Transitions, Orgel Diagrams, Tanabe-Sugano Diagrams, d-Orbital Transitions, Crystal Field Splitting (10Dq), Charge Transfer, Spectra Spectral Applications, Solvent Polarity Effects ***Activities:*** 1. Ask the students to prepare a Poster: a) Colour and Electronic Transitions in Metal Complexes. b) Ancient Indian Rasashastra vs Modern Coordination Chemistry. c) Orgel and Tanabe-Sugano Diagrams (d^1–d^9 states). d) Ligand Field Theory and Charge Transfer Bands. 2. Preparation of Charts: a) Tanabe-Sugano diagrams for selected d^n systems. b) Franck–Condon principle with energy diagrams. c) Comparison: Spin-allowed vs Spin-forbidden transitions. d) Solvent effect on electronic spectra (CT bands shift).	15

	3. Organize Group Discussion on: a) Significance of colour in coordination compounds. b) Real-life applications of electronic spectra (e.g., in dyes, medicine). c) Alignment of Rasashastra's concept of *Rasa* with modern energy transitions. 4. Student Seminar/ Presentation on: a) Ligand field splitting and selection rules. b) Charge Transfer Spectra: LMCT vs MLCT. c) Application of Electronic Spectroscopy in Bhasma characterization.	
2	**Stereochemistry and Bonding in Main Group Compounds:** Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. Walsh diagram (triatomic and penta-atomic molecules), and dπ-pπ bond. **Metal-Ligand Equilibrium in Solution** Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry and spectrophotometry. ***Keywords***: Bent Rule, Hybridization Energetics, Walsh Diagram, dπ-pπ Bonding, Chelate Effect, Stability of Metal Complexes, Potentiometry, Spectrophotometry ***Activities:*** 1. Preparation of Chart/ Poster: a) Bent rule and hybridization trends. b) Walsh diagrams for triatomic and penta-atomic molecules. c) Understanding dπ–pπ bonding. 2. Virtual Lab Activity/ Simulation: a) Simulate metal-ligand titrations using potentiometry or spectrophotometry. b) Observe formation curve and calculate stability constants. c) Example systems: Cu(II)-NH_3, Fe(III)-oxalate. 3. Organize Group Discussion on: a) Stability of chelates over to simple complexes. b) Role of entropy and enthalpy in complex stability. c) Influence of ligand denticity and ring size on complex formation. 4. Building of Molecular Model to visualize molecular geometries (e.g., BF_3, NH_3, PCl_5, ClF_3, etc). 5. Arrange a Debate on the topic "Chelating ligands are always better complexing agents than monodentate ligands".	20

3	**Organometallic chemistry:** Introduction: 18-electron rule and its limitations, electron counting.; Transition Metal hydrides, alkyls, aryls, carbonyls, nitrosyls, phosphines and related ligands. Wade's rule, metal-metal bond counting. Mechanism of Substitution reactions.; Organometallic complexes of n-bound ligands (Alkene, Alkyne, Allyl, Diene, Cyclopentadienyl, Arenes and other Alicyclic Ligands); Mechanism and application of Oxidative Addition and Reductive Elimination reaction, Insertion and β-hydride elimination. Fischer and Schrock carbene. **Application of organometallic complexes in homogeneous catalysis:** Alkene hydrogenation (Wilkon's catalyst, Monsanto, Cativa reaction), Alkene Hydroformylation, Wacker's reaction, Cross-coupling reaction; Heck coupling, Sonagashira reaction, Suzuki Miyara coupling, Hiyama-coupling, Stille coupling). Buchwald-Hartwig amination, Tebbe's reagent, Grubbs catalyst. ***Keywords***: Organometallic chemistry, Wade's rule, Organometallic complexes, Mechanism of Substitution reactions ***Activities:*** 1. Conceptual and visual understanding through Chart/Model Preparation for: a) 18-electron rule with examples. b) Electron counting using neutral and ionic methods. c) Wade's Rule: Cluster compounds and electron count correlation. d) Comparative structures of Fischer vs Schrock carbenes. e) "Catalytic Cycles in Homogeneous Catalysis" (e.g., Heck, Suzuki, Monsanto). 2. Virtual Lab Simulation / Mechanism Animation for: a) Metal-ligand bonding (e.g., π-back bonding in carbonyls). b) Catalytic cycles (e.g., Wilkinsons, Wacker, Grubbs). c) Organometallic reactions (e.g., β-hydride elimination). 3. Seminar on the topics: a) Comparison of Cross-Coupling Reactions. b) Mechanism of Fischer vs Schrock Carbene Reactions.	20
4	**Metal-Clusters** Higher boranes, carboranes, metallo-boranes, and metallo-carborane compounds with metal-metal multiple bonds, STYX no. cluster types identifications, calculations of bond order and magnetic behaviour. **Metal π-Complexes** Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of	15

	metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and tertiary phosphine as ligands. ***Keywords***: Metal-Clusters, Metal Carbonyls, STYX Number, Magnetic Behaviour, Vibrational Spectra, Bonding and Structure, Transition Metal Nitrosyl, Tertiary Phosphine Ligands ***Activities:*** 1. Chart Preparation on the topics: a) Classification of clusters using Wade's Rules and STYX numbers b) Comparison of boranes, carboranes, metallo-carboranes c) Correlate IR stretching frequencies with the bonding nature of carbonyls and nitrosyls (terminal vs bridging) 2. Worksheet on Calculations of Bond order, magnetic behavior, and electron count in metal-metal bonded clusters. 3. Poster Making on the topics: a) Understanding of Borane and Carborane Clusters. b) STYX Rules and Cluster Classification Simplified. c) Metallo-boranes in Modern Inorganic Chemistry. 4. Virtual Lab/Structure Viewer Using Avogadro or other online databases to visualize 3D structures of M–M bonded clusters and borane cages. 5. Preparation of molecular models for $Fe(CO)_5$, $Cr(CO)_6$, $[Mn(CO)_5NO]$, $[Ru(NH_3)_5N_2]^{2+}$.	
5	**Symmetry, Group Theory and its Applications** Introduction of symmetry aspects with operations, Associated operations, Products of symmetry operations, Definition of group, subgroup, Conjugacy relation and classes. Point symmetry groups, Schonfilies symbols, representations of groups by matrices, and Character of representations. Matrix representation of symmetry operations: Transformation matrices, The Great Group Orthogonality Theorem (GOT) and its importance, Character tables. Derivation of character table for different point groups, Infra-red and Raman active molecular vibrations of different molecules. ***Keywords***: Group Theory, Symmetry Operations, Transformation Matrices, Group Orthogonality Theorem, Character Tables, Point Groups, Molecular Vibrations ***Activities:*** 1. Poster/Chart Preparation: a) Symmetry operations and elements. b) Point groups with Schoenflies symbols. c) Character tables overview. 2. Matrix Representation Exercises: a) Write transformation matrices for simple symmetry operations. b) Practice matrix multiplication of symmetry operations. c) Students can perform symmetry operations on models or themselves to internalize concepts of operation products and classes.	20

Part C-Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:
Books

1. Rasaratna Samuccaya, Various editions with commentary on Rasashastra and bhasmas.
2. Mukherjee, K.C., Rasashastra: The Ancient Science of Indian Alchemy, Motilal Banarsidass, Delhi.
3. Cotton, F.A., Wilkinson, G.W., Advanced Inorganic Chemistry, John- Wiley and Sons.
4. Huheey J.E., Keiter E.A., Keiter, R.L., Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India.
5. Douglas, B.E., McDaniel D.H, Alexander J.J., Concepts and Models of Inorganic Chemistry, John Wiley.
6. Das, A.K. Das, M., Fundamental concepts of Inorganic Chemistry, CBS publishers and distributors.
7. Miessler G.L., Tarr, D.A., Inorganic Chemistry, Pearson Education.
8. Wilkinson, G., Comprehensive Coordination Chemistry, Pergamon Press.
9. Sharpe, A.G., Modern Aspect of Inorganic Chemistry. Routledge and Kegan Paul PLC
10. Lever, A.B.P., Inorganic Electronic Spectroscopy, Elsevier.
11. Hollas, J.M., Modern Spectroscopy, John Wiley.
12. Chang R., Basic Principles of Spectroscopy, Mc Graw Hill.
13. Gupta, B.D., Basic Organometallic Chemistry: Concepts, Syntheses and Applications Paperback, Universities Press.
14. Bajpai, D.N., Advanced Physical Chemistry, S. Chand and Company Ltd.
15. Cotton F.A., Chemical Applications of Group Theory, John Wiley & Sons.

Suggested equivalent online courses and Web Sources:

- https://archive.nptel.ac.in/course.html
- https://ugcmoocs.inflibnet.ac.in/index.php/courses/moocs
- https://swayam.gov.in/explorer

Part D-Assessment and Evaluation

Maximum Marks: 100

Internal Assessment (CCE): 40

External Assessment (UE): 60

	Internal Assessment	
	Continuous and Cumulative Evaluation (CCE) Methods will be based on the following defined components:	**Marks**
a.	**Class Tests**	
b.	**Presentation/ Assignment/ Quiz/ Group Discussion**	
c.	**Appropriate weightage of attendance in the Class**	
	Total	**40**
	External Assessment	
	Theory Paper as per University Examination	
	Total	**60**
	Grand Total	**100**

For 2-Year PG Programme
(Scheme B-1)
With Major Practicum Component

CHEMISTRY-CORE (PRACTICUM) SYLLABUS
M.Sc. I Semester

Part A: Introduction				
Program: 2-Year PG		**Class-M.Sc.**	**Semester-I**	**Session:2025-26**
Subject– Chemistry				
1	**Course Code**	**PC-11**		
2	**Course Title**	**Advanced Organic Chemistry**		
3	**Course Type**	**PRACTICUM Course**		
4	**Course Learning Outcomes (CLO)**	**Upon successful completion of this Course, learners will be able to:** ➢ Describe the theoretical principles and fundamental concepts underlying organic and inorganic laboratory experiments. ➢ Apply laboratory skills to perform single-step, two-step, and three-step synthetic preparations in organic and inorganic chemistry. ➢ Discuss aromatic substitution and other key organic reactions; predict products and intermediates, and explain reaction types and mechanisms. ➢ Identify and analyze the products obtained through various experimental techniques; demonstrate effective purification and recrystallization strategies. ➢ Interpret spectroscopic and chromatographic data to characterize compounds and propose structures; apply green chemistry principles in practical synthesis.		
5	**Credit Value**	**Practical–04**		
6	**Total Marks**	**Maximum Marks: Total 100** **University Exam (UE)-60, CCE-40**		**Minimum Passing Marks: 40**

Part B: Content of the course	
Total No. of Lectures- Tutorials-Practical (08 hours per week): **L-T-P: 0-0-120 (Total Hours)**	
A. Assignments/Practice/ Survey/Fieldwork	**No. of Hours: 120**
B. List of Experiments to be performed in laboratory	

1. Qualitative analysis of binary/ ternary mixture of organic compounds.
2. Determination of phenol/ Aniline by Bromination method.
3. Preparation of β- Benzoyl propionic acid-A Friedel-Crafts Reaction.
4. Nitration of Salicylic acid using Calcium nitrate as nitrating agent (Green Chemistry Approach): Electrophilic aromatic substitution.
5. Bromination of Acetanilide using KBr and Ceric Ammonium Nitrate (CAN) - A green procedure to demonstrate Electrophilic Aromatic Substitution Reaction.
6. Preparation of Dibenzalacetone: A Claisen reaction.
7. Preparation of Anthraquinone (Oxidation).
8. Preparation of Phenyl-azo-β-naphthol: A Diazotisation/Coupling reaction.
9. Preparation of p-Chloronitrotoluene (Sandmeyer Reaction).
10. Preparation of 1,1-bis-2-naphthol using ferric chloride, considering green procedure: Radical coupling reaction.
11. Three step preparations such as-Benzilic acid from Benzaldehyde, Hydantoin from Glycine, m-Nitro aniline from Benzene, Picric acid from Chlorobenzene, and p-Chloro benzoic acid from p-Toluidine.
12. Other experiments based on – Organic concepts and reactions, *viz.* Oxidation, Reduction, Bromination, Nitration, Condensation, and Rearrangements etc.
13. Preparation of Benzilic acid from Benzil.

    (Benzil → Benzilic acid - benzilic acid rearrangement)
14. Preparation of *m*-nitroaniline from benzene.

    (Benzene → Nitrobenzene → m-Nitroaniline)
15. Preparation of picric acid from chlorobenzene.

    (Chlorobenzene → Phenol → 2,4,6-Trinitrophenol (Picric acid))
16. Preparation of Benzidine from benzene.

    (Benzene → Nitrobenzene → Hydrazobenzene → Benzidine (Benzidine rearrangement))
17. Preparation of *p*-Chlorotoluene (Sandmeyer reaction).

    (Toluene → p-Toluidine → p-Tolyl diazonium chloride → p-Chlorotoluene (Sandmeyer reaction))
18. Preparation of α–nitronaphthalene from naphthalene.

    (Naphthalene → α–Nitronaphthalene - electrophilic aromatic substitution)
19. Preparation of sym. Benzyl thiouronium chloride from thiourea.

    (Thiourea + Benzyl chloride → sym. Benzyl thiouronium chloride - nucleophilic substitution)

Part C-Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

Books

1. Ahluwalia, V.K., Aggarwal, R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.
2. Vogel, A.I., Quantitative Organic Analysis, Pearson.
3. Singh, J., Singh, R.K.P., Singh, J., Yadav, L.D.S., Siddiqui, I.R., Shrivastava, J., Advanced Practical Chemistry, Pragati Prakashan, Meerut.
4. Mendham, J., Vogel's Quantitative Chemical Analysis, Pearson Education.
5. Vogel, A.I., Vogel's Textbook of Practical Organic Chemistry, Pearson Education.
6. Mann, F.G., Saunders, B.C., Practical Organic Chemistry, Pearson.

Suggested equivalent online courses and Web Sources:

- https://archive.nptel.ac.in/course.html
- https://ugcmoocs.inflibnet.ac.in/index.php/courses/moocs
- https://swayam.gov.in/explorer

Part D-Assessment and Evaluation

Maximum Marks: 100
Internal Assessment (CCE): 40
External Assessment (UE): 60

Internal Assessment

	Continuous and Cumulative Evaluation (CCE) Methods will be based on the following defined components:	Marks
a.	Class/ Laboratory Practical Tests	
b.	Seminar/ Demonstration/ Viva voce/ Lab Record etc.	
c.	Appropriate weightage of attendance in the Class	
	Total	40

External Assessment

	Practicum Paper as per University Examination	
	Total	60

Grand Total

100

For 2-Year PG Programme
(Scheme B-1)
With Major Practicum Component

CHEMISTRY-CORE (PRACTICUM) SYLLABUS
M.Sc. I Semester

Program: 2-Year PG		Class-M.Sc.	Semester-I	Session:2025-26
Subject– Chemistry				
1	Course Code	PC-12		
2	Course Title	Advanced Inorganic Chemistry		
3	Course Type	PRACTICUM Course		
4	Course Learning Outcomes (CLO)	Upon successful completion of this Course, learners will be able to: ➢ Describe the theoretical principles and concepts related to experiments. ➢ Apply laboratory skills in organic and Inorganic chemistry in carrying out single/ two-step/ three-step preparations. ➢ Discuss aromatic substitution reactions and predict the products/ intermediates, and explain the type of reactions and mechanisms. ➢ Identify and analyze the product obtained by different techniques. ➢ Demonstrate purification/ recrystallization strategies. ➢ Gain the knowledge of preparing complexes/ organometallic/ inorganic compounds, prediction of products and their applications. ➢ Understand basic principles of spectroscopy and demonstrate applications of various spectroscopic techniques. ➢ Propose structures using spectroscopic data. ➢ Develop a correlation between the symmetry concept of molecules and with spectral properties. ➢ Perform experiments, analyse and interpret the experimental results.		
5	Credit Value	Practical–04		
6	Total Marks	Maximum Marks: Total 100 University Exam (UE)-60, CCE-40		Minimum Passing Marks: 40

Total No. of Lectures- Tutorials-Practical (08 hours per week): L-T-P: 0-0-120 (Total Hours)	
A. Assignments/Practice/ Survey/Fieldwork	No. of Hours: 120
B. List of Experiments to be performed in laboratory	

1. Preparation of Potassium tris(oxalate)chromate(II).
2. Preparation of Hexaammine cobalt (III) chloride $[Co(NH_3)_6]Cl_3$.
3. Preparation of metal acetylacetonate complexes, *e.g.*, $Mn(acac)_2$ and $Ni(acac)_2$.
4. Preparation of Metal/ Ethylene diamine complexes.
5. Preparation of Sodium hexanitritocobaltate (III), $Na_3[Co(NO_2)_6]$.
6. Synthesis of Fe_3O_4 (Magnetite) Nanoparticles *via* Coprecipitation Method.
7. Coprecipitation of Ferrite Nanoparticles (e.g., $NiFe_2O_4$ or $CoFe_2O_4$).
8. Synthesis of metal-doped nano ferrites, *e.g.*, Fe_3O_4: Ni/Cu by the co-precipitation method.
9. Preparation of Prussian blue compound and determination of magnetic moments.
10. Identification of metal ions present in the given compounds and calculation of retention factor (Rf) values by paper/TLC chromatography.
11. Determination of Ni^{2+} in an unknown chemical mixture using complexometric titration.
12. Determination of Nickel by extractive spectrophotometric method/ colorimetric method.
13. Determination of stoichiometry and stability constant of inorganic complexes by Job's method.

Part C: Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

Books

1. Mendham, J., Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education.
2. Svehla, G., Vogel's Qualitative Inorganic Analysis, Pearson Education.
3. Levie, D., Quantitative Chemical Analysis, Tata McGraw-Hill.
4. Vogel, A.I., A Textbook of Quantitative Inorganic Analysis, Longman.
5. Schoder, W.R., Powell, A.R., Analysis of Minerals and Ores of Rare Elements, Kessinger Publishing.
6. Kolthoff, I.M., Sanderson, E.M., Quantitative Chemical Analysis, Macmillan.
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Suggested equivalent online courses and Web Sources:

- https://archive.nptel.ac.in/course.html
- https://ugcmoocs.inflibnet.ac.in/index.php/courses/moocs
- https://swayam.gov.in/explorer

Maximum Marks: 100
Internal Assessment (CCE): 40
External Assessment (UE): 60

	Continuous and Cumulative Evaluation (CCE) Methods will be based on the following defined components:	Marks
a.	Class/ Laboratory Practical Tests	
b.	Seminar/ Demonstration/ Viva voce/ Lab Record etc.	
c.	Appropriate weightage of attendance in the Class	
	Total	40
	Practicum Paper as per University Examination	
	Total	60