Scheme for M.Sc. Chemistry NEP 2020

For 2 Year PG programme

First Year

Scheme for M.Sc. Chemistry NEP 2020

For 2 Year PG programme

Scheme sem-1: (For the course of science having major practicum components)

M.Sc. Chemistry I Semester

S.No	Course Code	Course Name	Total Mark	Credit (s)	End Semester Exam Marks		Internal Marks	
					Max	Min.	Max	Min.
1.	MCH2-511	Advance Organic Chemistry	100	6	60	24	40	16
2.	MCH2-512	Advance Inorganic Chemistry	100	6	60	24	40	16
3.	MCH2-513	Practical - I	100	4	60	24	40	16
4.	MCH2-514	Practical – II	100	4	60	24	40	16
5.	MCH2-515	Internship/Seminar/Field Project	100	2	-	-	100	40
		Grand Total	500	22				

BRANCH	Subject	Subject Code
M.Sc. (Chemistry)	**Advance Organic Chemistry**	**MCH2-511**

Course learning outcomes (CLO):-

1. Explain the concept of aro antiaromatic, nonarohe structural features an and differentiate between aromatic, homoaromatic compounds using copic data.
2. Apply the annulenes, nterpret aromatic character in systems like and crown ether complexes of Demens mechanisms of major condensation reactions such as en, Mannich, Perkin, and Stobbe, etc, highlighting the role intermediates.
3. the stability and reactivity of Free radicals and describe their ehavior in reactions like allylic halogenation, Sandmeyer, and Hunsdiecker transformations
4. Interpret reaction mechanisms through energy diagrams, transition states, and isotope effects, relate structural effects to reactivity using Hammett and Taft correlations.
5. Classify pericyclic reactions and predict their stereochemical outcomes based on orbital symmetry principles and the Woodward-Hoffmann rules
6. Describe the mechanisms and applications of photochemical reactions such as Paterno-Büchi, di-z methane rearrangement, and photo-Fries rearrangement in organic synthesis

Unit-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 benozoid and non benzoide compounds, Antiaromatic compounds, Homoaromatic compounds, PMO approach, Annulenes,metalocenes, Crown ether complexes and cryptates

Unit-2

Free radical reactions:

Structure, stability and geometry, and properties of Free radicals. Free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance, reactivity for aliphatic and aromatic substrates at a bridgebead, reactivity in the attacking radicals, the effect of solvent on the reactivity.

Name Reactions:

Birch Reduction, Nef reaction, Houveault-Blanc reaction, Chichibabin, Mannich reaction, Meerwein-Ponndorf-Verley reduction, Oppherneur oxidation, Curtius reaction, Claisen Schmidt reaction, Sharples-epoxidation, Pechman reaction, Aldol condensation, mannich reaction, Benzoin condensation, Perkin reaction Sandreyer's and hundecker reaction

Unit-3

Reaction Mechanism:-Structure and reactivity : Types of reaction mechanism thermodynamics and kinetic requirements kinetic thermodynamic control curtin-Hammet Principle. Potential energy diagrams, transitionates and intermediates, method of determining the mechanism and isotope effects. Generation structure stability and reactivity of carbocations carbonates free radicals, carbene and nitrenes.

Effect of structure on reactivity-resonance and field effects quantitative treatment. The hammet equation and linear free energy relationships substituent and reaction constant.

Unit-4

Pericyclic Reactions

Molecular orbital symmetry, Funnies ontstals of ethylene, 1.3-butadiene 1,3,5-hexatriene and allyl systems. Classificance of pericyclic action Woodward-Hollmans correlation diagrams. FMO and PMO approach 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 cyclo additions and chelectropic reaction 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

Unit-5

Photochemical Reactions:

Photochemistry of alkenes reaction, di-pi methane Barton reaction, Photoch polymers Compounds, Patermo-Buchi Photo-Fries rearrangement, mation of smog, Photodegradation of vision

BRANCH	Subject	Subject Code
M.Sc. (Chemistry)	Inorganic chemistry	MCH2-512

Unit 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'-d states), Selection rule for electronic spectroscopy. Intensity of various types of electronic transitions. Calculations of 10Dq, B and ß 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.

Unit 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 ds-pa 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.

Unit-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 B-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

Unit-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 x-Complexes

Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation Bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and tertiary phosphine as ligands.

Unit 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 Raman active molecular vibrations of different molecules

BRANCH	Subject	Subject Code
M.Sc. (Chemistry)	**Practical – I**	**MCH2-513**

Course learning outcomes (CLO):-

1. Describe the theoretical Principles and fundamental concepts underlying organic and inorganic
2. Apply laboratory skills to perform single-step, two-step, and three-organic and inorganic chemistry.
3. Discuss aromatic substitution and other key organic reaction predict products and intermediates and explain reaction types mechanism.
4. Identify and analyse the products obtained through various experimental techniques demonstrate effective purification and recrystallization Strategies.
5. step synthetic and other key organic reactions, Anediates, and explain reaction types and
6. Discuss arom predict prod
7. Identify analyze the products obtained through various techniques, demonstrate effective purification and ration strategies.
8. Interpret spectroscopic and chromatographic data to characterize mpounds and propose structures, apply green chemistry principles in practical synthesis.

List of practical

1. Qualitative analysis of binary/ ternary misture of organic compounds.

2. Determination of phenol Aniline by Bromination method

3. Preparation of B- Benzoyl propionic acid-A Friedel-Crafts Reaction

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-aro-f-naphthol: A Diazotisation/Coupling react

9. Preparation of p-Chloronitrotoluene (Sandmeyer Reaction)

10. Preparation of 1,1-bis-2-naphthol using ferric chloride, procedure: Radical coupling reaction

11. Three step preparations such as-Benzilic acid from Benza from Glycine, m-Nitro aniline from Benzene, Picric a and p-Chloro benzoic acid from p-Toluidine. 12. Other experiments based on-Organic concepts Morobenzene, ions, viz. Oxidation, Reduction, Bromination, Nitration, Conder

13. Preparation of Benzilic acid from Ben(Benzil Benzilic acid-benzilic Higher)

14. Preparation of m-nitroaniline of (Benzene Nitrobenzene aniline

15. Preparation of picric (Chlorobenzene lorobenzene 2.4.6-Trinitrophenol (Picric acid))

16. Preparation of benzidine from benzene (Benzene Fear from benzene benzene Hydrazobenzene Benzidine (Benzidine

17. Prepration of p-Chlorotoluene (Sandmeyer reaction) p-Toluidine-p-Tolyl diazontum chloride-p-Chlorotoluene reaction))

18)Preparation of a-nitronaphthalene from naphthalene. (Naphthalenea-Nitromaphthalene electrophilic aromatic subanturia)

19. Preparation of sym. Benzyl thiouronium chloride from thioures (Thiourea Benzyl chloride mucleophilic substitution) tym. Benzyl thiouronium chloride

BRANCH	Subject	Subject Code
M.Sc. (Chemistry)	**Practical – II**	**MCH2-514**

Course learning outcomes (CLO):-

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

1. Describe the theoretical experiments. concepts related to experiments.
2. Apply laboratory skills in organic and inorganic chemistry carrying out single two step/Three step preparation.
3. Discuss aromatic substitution reaction and predict the products/intermediate and explain the type of reactions and mechanisms.
4. Identify and analyze the product obtained by different techniques.
5. Demonstrate purification/ recrystallization strategies.
6. Gain the knowledge of preparing complexes/ organometallic/ Inorganic compounds, prediction of products and their applications.
7. Understand basic principles of spectroscopic techniques.
8. Propose structures using spectroscopic data.
9. Develop a correlation between the symmetry concept of molecules with spectral properties..

List of Practical

1. Preparation of Potassium tris(oxalate)chromate(II).

2. Preparation of Hexaammine cobalt (III) chloride [Co(NH3)Cl

3. Preparation of metal acetylacetonate complexes, eg., Mn(acac), and Ni(acac)

4. Preparation of Metal/ Ethylene diamine complexes.

5. Preparation of Sodium hexanitritocobaltate (III), Na,[Co(NO_2)%)

6. Synthesis of Fe:O. (Magnetite) Nanoparticles via Coprecipitation Method.

7. Coprecipitation of Ferrite Nanoparticles (eg, NiFeO, or CoFe:O4).

8. Synthesis of metal-doped nano ferrites, eg, Fe,O Ni/Cu by precipitation method.

9. Preparation of Prussian blue compound and determination of magh moments.

10. Identification of metal ions present in the given compounds and of retention factor (Rf) values by paper/TLC chromatography

11. Determination of Ni" in an unknown chemical mixture titration. plexometric

12. Determination of Nickel by extractive colorimetric method. Metric method/

13. Determination of stoichiometry and complexes by Job's method.

BRANCH	Subject	Subject Code
M.Sc. (Chemistry)	**Internship/Seminar/Field Project**	MCH2-515

Project /Dissertation work (Six weeks) in the form of small thesis based upon the topic related to the M.Sc. Chemistry syllabus . The topics of the dissertation with synopsis will be decided by the

Departmental Research Advisory Committee (DRAC).