**Department of Chemistry and Chemical Sciences**
**CENTRAL UNIVERSITY OF JAMMU**
**Rahya-Suchani (Bagla), District-Samba,**
**Jammu-181143, (J&K) India**

**Five-Year Integrated M.Sc Chemistry**
**Teaching Plan (February, 2021- June, 2021)**

**Semester: VIII**
**Course: Group Theory, Transition Metal Chemistry and Photochemistry(ICCHM8C001T)**
**Course Teacher: Dr. Mousumi Pal**

| Week | Lecture No/Day | Topic to be taught | No of Hour | Suggested Reading |
|---|---|---|---|---|
| 1st Week | I | Introduction of symmetry and group theory in Chemistry: The Concept of group, sub-group, point symmetry group | 1 | 1,2 |
| | II | Symmetry elements and symmetry operations | 1 | 2, 4, 5, 8 |
| | III | Contd. | 1 | 2, 4, 5, 8 |
| | IV | Assignments of point groups to inorganic molecule | 1 | 2, 4 |
| 2nd Week | I | Some general rules for multiplication of symmetry operations | 1 | 2 |
| | II | Multiplication table for water and ammonia | 1 | 2 |
| | III | Contd. | 1 | 2 |
| | IV | Representations(matrices, matrix ) | 1 | 1,2 |
| 3rd Week | I | Representation $C_{2V}$ and $C_{3V}$ point groups irreducible representations | 1 | 1,2 |
| | II | Schonfilies symbols, conjugacy relation and classes | 1 | 1,2 |
| | III | Character and character tables for $C_{2V}$ point groups | 1 | 1,2,4 |
| | IV | Character and character tables for $C_{3V}$ point groups | | |
| 4th Week | I | Orthogonality theorm (without derivation), | 1 | 1,2 |
| | II | Application of group theory to chemical bonding (hybrid orbitals for sigma bonding in different geometries and hybrid orbitals for π-bonding) | | 1,2 |
| | III | Symmetries of molecular orbitals in $BF_3$, $C_2H_4$ and $H_2O$ | 1 | 2,4, 8,9 |
| | IV | Introduction of electronic Spectra of transition metal complexes: Important features of transition metal electronic spectra-Band intensities | 1 | 6, 7, 10, 11 |
| 5th Week | I | Band energy, band width and sets, | 1 | 2, 10, 11 |
| | II | Group theoretical approach to selection rule | 1 | 2, 10, 11 |
| | III | Effect of distortion and spin-orbit coupling on spectra (3d, 4d, and 5d transition series complexes) | 1 | 2, 10, 11 |
| | IV | Contd… | 1 | 2, 10, 11 |
| 6th Week | I | Spectrochemical and nephelauxetic series | 1 | 10,11 |
| | II | Charge transfer spectra | 1 | 10,11 |
| | III | Spectroscopic ground state, | 1 | 2, 10, 11 |
| | IV | Orgel and Tanabe-Sugano diagram for transition metal complexes ($d^1$ to $d^9$ systems) | 1 | 2, 10, 11 |
| 7th Week | I | Calculation of Dq, B and beta parameters, | 1 | 6,7, 10,11 |
| | II | Jahn Teller effect | 1 | 6,7, 10,11 |
| | III | Electronic spectra of $[Ru(bipy)_3]^{2+}$ | 1 | 11 |

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| | **IV** | Introduction to Reagents in Inorganic Chemistry<br>Chelation | 1 | 13,14 |
| **8th Week** | **I** | Factors determining the stability of the chelates (effect of ring size, oxidation state of the metal, coordination number of the metal) | 1 | 13,14 |
| | **II** | Contd. | 1 | 13,14 |
| | **III** | Use of the following reagents in analytical chemistry and chemotherapy: Grignard's reagents, Tollen's reagent | 1 | 13-16 |
| | **IV** | Lucas Reagent, Fenton's reagent, Collman's reagent | 1 | 13-16 |
| **9th Week** | **I** | Dimethylglyoxime, EDTA, | 1 | 13-16 |
| | **II** | 8-Hydroxyquinoline, 1,10-Phenanthroline , | 1 | 13-16 |
| | **III** | Thiosemicarbazone, Diathiazone | 1 | 13-16 |
| | **IV** | Basics concept on principle and charge transfer of photochemistry: Absorption, Excitation | 1 | 12, 17 |
| **10th Week** | **I** | Photochemical laws, Quantum yield | 1 | 12, 17 |
| | **II** | Absorption and emission for complexes with different ground state/excited state for $ML_6$ complexes | 1 | 12, 17 |
| | **III** | Contd. | 1 | 12, 17 |
| | **IV** | Potential energy function and energy levels for $ML_6$ complexes, | 1 | 12, 17 |
| **11th Week** | **I** | Photolysis rules, Flash photolysis | 1 | 12, 17 |
| | **II** | Stopped flow techniques, Franck-Condon principle | 1 | 12, 17 |
| | **III** | Photochemical stages-primary and secondary processes, | 1 | 12, 17 |
| | **IV** | Jablonski diagram for photochemical process | 1 | 12, 17 |
| **12th Week** | **I** | Charge transfer photochemistry:<br>Introduction, charge transfer absorption spectra, | 1 | 12, 17 |
| | **II** | Types of charge transfer excitation and their energy level scheme for charge transfer excitation | 1 | 12, 17 |
| | **III** | Contd. | 1 | 12, 17 |
| | **IV** | Types of reactions observed by charge transfer metal complexes | 1 | 12, 17 |
| **13th Week** | **I** | Basic concept on ligand field photochemistry of transition metal complexes:<br>Photochemistry of Cr(III)complexes: Photo substitutions, | 1 | 12, 17 |
| | **II** | Properties of ligand field excited states | 1 | 12, 17 |
| | **III** | Photo aquation reaction, Photolysis rule | 1 | 12, 17 |
| | **IV** | Photoisomerization, Photo racemization | 1 | 12, 17 |
| **14th Week** | **I** | Photoanation Reactions, sensitizer, Electron transfer process, | 1 | 12, 17 |
| | **II** | Mechanism of photosensitization, photo reactive excited state | 1 | 12, 17 |
| | **III** | The doublet hypothesis, Role of quartet excited states | 1 | 12, 17 |
| | **IV** | Photophysics and photochemistry of ruthenium polypyridyl complexes, | 1 | 12, 17 |
| **15th Week** | **I** | Photo redox properties of Ce(III) and Ce(IV) complexes | 1 | 12, 17 |
| | **II** | Photochemistry of Cu(II) (1,3-diketone) complexes | 1 | 12, 17 |
| | **III** | Ligand-field Photo chemistry of compounds with metal-metal bonding, | 1 | 12, 17 |
| | **IV** | Reineck's salt chemical actinometer | 1 | 12, 17 |

**References:**


1. D. M. Bishop, *GroupTheory and Chemistry*, RevisedEd., DoverPublications, 1993**.**
2. F.A. Cotton, *Chemical Applications of Group Theory,* 3rd Revised Ed.,Wiley-Blackwell,1990.
3. G. M .Barrow, *Introduction to Molecular Spectroscopy*, McGraw-HillInc.,US,1962.
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5. H.H. Jaffeand M. Orchin, *Symmetry in Chemistry*, Dover Publications,2002.
6. D. C. Harris and M. D. Bertolucchi, *Symmetry and Spectroscopy: An introduction to Vibrational and Electronic spectroscopy*, DoverPublications,1990
7. K.V.Reddy, *Symmetry and Spectroscopy of Molecules*, NewAgeInternational,2009.
8. K. Bansal, *Group Theory and Symmetry in Chemistry*, 1st Ed., Campus Books International, 2006.
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10. A.B.P. Lever, *Inorganic Electronic Spectroscopy*, Elsevier, Amsterdam, Oxford, NewYork, 1984.
11. I. B. Bersuker, *Electronic Structure and Properties of Transition Metal Compounds: Introduction to the Theory*, 2ndEd., John Wiley & Sons,2010
12. A.W. Adamson and P.D. Fleischauer, *Concepts of Inorganic Photochemistry*, John Wiley &Sons, NewYork,1975
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14. D. Farrusseng, *Metal-OrganicFrameworks*, Wiley, 2011.
15. L. R. MacGillivray, *Metal-Organi cFrameworks: Design and Application*,Wiley, 2010.
16. B.Chenand G. Qian, Metal-OrganicFrameworks for Photonics Applications, Springer, 2014.
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## Five-year Integrated M.Sc. Chemistry
## Teaching Plan (Feb 2021-June 2021)

Semester: VIII
Course: Group Theory and Spectroscopy (ICCHM8C002T)
Course Teacher: Dr. Tapta Kanchan Roy

| Week | Lecture No./Day | Topic to be Taught | No of Hours | Suggested Readings |
|---|---|---|---|---|
| 1st Week | I | Introduction to spectroscopy | 1 | 1, 2 |
| | II | Basics of rotational spectroscopy | 1 | 1, 2 |
| | III | Classification of rotors, Diatomic and linear polyatomic molecules, Transition frequencies or wave numbers | 1 | 1, 2 |
| | IV | Rotational energy levels of polyatomic molecules, Intensities, Centrifugal distortion | 1 | 1, 2 |
| 2nd Week | I | Symmetric rotor molecules, Stark effect in diatomic, linear and symmetric rotor molecules | 1 | 1, 2, 3 |
| | II | Asymmetric rotor molecules, Spherical rotor molecules. | 1 | 1, 2, 3 |
| | III | Introduction to RAMAN spectroscopy and basics of Rotational Raman spectroscopy | 1 | 1, 2, 3 |
| | IV | Theory of rotational Raman scattering | 1 | 1, 2, 3 |
| 3rd Week | I | Rotational Raman spectra of diatomic and linear polyatomic molecules | 1 | 1, 2, 3 |
| | II | Rotational Raman spectra of symmetric and asymmetric rotor molecules | 1 | 1, 2, 3 |
| | III | Structure determination from rotational constants. | 1 | 1, 2, 3 |
| | IV | Numerical | 1 | 1, 2, 3 |
| 4th Week | I | Introduction of vibrational spectroscopy | 1 | 1, 2, 3 |
| | II | Diatomic molecules, Infrared spectra | 1 | 1, 2, 3 |
| | III | Raman spectra, Anharmonicity | 1 | 1, 2, 3 |
| | IV | Vibration–rotation spectroscopy and spectral branches, Polyatomic molecules | 1 | 1, 2, 3, 8 |
| 5th Week | I | Normal modes and vibrations of polyatomic molecules | 1 | 1, 2, 3, 8 |
| | II | Group vibrations, Number of normal vibrations of each symmetry species | 1 | 1, 2, 3, 8 |
| | III | Vibrational selection rules for IR spectra, | 1 | 1, 2, 3, 8 |
| | IV | Vibrational selection rules for RAMAN spectra, Exclusion principle | 1 | 1, 2, 3, 8 |
| 6th Week | I | Anharmonicity | 1 | 1, 2, 3, 8 |
| | II | potential energy surfaces. | 1 | 1, 2, 3, 8 |
| | III | Numerical | 1 | 1, 2, 3, 8 |
| | IV | Class test-I | 1 | 1, 2, 3, 8 |
| 7th Week | I | Introduction to electronic spectroscopy | 1 | 1, 2, 3, 8 |
| | II | Basics of Atomic spectroscopy, Electronic angular | 1 | 1, 2, 3, 8 |

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| | III | Term symbol | 1 | 1, 2, 3, 8 |
| | IV | Photoelectron spectroscopy, Electronic spectroscopy of diatomic molecules | 1 | 1, 2, 3, 8 |
| 8th Week | I | Franck-Condon principle, Selection rules | 1 | 1, 2, 3, 8 |
| | II | Mid term exam | 1 | 1, 2, 3, 8 |
| | III | Walsh diagram and molecular geometry | 1 | 1, 2, 3, 8 |
| | IV | The electronic spectra of polyatomic molecules, *d–d* transitions, Charge-transfer transitions, $\pi^* \leftarrow \pi$ and $\pi^* \leftarrow n$ transitions, | 1 | 1, 2, 3, 8 |
| 9th Week | I | Resonance Raman transitions and application, Radiative and non-radiative decay-internal conversion and intersystem crossing | 1 | 1, 2, 3, 8 |
| | II | Fluorescence and phosphorescence, Jablonski diagram | 1 | 1, 2, 3, 8 |
| | III | Principles of Laser and its applications. | 1 | 1, 2, 3, 8 |
| | IV | Numerical | 1 | 1, 2, 3, 8 |
| 10th Week | I | Introduction to group theory | 1 | 1, 4, 5, 6, 7 |
| | II | Definition of group, Subgroup, Relation between order of a finite group and its sub-group, classes | 1 | 4, 5, 6, 7 |
| | III | Contd. | 1 | 4, 5, 6, 7 |
| | IV | Contd., Numerical | 1 | 4, 5, 6, 7 |
| 11th Week | I | Point symmetry group, Symmetry classification of molecules with examples | 1 | 4, 5, 6, 7 |
| | II | Contd. | 1 | 4, 5, 6, 7 |
| | III | Contd. | 1 | 4, 5, 6, 7 |
| | IV | Elements of group theory: Dipole moment and optical isomerism. | 1 | 4, 5, 6, 7 |
| 12th Week | I | Representation of groups by matrices, Character of the representation | 1 | 1, 4, 5, 6, 7 |
| | II | Reducible and irreducible representations | 1 | 1, 4, 5, 6, 7 |
| | III | Contd. | 1 | 1,4, 5, 6, 7 |
| | IV | The great orthogonality theorem (without proof) and its importance, | 1 | 4, 5 |
| 13th Week | I | Construction of character tables and their applications | 1 | 4, 5, 6, 7 |
| | II | Contd. | 1 | 4, 5, 6, 7 |
| | III | Class test-II | 1 | 4, 5, 6, 7 |
| | IV | Determination of IR/RAMAN active modes of molecular vibrations | 1 | 4, 5, 6, 7 |
| 14th Week | I | Contd. | 1 | 4, 5, 6, 7 |
| | II | Contd. | 1 | 4, 5, 6, 7 |
| | III | Symmetry and molecular orbital theory. | 1 | 4, 5, 6, 7 |
| | IV | Contd. | 1 | 4, 5, 6, 7 |
| 15th Week | I | Contd. | 1 | 4, 5, 6, 7 |
| | II | Tutorials | 1 | 4, 5, 6, 7 |
| | III | Problem solving | 1 | 4, 5, 6, 7 |
| | IV | Problem solving | 1 | 4, 5, 6, 7 |

## REFERENCES

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2. C. Banwell and E. McCash, *An Introduction to Molecular Spectroscopy*, McGraw Hill college, 5thEd., 2013.
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**Five-year Integrated M.Sc. Chemistry**
**Teaching Plan (Jan 2021-July 2021)**

Semester: VIII
Course: Organic Synthesis and Reaction Mechanism (ICCHM8E001T)
Course Teacher: Dr. Princy Gupta

| Week | Lecture No./Day | Topic to be Taught | No of Hours | Suggested Readings |
|---|---|---|---|---|
| 1st Week | I | **Aliphatic nucleophilic substitution:** SN1, SN2, Reactivity, Structural and solvent effects, Stereochemical aspects, | 1 | 1, 2, 3, 4 |
| | II | SNi and SET mechanisms, Reactivity, Structural and solvent effects, Stereochemical aspects, | 1 | 1, 2, 3, 4 |
| | III | The neighboring group mechanism, Substitution in norbornyl and bridge-head systems, | 1 | 1, 2, 3, 4 |
| | IV | Substitution at benzylic, allylic and vinylic carbons, Substitution at *sp*2 carbons, | 1 | 1, 2, 3, 4 |
| 2nd Week | I | Alkylation and acylation of amines, Alkylation and acylation of active methylene compounds, | 1 | 1, 2, 3, 4 |
| | II | Hydrolysis of esters | 1 | 1, 2, 3, 4 |
| | III | Claisen and Dieckmann condensation | 1 | 1, 2, 3, 4 |
| | IV | **Aromatic nucleophilic substitution:** SNAr via Meisenheimer complex | 1 | 1, 2, 3, 4 |
| 3rd Week | I | Benzyne and SRN1 mechanisms, Reactivity, | 1 | 1, 2, 3, 4 |
| | II | Cine substitution, Chichibabin reaction. | 1 | 1, 2, 3, 4 |
| | III | **Electrophilic substitution**: SE1, SE2 and SEi Mechanisms, Aromatic electrophilic substitution via Wheland intermediates, | 1 | 1, 2, 3, 4 |
| | IV | Orientation and reactivity, Ortho effect, Substitution of $H^+$ versus ipsosubstitution, | 1 | 1, 2, 3, 4 |
| 4th Week | I | Ar-Halogen, Ar-$SO_3H$ | 1 | 1, 2, 3, 4 |
| | II | Ar-$NO_2$ bond formation, Diazonium coupling, | 1 | 1, 2, 3, 4 |
| | III | Friedel-Crafts related reactions and Vilsmeier-Haack. | 1 | 1, 2, 3, 4 |
| | IV | **Addition reactions:** Addition to C-C multiple bonds, Electrophilic, nucleophilic and free radical addition, Mechanisms | 1 | 1, 2, 3, 4 |
| 5th Week | I | Orientation and reactivity, Stereochemistry of addition reactions of alkenes: Bromine addition, | 1 | 1, 2, 3, 4 |
| | II | Hydrogen bromide addition, Catalytic hydrogenation | 1 | 1, 2, 3, 4 |
| | III | Hydroboration-oxidation, | 1 | 1, 2, 3, 4 |
| | IV | 1,2 and 1,4-additions of organometallic reagents (Mg, $R_2CuLi$ | 1 | 1, 2, 3, 4 |

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| 6th Week | I | Michael addition | 1 | 1, 2, 3, 4 |
| | II | Addition to C-heteroatom multiple bond | 1 | 1, 2, 3, 4 |
| | III | **Elimination reactions:** E1, E2 Mechanisms, Regioselectivity, Stereochemistry of elimination | 1 | 1, 2, 3, 4 |
| | IV | E1cB Mechanisms, Regioselectivity, Stereochemistry of elimination: | 1 | 1, 2, 3, 4 |
| 7th Week | I | Cyclic and acyclic systems, Bredt's rule, | 1 | 1, 2, 3, 4 |
| | II | Pyrolytic elimination, Chugaev reaction, Hofmann degradation, Shapiro reaction, Cope elimination | 1 | 1, 2, 3, 4 |
| | III | Competition between substitution and elimination | 1 | 1, 2, 3, 4 |
| | IV | **Molecular rearrangements:** Mechanism and stereochemical aspects of Pinacol-pinacolone, Demjanov rearrangements | 1 | 1, 2, 3, 4 |
| 8th Week | I | Wagner-Meerwein Pummerer rearrangements | 1 | 1, 2, 3, 4 |
| | II | Beckmann, Schmidt Hofmann rearrangements | 1 | 1, 2, 3, 4 |
| | III | Benzilbenzilic acid, Favorskii rearrangements | 1 | 1, 2, 3, 4 |
| | IV | Wolff, Fries, Stevens rearrangements | 1 | 1, 2, 3, 4 |
| 9th Week | I | Curtius, Lossen rearrangements | 1 | 1, 2, 3, 4 |
| | II | Baeyer-Villiger, Sommelet-Hauser rearrangements | 1 | 1, 2, 3, 4 |
| | III | Problems on rearrangement | 1 | 1, 5, 6, 7 |
| | IV | **Retrosynthetic analysis:** Disconnection approach, Synthons and synthetic equivalents | 1 | 5, 6 |
| 10th Week | I | Transform, Functional group interconversion, Umpolung, Chemo-, regio and stereoselectivities, | 1 | 5, 6 |
| | II | One group disconnection: Alcohols and carbonyl compounds | 1 | 5, 6 |
| | III | Two group disconnections: 1,2- difunctional compounds | 1 | 5, 6 |
| | IV | Two group disconnections: 1,3-difunctional compounds, | 1 | 5, 6 |
| 11th Week | I | Two group disconnections: 1,4-difunctional compounds, | 1 | 5, 6 |
| | II | Two group disconnections:1,5-difunctional compounds, | 1 | 5, 6 |
| | III | Two group disconnections: 1,6-difunctional compounds, | 1 | 5, 6 |
| | IV | Diels-Alder reactions | 1 | 5, 6 |
| 12th Week | I | Robinson annulation | 1 | 5, 6 |
| | II | Michael addition | 1 | 5, 6 |

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| | III | Retrosynthetic analysis of longifolene | 1 | 5, 6 |
| | IV | **Protecting groups in organic synthesis:** Importance, Protection and deprotection of hydroxyl groups | 1 | 7,8 |
| 13th Week | I | MOM, MTM, SMOM and THP ethers | 1 | 7,8 |
| | II | Silyl ethers (TMS, TES, TIPS, TBDMS and TBDPS ethers) | 1 | 7,8 |
| | III | Protection for 1,2- and 1,3-diols | 1 | 7,8 |
| | IV | Protection and deprotection of carbonyl compounds: Acyclic and cyclic acetals and ketals | 1 | 7,8 |
| 14th Week | I | monothio and dithioacetals and ketals | 1 | 7,8 |
| | II | Monoprotection of dicarbonyl compounds, | 1 | 7,8 |
| | III | Protection of amines, Boc, Cbz, PMB as protecting groups | 1 | 7,8 |
| | IV | Bn, Ac, Bz and Ts as protecting groups | 1 | 7,8 |
| 15th Week | I | Common protecting groups for carboxylic acids and thiols | 1 | 7,8 |
| | II | Contd. | 1 | 7,8 |
| | III | Revision of Unit I | 1 | |
| | IV | Revision of Unit II | 1 | |
| 16th Week | I | Revision of Unit III | 1 | |
| | II | Revision of Unit IV | 1 | |
| | III | Revision of Unit V, Discussion of model question papers | 1 | |
| | IV | Discussion of model question papers | 1 | |

**REFERENCES**

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**Five-year Integrated M.Sc. Chemistry**

**Teaching Plan (February 2021-June 2021)**

Semester: VIII
Course: **Organic Spectroscopy and Organometallics** (ICCHM8F001T)
Course Teacher: Dr. M. Karuppasamy

| Week | Lecture No./Day | Topic to be Taught | No of Hours | Suggested Readings |
|---|---|---|---|---|
| 1st Week | I | **UV-VIS spectroscopy**: Woodward-Fieser rules | 1 | 1-3 |
| | II | UV spectra of aromatic and heterocyclic compounds | 1 | 1-3 |
| | III | Contd. | 1 | 1-3 |
| | IV | Applications of UV-VIS spectroscopy in organic chemistry | 1 | 1-3 |
| 2nd Week | I | **IR Spectroscopy:** FT technique | 1 | 1-3 |
| | II | Characteristic functional group absorptions | 1 | 1-3 |
| | III | Factors influencing group frequencies, Hydrogen bonding, Overtones, Combination bands, Fermi Resonance | 1 | 1-3 |
| | IV | NIR spectroscopy | 1 | 1-3 |
| 3rd Week | I | **Optical rotatory dispersion and circular dichroism**: Introduction to theory and terminology, Cotton effect, ORD curves | 1 | 2 |
| | II | Axial haloketone rule and its applications, Octant rule | 1 | 2 |
| | III | Applications of ORD to determine absolute configuration of monocyclic ketones | 1 | 2 |
| | IV | Comparison between ORD and CD – their inter relationships | 1 | 2 |
| 4th Week | I | **NMR spectroscopy:** 1H-NMR: FT technique, Shielding, Chemical shift, Diamagnetic anisotropy | 1 | 1-3 |
| | II | Integration, Exchangeable hydrogens, Chemical equivalence, Magnetic equivalence | 1 | 1-3 |
| | III | Exchangeable hydrogens, Chemical equivalence, Magnetic equivalence | 1 | 1-3 |
| | IV | Spin coupling, Non-first order spectra, Spin systems (AB, AX, AB2, AX2, AMX, ABX, ABC etc.), | 1 | 1-3 |
| 5th Week | I | Geminal, Vicinal and Long range coupling, Coupling constants, | 1 | 1-3 |
| | II | Spin decoupling, Relaxations, Nuclear Overhauser effect, NMR shift reagents | 1 | 1-3 |
| | III | Variable temperature 1H-NMR, Coupling of proton with $^{13}C$, $^{19}F$, $^{31}P$ and $^{29}Si$ | 1 | 1-3 |
| | IV | $^{13}C$-NMR: Proton-decoupled and off-resonance, Chemical shifts | 1 | 1-3 |
| 6th Week | I | DEPT (45, 90 and 135) | 1 | 1-3 |
| | II | 2D NMR: Introduction, HOMOCOSY, HETCOR | 1 | 1-4 |

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| | III | HMQC, HMBC | 1 | 1-4 |
| | IV | INADEQUATE and NOESY | 1 | 1-4 |
| 7th Week | I | **Mass spectrometry:** Mass spectrometry, Principle, Basic instrumentation | 1 | 1-3 |
| | II | Ionization techniques – EI, CI, | 1 | 1-3 |
| | III | FD and FAB | 1 | 1-3 |
| | IV | Fragmentation, Molecular ion peak, Base peak | 1 | 1-3 |
| 8th Week | I | Metastable ions, Isotopes, Nitrogen rule | 1 | 1-3 |
| | II | McLafferty rearrangement, Retro Diels-Alder | 1 | 1-3 |
| | III | Characteristic fragmentation patterns of hydrocarbons, ethers, | 1 | 1-3 |
| | IV | alcohols, phenols, | 1 | 1-3 |
| 9th Week | I | ketones, aldehydes, | 1 | 1-3 |
| | II | carboxylic acids and amides | 1 | 1-3 |
| | III | HRMS, Introduction to ESI-MS | 1 | 1-3 |
| | IV | Introduction to MALDI-TOF | 1 | 1-3 |
| 10th Week | I-IV | **Applications of spectroscopic techniques**: Problems on the structural elucidation of organic compounds using UV, IR, NMR and Mass techniques. | 4 | 1-4 |
| 11th Week | I-IV | Contd. | 4 | 1-4 |
| 12th Week | I-IV | Contd. | 4 | 1-4 |
| 13th Week | I | **Organometallic reagents**: Organozinc and copper reagents: Preparation | 1 | 7-12 |
| | II | Functionalized zinc and copper reagents, Synthetic applications | 1 | 7-12 |
| | III | Gilman reagents, Reformatsky reaction, Simmons-Smith reaction | 1 | 7-12 |
| | IV | Contd. | 1 | 7-12 |
| 14th Week | I | Grignard and organolithium reagents in organic synthesis | 1 | 7-12 |
| | II | Contd. | 1 | 7-12 |
| | III | Organoboron reagents | 1 | 7-12 |
| | IV | Synthetic application of Sn and Si reagents | 1 | 7-12 |
| 15th Week | I | Wittig, Horner-Wadsworth-Emmons Reactions | 1 | 7-12 |
| | II | Cross-coupling reactions (Suzuki, Heck), Ring closing metathesis | 1 | 7-12 |
| | III | Contd. | 1 | 7-12 |
| | IV | Revision of Units I and II | 1 | |
| 16th Week | I | Revision of Units III and IV | 1 | |
| | II | Revision of Unit V | 1 | |
| | III | Discussion of model question papers | 1 | |
| | IV | Discussion of model question papers | 1 | |

**REFERENCES**


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