A–0989

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MSCCH-602

M.Sc. Chemistry (MSCCH)

Spectroscopy–II

Examination February, 2026

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

Long Answer Type Questions (2×19=38)

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. Explain the concept of chemical shift in NMR spectroscopy. What factors influence the chemical shift of a nucleus, and how can chemical shifts be used to deduce molecular structure ?

2. Describe the DEPT (Distortionless Enhancement by Polarization Transfer) NMR experiment. How does it differentiate between CH, CH_2, and CH_3 groups, and how can it be used to aid in structural elucidation of organic compounds ?

3. Compare and contrast Electron Ionization (EI) and Chemical Ionization (CI) techniques in mass spectrometry. Discuss their mechanisms, types of ions produced, and typical applications in analyzing organic compounds.

4. Discuss the role of hyperfine interactions in the study of free radicals using Electron Spin Resonance (ESR) spectroscopy. How do hyperfine couplings provide information about the structure and environment of unpaired electrons in free radicals ?

5. Explain the process of mass fragmentation in organic compounds during mass spectrometry and discuss how the fragmentation pattern helps in determining the structure of the compound. Provide examples to illustrate your answer.

Section–B

Short Answer Type Questions (4×8=32)

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. What is the McLafferty rearrangement in mass spectrometry, and what type of molecular structure typically undergoes this rearrangement ?

2. Name two common types of 2D NMR experiments and briefly state what structural information each provides.

3. Explain zero-field splitting in electron paramagnetic resonance (EPR) spectroscopy.

4. What is the difference between magnetic equivalence and chemical shift equivalence in NMR spectroscopy ?

5. What is a molecular ion peak in mass spectrometry, and why is it important for molecular weight determination ?

6. Explain how the coupling constants affect the splitting patterns observed in an AMX molecule.

7. Explain the basic principle behind electron spin resonance (ESR) spectroscopy.

8. How does chemical exchange affect the appearance of NMR signals ?

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