

- N. B. :**
- 1. All questions are compulsory.**
 - 2. Figures to the right indicate full marks.**
 - 3. All questions carry equal marks.**

- 1. a) Attempt any two of the following : (08)**
- State and explain Bragg's equation.
 - Discuss and explain the features of Laue method in the determination of Lattice parameters.
 - Draw schematic diagram for x-ray diffractometer and explain its working.
 - Write salient features of Debye Scherrer method of x-ray analysis.
- b) Attempt any one of the following : (04)**
- What are miller indices? What procedure is generally followed to determine miller indices?
 - Enlist the Bragg's conditions for x-ray diffraction.
- 2. a) Attempt any two of the following : (08)**
- Discuss the applications of neutron diffraction to study the magnetic material.
 - Draw a neat labelled diagram of electron diffraction apparatus and explain its working.
 - Explain the following with respect to neutron diffraction.
 - Source
 - Detector
 - Scattering factor.
 - Write an informative note on "Wierl equation".
- b) Attempt any one of the following : (04)**
- Explain the scattering of neutrons by liquids and gases.
 - Discuss the significance of scattering intensity in electron diffraction.
- 3. a) Attempt any two of the following : (08)**
- Describe the working of ESR spectrometer with a neat block diagram.
 - What is 'g' value in ESR? Enlist the different factors affecting 'g' value.

- iii) Explain the applications of ESR spectroscopy to metal complexes in biological systems.
- iv) Describe the ESR spectra of methyl radical and hydrogen radical.

b) Attempt **any one** of the following : (04)

- i) Discuss the role of modulation curve and microwave bridge in ESR spectroscopy.
- ii) Comment on hyperfine coupling and spin – polarization for atoms in ESR spectroscopy.

4. a) Attempt **any two** of the following : (08)

- i) Write an informative note on “cosine effect”.
- ii) Describe the effects of temperature and pressure on Mossbauer spectra of Fe^{+2} and Fe^{+3} compounds.
- iii) Draw a neat block diagram and discuss instrumental set up of Mossbauer spectroscopy.
- iv) Explain the principle of Mossbauer spectroscopy with respect to :
 - A) Quadra pole Splitting.
 - B) Nuclear Zeeman Effect.

b) Attempt **any one** of the following : (04)

- i) Describe the recoil free emission and absorption with respect to Mossbauer spectroscopy.
- ii) Elucidate the role of drive mechanism in Mossbauer spectroscopy.

5. Attempt **any four** of the following : (12)

- a) Describe the use of x-ray diffraction data in order to obtain configuration of a molecule.
 - b) What are the merits of electron diffraction?
 - c) Comment on spin-lattice relaxation in ESR spectroscopy.
 - d) Explain the term ‘Doppler Shift’ w.r.t. Mossbauer spectroscopy.
 - e) How x-ray intensities are related to structural factors and electron density.
 - f) Describe the measuring technique of neutron diffraction.
 - g) Explain the principle of ESR spectroscopy?
 - h) What are the characteristics of the source material essential for Mossbauer spectroscopy?
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