

**M.Sc. III Semester Degree Examination, April/May - 2024****CHEMISTRY****Nuclear Chemistry and Materials Science****(NEP)**

Time : 3 Hours

Maximum Marks : 70

Note : Answer **any five** of the following questions with Question No. **1 (Q.1)** is **Compulsory**.
Each question carries **equal** marks.

1. (A) What are the main features of the shell model of the nucleus ? How does it explain the magic numbers ? **5**
- (B) Compare and contrast the liquid drop model and the Fermi gas model of the nucleus. What are the advantages and limitations of each model ? **5**
- (C) Define the terms half-life, mean life, and decay constant of a radioactive element. How are they related to each other ? **4**
2. (A) What is the theory of nuclear fission ? How does it account for the neutron evaporation and spallation phenomena ? **5**
- (B) What are the steps involved in reprocessing of spent fuels in nuclear reactors ? Why is it necessary to reprocess the spent fuels ? **5**
- (C) What is the difference between nuclear fission and nuclear fusion ? Give one example of a thermonuclear reaction and write the corresponding equation. **4**
3. (A) What is polymorphism and isomorphism ? How are they related to solid solutions ? Give some examples. **5**
- (B) Explain the difference between point defects, line defects, and plane defects with suitable diagrams. **5**
- (C) What are the characteristics of one-component, two-component, and three-component systems ? How are they represented on phase diagrams ? **4**



4. (A) What are the differences between metals, insulators and semiconductors in terms of their electronic structure and band theory ? 5
- (B) What is k-space and what are Brillouin zones ? Draw the schematic diagram of the first Brillouin zone for a simple cubic lattice. 5
- (C) How does temperature affect the magnetic properties of substances ? Explain the concepts of Curie temperature, Curie-Weiss law, and Néel temperature. 4
5. (A) Explain the principle and working of a Light-Emitting Diode (LED). How is it different from a conventional light source ? 5
- (B) What are the main types of lasers and how are they classified based on the active medium, pumping mechanism, and mode of operation ? 5
- (C) What are organic charge transfer complexes and how are they related to superconductivity ? 4
6. (A) What is the difference between elastic and plastic deformation of crystals ? What are the factors that influence the elastic and plastic behaviour of crystals ? 5
- (B) What are the criteria for classifying phase transitions ? How are they represented on phase diagrams ? 5
- (C) What are the advantages and disadvantages of nuclear reactors for energy production ? How can the safety and security of nuclear reactors be ensured ? 4
7. (A) What are permanent magnets and how are they different from induced magnets ? What are the factors that determine the strength and stability of a permanent magnet ? 5
- (B) What are phosphors and how are they used for phosphor thermometry ? What are the advantages and limitations of this technique ? 5
- (C) What are the applications of semiconductors in electronics and optoelectronics ? 4
8. (A) Explain the concept of effective mass of an electron in a solid. How does it depend on the shape and curvature of the energy band ? 5
- (B) What is thermo-luminescence dating and how does it work ? What are the factors that affect the accuracy and reliability of this method ? 5
- (C) What is anisotropy in crystals ? How does it arise and how does it affect the mechanical behaviour of crystals ? 4

