(f) Increase in magnetization of Fe_3O_4 nanoparticles is observed with decrease in size. Explain.

(g) What are the differences between thermotropic and lyotropic liquid crystals? Smectic state is more solid like than nematic. Explain.

★★★

M. Sc. Chemistry Examination, 2025

(3rd Semester)

Chemistry

Paper : IX-IP-2

[Inorganic Chemistry (I-2) + Physical Chemistry (P-2)]

Time : *Two Hours* *Full Marks* : 40

(20 *marks for each Unit*)

Use a separate Answer Script for each Unit.

UNIT—309-I-2

Attempt either **Question No.1** or **2**. **Question No.3** is compulsory.

1. *(a)* Why is separation of lanthanoid elements difficult? How do you carefully separate the elements present in monazite?

(b) Calculate magnetic moment (μ) of $Eu^{3+}(4f^6)$. Compare with the experimental value, 3·55 BM. Explain, if there is any difference.

(c) What is Superconductor? Why $YBa_2Cu_3O_7$ shows superconductivity?

(OR)

(d) Give separation of U-235 schematically from Pitchblende. 3½+4+2½=10

2. *(a)* Write short note on the use of Gd^{3+} complexes in the Magnetic Resonance Imaging (MRI) technique.

(b) Write about the application of chemistry in the 'Nuclear Waste Processing' for Pu-239 extraction.

(c) Explain the role of Nd-YAG in LASER generation in NIR region.

(d) Write down the preparation of 'CAN' and its application.

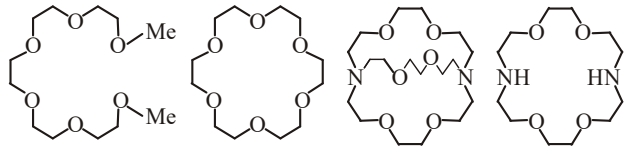
2½+2½+2½+2½=10

3. Answer *any* **five** questions : 2×5=10

(a) Edge-to-face π-π interactions are responsible for the characteristic herringbone packing in the crystal structures of benzene. Are these interactions attractive? Explain in detail.

(b) Define hydrogen bond according to the latest IUPAC meeting. Write down the criteria of a hydrogen bond.

(c) Rationalize the observed binding constant value (log *K*) of K^+ ion in methanol at 25 ºC with the following hosts :



log*K*: 2·3 6·08 10·0 2·04

(d) Discuss, with suitable example, the 'allosteric effect' for the binding of two different metal ions to a particular host.

(e) Why is high dilution method favored for the synthesis of macrocyclic compounds? Describe synthesis of a cryptand using the high dilution method.

(f) The soccer ball cryptand is described as the molecular chameleon — justify the statement.

(g) What is purple benzene? How does it act as a powerful oxidizing agent?

UNIT—309-P-2

1. Answer *any* **five** questions : 4×5=20

(a) Optical property of nanoparticle arises due to quantum confinement effect — explain. Explain anomalous melting point for nanosized particles with an example.

(b) Metal to nonmetal transitions occur for nanosized metal particles — explain why. When can organic molecule conduct electricity?

(c) What are nanocomposites? What are the major types of nanocomposites?

(d) How are the surface of a nanoparticle characterized by AFM technique? What is the advantage of using SEM over TEM?

(e) Explain the role of stabilizer during the synthesis of nanoparticles. State the types of stabilization of nanostructure against aggregation.