

RANI RASHMONI GREEN UNIVERSITY
DEPARTMENT OF CHEMISTRY
Semester – III, Final Examination: 2025
M.Sc. Course in Chemistry
Course ID: CHEM-C32

Full Marks: 40

Time: 2 h

Answer all the questions. Candidates are required to write answers in their own words and with proper scientific representations, if needed.

Unit-1: Nuclear Chemistry

- Q1. (a) What is cross section of a nuclear reaction? What is its unit.
(b) Example of semiconductor detector is HPGe detector. Similarly, example of scintillation detector is NaI(Tl) detector. Fill in the blanks of the table with respect to the two important properties of the detector efficiency and resolution (write either **high** or **low** in the blanks)

	HPGe detector	NaI(Tl) detector
Efficiency		
resolution		

- (c) What is parent-daughter generator system? What relation must exist between parent and daughter? Why parent-daughter generator system is important in the field of nuclear medicine. [2+2+4]

Or

- Q2. (a) Briefly describe production of radioisotopes by neutron activation and charged particle activation, citing one example from each. Classify neutrons according to their energy.
(b) 100 mg gold was irradiated with a neutron flux 10^{14} neutron $\text{cm}^{-2} \text{ s}^{-1}$ for 4 hours. What will be the activity of ^{198}Au just after the irradiation. (Given, cross section of $^{197}\text{Au}(n, \gamma)$ reaction is 700 mb, Half-life of ^{198}Au is 2.7 d, Atomic weight of Au is 196.97.
(c) What is saturation activity? [3+4+1]

Unit-2: Photochemistry-2

- Q3. (a) What are photoactive compounds? Which two steps these two compounds perform, in order to undergo a photochemical reaction?
(b) What are the factors on which lifetime of a photoexcited state depend?
(c) What is meant by d – d intervalence in co-ordinated compounds? In which kind of metal pairs, d – d intervalence occur? Give an example of a compound showing d – d intervalence resulting in strong colouration. [(1+2)+2+(1+1+1)]

Or

- Q4. (a) Draw the MO diagram of MLCT and LMCT transition of d^5 high spin complex.

(b) What is Static quenching and Inner Filter Effect. Write down the Stern-Volmer equation for Static Quenching, naming the terms involved.

(c) Write notes on any **two**

- i. Triboluminescence
- ii. Role of Porphyrin π -cation radical in photosynthesis. [2+2+(2+2)]

Unit-3: Bioinorganic Chemistry-2

Q5. (a) What is the difference between Oxidation and Oxygenation? How does spin-state of given metal ion in Haemoglobin (Hb) responsible for Oxygenation?

(b) Why does Hb show cooperativity in oxygen binding but not Mb? Explain the role of pH in the O₂-binding affinity of Hb. [(1+3)+(2+2)]

Or

Q6. (a) Cytochromes are electron transfer proteins and not oxygenation proteins, despite iron centers.

(b) The mechanism of O₂ binding in hemocyanin.

(c) What is the role of PS-I and PS-II in the Photosynthesis? Which one is more energy demanding site? [2+2+(3+1)]

Unit-4: Environmental Chemistry

Q7. (a) State sources and sinks of NO_x in the atmosphere.

(b) What is photochemical smog? [(4+2)+2]

Or

Q8. (a) While oxygen plays an important role in the troposphere, ozone plays a key role in the stratosphere—explain.

(b) Why does ozone hole in Antarctica appear during late winter? [(3+3)+2]

Unit-5: Green Chemistry

Q9. (a) Discuss the advantages and disadvantages of microwave-assisted reactions compared to conventional heating in organic synthesis.

(b) Describe the green synthesis of adipic acid.

(c) Describe the green synthesis of catechol.

(d) What conditions must a molecule satisfy to be microwave-active? [2+2+2+2]

Or

- Q10.** (a) Differentiate between a “susceptor” and a “catalyst”.
- (b) Mention the reaction conditions for oxidation of toluene under microwave irradiation (MWI). Write the reaction and compare it to the conventional process.
- (c) Compare conventional heating with ultrasonic heating in terms of reaction mechanism and efficiency.
- (d) Provide two examples of ultrasound-assisted organic reactions. [2+2+2+2]