[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 9211 **J**

Unique Paper Code : 2173012010

Name of the Paper : DSE : NUCLEAR AND ENVIRONMENTAL CHEMISTRY

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : IV

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **SIX** questions in all.
3. **All** questions carry equal marks.

1. (a) If an atom of $^{235}U_{92}$ undergoes nuclear fission reaction after absorbing a slow moving neutron, then $^{98}Zn_{40}$ and $^{136}Te_{52}$ are produced. What other particles are produced and how many?

   (b) Calculate the binding energy per nucleon for an oxygen atom with atomic mass 15.994910 amu. (Given: neutron = 1.008665 amu, proton = 1.007277 amu, electron = 0.0005486 amu)

   (c) Explain the working and principle of an ionization chamber. (5,5,5)

2. (a) What is artificial transmutation? Give the nuclear reactions induced by neutron, proton and α-particles.

   (b) Compare nuclear fission and nuclear fusion with examples.

   (c) Draw and describe the binding energy per nucleon vs mass number curve. What does its shape indicate about nuclear stability? (5,5,5)

3. (a) Explain the construction and working principle of a fast breeder nuclear reactors.

   (b) Explain the following models to describe the structure and stability of the nucleus :
   (i) Shell Model
   (ii) Liquid Drop Model

   (c) Derive a relation between half-life and decay constant. What is the order of a radioactive disintegration process? (5,5,5)

P.T.O.

4. (a) Explain the formation of ozone in the stratosphere through photochemical reactions. Discuss the role of chlorofluorocarbons (CFCs) behind ozone depletion.

   (b) What are SPM's? How do they cause harm to human beings? What is the significance of PM2.5 and PM10 in air quality monitoring?

   (c) Compare and contrast the environmental impacts of CO, NOx, and SOx. Describe methods used to estimate the concentration of **any one** of these air pollutants. (5,5,5)

5. (a) What is the mechanism of PAN formation in photochemical smog?

   (b) Evaluate the working principle and efficiency **any two** of the following air pollution control devices :
   (i) Settling Chamber
   (ii) Venturi Scrubber
   (iii) Electrostatic Precipitator (ESP)

   (c) What are air pollutants? Describe the major types of air pollutants, giving examples of each and their sources. (5,5,5)

6. (a) Explain the hydrological cycle in detail. How can water pollution disrupt this cycle?

   (b) What are the major sources of water pollution? Classify pollutants based on their nature and provide examples of each.

   (c) Enlist and explain the various techniques for measuring water pollution. (Atleast **three**) (5,5,5)

7. (a) Define DO. How is DO measured in a water sample?

   (b) Compare and contrast reverse osmosis, ion exchange, and electro-dialysis as water purification methods.

   (c) How can industrial waste be managed to reduce water pollution? Discuss preventive and treatment-based strategies. (5,5,5)

8. Write short notes on **any three** of the following :
   (a) Nuclear Waste Management
   (b) Group Displacement Law in Radioactivity
   (c) Scintillation Detector
   (d) Carbon-dating Technique (5,5,5)

(100)