

**Master of Science (M.Sc.) Semester-III (CBCS)
(Chemistry) Examination
Nuclear Chemistry (CH-3T3)
Paper-XI**

Time: Three Hours]

[Max. Marks: 60

- N.B.: 1. All questions are compulsory
2. All questions carry equal marks
3. Use of Calculator is permitted
4. Draw labelled diagrams wherever necessary

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| 1 (a) | What is transient equilibrium? Explain the conditions and its profile. | 4 |
| (b) | Explain the phenomena: electron capture and positron emission. | 4 |
| (c) | What is natural radioactivity? Derive an expression for decay constant. | 4 |
| OR | | |
| 1(d) | Write a note on secular equilibrium. | 4 |
| (e) | What is successive radioactive decay? Explain with one example. | 4 |
| (f) | ^{40}K decay through beta emission and positron emission with half lives 1.28×10^9 years and 1.9×10^{10} years respectively. Calculate decay constant and half life of ^{40}K . | 4 |
| 2(a) | Explain beta decay of odd-A isobars with suitable example. | 4 |
| (b) | Explain the following :
(i) Nuclear spin and parity (ii) Square wave potential | 4 |
| (c) | State and explain Nordheim's rule with suitable example. | 4 |
| OR | | |
| 2(d) | What are the assumptions of LDM? State its limitations. | 4 |
| (e) | Explain the wave mechanical theory of alpha decay in brief. | 4 |
| (f) | What are the assumptions of shell model? State its limitations. | 4 |
| 3(a) | Define range of radioactive particle and explain the Bragg curve. | 4 |
| (b) | Write note on working of G.M counter and role of quenching gas. | 4 |
| (c) | What is FWHM? How it is useful for calculating energy resolution of scintillation counter? | 4 |

OR

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| 3(d) | Write short notes on Compton scattering and photoelectric absorption. | 4 |
| (e) | Explain the different regions of gas filled detectors with the help of graph obtained due to variation of pulse height as a function of applied voltage. | 4 |
| (f) | Calculate the dead time of GM counter if $R_1 = 470$, cps $R_2 = 495$ cps, $R_{12} = 887$ cps and $R_0 = 7$ cpm | 4 |
| 4(a) | What do you mean by Spontaneous Fission? Explain with suitable example. | 4 |
| (b) | How heavy water is produced using Girdler Sulphide Process? | 4 |
| (c) | What is a Nuclear Reactor? Draw a neat sketch of a Nuclear Reactor and explain it. | 4 |
| OR | | |
| 4(d) | Explain PUREX process with proper reactions. | 4 |
| (e) | Explain the reason for providing excess reactivity in a fission reactor. | 4 |
| (f) | Explain the dynamics of fission chain reaction. Emphasize the importance of delayed neutrons. | 4 |
| 5(a) | Write note on branching decay. | 3 |
| (b) | Write the semi-empirical mass formula and explain surface energy term. | 3 |
| (c) | Give characteristics of ideal scintillator. | 3 |
| (d) | Define: a) Separation factor & separation unit b) fertile & fissile isotopes | 3 |