MANIPAL ACADEMY of HIGHER EDUCATION (Institution of Eminence Deemed to be University)

Reg.No.									

DEPARTMENT OF SCIENCES, IV SEMESTER M.Sc. (Chemistry)
END SEMESTER EXAMINATIONS, APRIL 2023
Nuclear and Radiation Chemistry [CHM 6261]
(CHOICE BASED CREDIT SYSTEM - 2021)

Time: 3 Hours Date: 24 - 04- 2023 MAX. MARKS: 50

Note (i) Answer ALL questions

(ii) Draw diagrams, and write equations wherever necessary

		Marks	CO	BL
1A	Give reason for the following statements (i) All nuclei will try to become larger or smaller to attain as mass number of nucleons (ii) Odd numbers of either or both protons and neutrons, the nucleus often has nonzero spin and magnetic moment. (iii) Nucleus is assumed to consist of particles that rarely interact with its neighbours, and mostly interact with a general Potential Field (iv)	3	1	3
1B	Explain liquid drop model of the nucleus. Mention three failures of this model	3	1	2
1C	Discuss the energetics of alpha decay. Calculate kinetic energy value of ^{238}U. Given: Δ (MeV) for ^{238}U, ^{234}Th, ^{4}He are 47.3070, 40.612 & 2.4249, respectively.	4	1	3
2A	Discuss neutrino hypothesis in β decay. Equate for all three types of decay.	3	1	3
2B	Explain the competing process to gamma-ray decay and why it is competing? Define its co-efficient "α".	3	1	2
2C	Discuss the energetics of nuclear reactions, neglecting electron binding energies.	4	2	2
3A	Give an account for identifying the probable type of photon for a given transition between nuclear states during γ decay.	3	2	3
3B	Predict and justify the mode of decay for the following radioactive isotopes. $_{84}Po^{210}$ ii) $_{8}O^{15}$ iii) $_{6}C^{14}$	3	2	3
3C	$_{27}Co^{60}$ decays with a half-life of 5.27 years to produce $_{28}Ni^{60}$. i) What is the decay constant for the radioactive disintegration of cobalt-60? ii) Calculate the fraction of a sample of the Co-60 isotope that will remain after 15 years. iii) How long does it take for a sample of Co-60 to disintegrate to the extent that only 2.0% of the original amount remains?	4	2	3
4A	Distinguish between secular and transient equilibrium. A sample of Uranium contains 15.78 % Uranium -238 and 5.26×10^{-6} % Radon -228. The half-life of Radon is 1590 years. Calculate the decay constant of Uranium -238.	3	2	3

4B	Explain the construction and working of GM counter.	3	3	2
4C	i) What is radiation dosimetry? Explain the working of Freckle dosimeter. ii) A protein hydrolysate is to be assayed for aspartic acid. Exactly 5.0 mg of aspartic acid having a specific activity of 0.46 mCi/mg, is added to the hydrolysate. From the hydrolysate, 0.21 mg of highly purified aspartic acid, with a specific activity of 0.01 mCi/mg, as isolated. How much aspartic acid is present in the original hydrolysate?	4	3	3
5A	What are radiometric titrations? Explain the different types of radiometric titrations.	3	3	2
5B	Define Gray and Sievert. What is tracer technique? Explain the use of radioactive tracer isotopes in the study of mechanism of chemical reactions with an example.	3	4	2
5C	i) What is enriched Uranium. Explain the method of separation of Uranium isotopes. ii) Explain the working of breeder nuclear reactor. Discuss the nuclear waste disposal method.	4	4	2

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