Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2025

Course:	**Radiation Safety**	**Semester: IV**
Program:	**BSc Physics by research**	**Time: 03 hrs.**
Course Code:	**HSFS 2026K**	**Max. Marks: 100**

Instructions:

1. *All questions are mandatory in Section A.*
2. *Internal choices are given in questions #9 and #11 of Sections B and C respectively.*
3. *A list of important constants is provided at the end of this question paper.*

SECTION A

(5Qx4M=20Marks)

S. No.		**Marks**	**CO**
Q 1	Compute the radiation absorbed dose in air corresponding to 1 Roentgen exposure. For air the average ionization energy is 34 J/ion.	**4**	**CO2**
Q 2	Illustrate the current voltage relationship for a gas filled detector, mentioning the regions to be used as counters.	**4**	**CO3**
Q 3	Describe the three radiation protection principles.	**4**	**CO1**
Q 4	Explain the concept of Annual Limit of Intake (ALI) and Derived Air Concentration (DAC) in the context of radiation protection.	**4**	**CO1**
Q 5	Explain the detection mechanism of neutrons.	**4**	**CO2**

SECTION B

(4Qx10M= 40 Marks)

S. No.		**Marks**	**CO**
Q 6	Briefly describe the principle, construction and working of proportional counter.	**10**	**CO1**
Q 7	Show that in Compton scattering the direction of the recoil electron is given as $tan\emptyset = \frac{cot\frac{\theta}{2}}{1+\frac{h\nu}{m_0c^2}}$. Where the symbols have their usual meaning.	**10**	**CO3**
Q 8	Discuss the internal and external exposure of radiation.	**10**	**CO2**
Q 9	A patient receives an injection of 1.1 x 10^8 Bq of ^{131}I, which gets accumulated in the thyroid (mass of thyroid ≈ 2 gm). Mean energy of the emitted radiation is E ≈ 300 keV. Determine the dose rate to the thyroid. **OR** Determine the thickness of a lead shield required to reduce the exposure rate due to Cs-137 from 100 R/hr to 1R/hr. mass attenuation coefficient for lead is 0.11 cm^2/gm and density of lead is 11.3 gm/cm^3.	**10**	**CO2**

(2Qx20M=40 Marks)			
Q 10	a) Describe the various interaction mechanism of gamma rays with matter. b) A gamma ray photon interacts with electron and gets scattered at an angle θ. Obtain expression for wavelength shift.	**10** **10**	**CO3**
Q 11	a) Explain the principle, construction and working of multi wire proportional counter b) Illustrate the functioning of projection imaging gamma camera. **OR** a) Describe briefly the Accelerator driven subcritical system for nuclear waste transmutation. b) Illustrate the nuclear technique for industrial applications such as nuclear gauges and material modification.	**10** **10** **10** **10**	**CO3**

Planck's constant, $h = 6.6 \times 10^{-34}$ J.s
Boltzmann's constant, $k = 1.38 \times 10^{-23}$ J/K
Mass of electron, $m_e = 9.1 \times 10^{-31}$ Kg
Charge on an electron, $e = 1.6 \times 10^{-19}$ C
Mass of proton, $m_p = 1.67 \times 10^{-27}$ Kg
Speed of light, $c = 3 \times 10^{8}$ m/s
Rydberg Constant, $R = 1.097 \times 10^{7}$ m-1
Avogadro's number = 6.023×10^{23}
Permeability of free space, $\mu_o = 4\pi \times 10^{-7}$ Henry/m
Permittivity of free space, $\varepsilon_o = 8.85 \times 10^{-12}$ F/m