D3APH2104 **(2 Pages)** **Name.....**
Reg.No.....

THIRD SEMESTER M. Sc. DEGREE EXAMINATION, NOVEMBER 2022
(Regular/Improvement/Supplementary)

PHYSICS
FPHY3E03: RADIATION PHYSICS

Time: 3 Hours **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.

1. Explain the fundamental principle behind: (a) a radioactive ion; (b) γ-ray source.
2. Sketch the ion range of 1 MeV protons (H^+) and 1 MeV gold (Au^+) beam incident on a thick silicon substrate and briefly discuss its beam profile.
3. Explain absorbed and effective dose and the SI units used for each of them.
4. Distinguish between deterministic and stochastic effects of ionizing radiation.
5. Give the main precautions required for handling unsealed radiation sources.
6. Briefly explain Compton scattering, give a plot of the intensity of scattered photons Vs energy.
7. An ion irradiation experiment is carried out using 10^{10} nitrogen ions of energy 30 keV falling in one second in one cm^2 area for 10 s. Calculate ion flux and fluence.
8. Briefly explain ALARA and mention the main features.

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.

9. Give the basic principle, schematic, working, and applications of Cyclotron.
10. Give a detailed account (various processes and their underline physics) for the interaction of an energetic beam of: (a) charged particle and (b) electrons with a solid.
11. Explain the basic principle and working using a schematic diagram of: (a) Solid dosimeters (TLD and RPL) and (b) any three area survey meters.
12. (a) Discuss the stochastic effects, mutation and chromosomal aberrations of ionizing radiation.
    (b) Briefly explain the precautions to be taken and radiation shielding while handling the source and experiments using β-rays, and γ-rays.

(2 × 5 = 10 weightage)

(P.T.O.)

Part C: Problems. Answer any *four* questions. Each carries *three* weightage.

13. The amount of ^{40}K in human body is 0.27% and also 0.21% of total ^{40}K content is radioactive with a half-life of 1.25×10^9 years. Calculate the number of radioactive K present in a body of mass of 60 Kg and the total absorbed dose for 80 **y**ears.

14. Photons of wavelength 0.4 nm strike a stationary electron and scatter at an angle of 120° to its original direction. Determine the wavelength of the scattered photons.

15. Determine the thickness of Pb used to shield 99 % of X–rays generated from a ^{60}Co source [mass attenuation coefficient of Pb-0.059 cm^2/g, density of Pb- 11.2g/cc].

16. Estimate the radiation exposure rate one meter from a 100 *mCi* point source of Cs-137. Γ=3.3 *mR-cm^2/hr-mCi*.

17. Calculate the KERMA given the photon flux $10^{16}/m^2$, photon energy 20 MeV, linear attenuation coefficient 0.028 cm^2/g and energy transfer attenuation coefficient 0.022 cm^2/g.

18. Determine the thickness of cadmium to reduce the intensity of an incident beam of thermal neutrons to 10% of its original level. Assume a thermal neutron cross section of 2520 barns, an atomic mass of 112.411 amu and a specific gravity of 8.65.

19. Give a detailed account of the effects of ionizing radiations at molecular, sub molecular and cellular levels.

(4 × 3 = 12 weightage)