D3APH1904 (2 Pages) **Name.....**
Reg.No.....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2020
PHYSICS
FPHY3E03: RADIATION PHYSICS

Time: Three Hours **Maximum Weightage: 30**

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

1. For a calibration experiment one require a monoenergetic electron source of energy tens of keV. Suggest a suitable source with details and explain the basic principle.
2. Distinguish between the X-rays generated using a conventional source (X-ray tube) and Synchrotron source.
3. Compare the ion Range and Straggling of (a) 1 MEV Protons (b) 1keV Protons (c)1 MEV Au^{++}, (b) 1keV Au^{++}interact with a thick slab of Silicon by using a sketch of the profile of ions in the substrate.
4. Briefly distinguish between deterministic and stochastic effects of ionizing radiation.
5. For an absorbed dose of 0.001 J/Kg, obtain the effective dose in Sv if the weighing factor is 0.03 and quality factor Q =1.
6. The interaction of ionizing radiation (IR) with biomolecules is much more aggressive than non-IR such as ultraviolet radiation. Justify the statement.
7. Briefly explain the concept of ALARA and give the main features.
8. Give the main precautions required for handling unsealed radiation sources.

(8 × 1 = 8 weightage)

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

9. Give the basic principle and working of (a) two sources of Gamma rays and (b) three sources for Neutron.
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 of (a) Solid dosimeters (TLD and RPL) and (b) any three area survey meters.

(P.T.O.)

12. (a) Discuss the genetic effects, mutation and chromosomal aberrationsof ionizing radiation on biological systems. (3 weightage)
    (b) Briefly explain the physics, choice of material and working of a radiation shield for γ-rays and neutrons. (2 weightage)

(2 × 5 = 10 weightage)

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

13. An archeologist finds a bone contains 5g of carbon with an activity of 0.5 Bq from C^{14} dating. Determine the age of the bone. [half-life of carbon-5730 years, C^{14}/C^{12} ratio-1.3×10^{-12}nuclei].
14. Sketch a typical γ-ray spectrum collected using a scintillator setup and indicate (a) Photo-peak and (b) Compton edge.
15. A beam of x-rays with wavelength 0.2400 nm is directed toward a sample. The X-rays scatter from the electrons within the sample, after scattering, the x-rays are detected at various angles relative to the direction of the incoming beam. Determine the scattering angle if the wavelength for the scattered x-rays of 0.2412 nm.
16. Calculate the KERMA value for γ-ray photon flux of $10^{18}/m^2$, photon energy 5 MeV, linear attenuation coefficient 0.028 cm^2/g and energy transfer attenuation coefficient 0.022 cm^2/g.
17. 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.
18. If the dose rate at 5*cm* from a small-sized radioactive source is 1 *Sv/h* (100 *rem/h*), estimate the dose rate at 20 *cm*.
19. When a beam of 10 keV helium ions travelled through a thick substrate, it has lost 6 keV before coming to rest inside the substrate. Estimate the ion range if the nuclear and electronic stopping are 5 eV/A and 1 eV/A respectively.

(4 × 3 = 12 weightage)