

THIRD SEMESTER M. Sc. DEGREE EXAMINATION, NOVEMBER 2025
(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. What is an artificial isotope? Give examples.
2. Briefly explain the methods of production of any one of the radiations.
3. What is range straggling?
4. Differentiate between flux, fluence and intensity of radiations.
5. What is effective dose? How is it related to biological effectiveness?
6. What is stochastic effect? Explain its relevance and the commonly noted stochastic effects.
7. Give the principle of radiation therapy.
8. What is radiolysis? What is its importance?

(8 × 1 = 8 weightage)

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

9. Discuss the mechanism of energy loss by heavy charged particles. Obtain the equation for specific energy loss, stopping power and range of the particle.
10. Discuss various quantities of measurement of radiations and their units. Explain the importance of each measurement. What are the types of detectors used for each measurement?
11. Give a detailed interaction of radiation in molecular level and tissue level. Identify various stochastic and deterministic effects induced and their thresholds.
12. Explain how radioactive materials are classified. Explain the precautions, measurements and labelling to be adopted while transporting each category of radioactive materials.

(2 × 5 = 10 weightage)

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

13. Calculate the maximum energies of a proton and an electron coming out of a cyclotron of radius 50 cm, working with a magnetic field of 1 Tesla.
14. A fission reactor is working on uranium fuel at a power of 1 MW. Calculate the amount of uranium- 235 used in gram. Average energy released per fission \approx 200 MeV.
15. 667 KeV gamma ray from Cs-137 isotope undergo Compton scattering with Cu-target. Calculate the energy of gamma ray scattered at 90° . What is the energy of electron?

(P.T.O.)

16. Calculate the thickness of copper foil to stop 5 MeV alpha particle. What should be the fluence of alpha particles to deposit a total energy of 1 Joule. ($dE/dx = 45\text{MeV/gcm}^2$.)
17. Calculate the effective dose of 10 MeV neutron and 10 MeV alpha particles on skin, liver, gonads and breast. The absorbed dose is 20 mGray. The data given below may be used.
- W_R , gamma =1, electron =1, proton = 2, neutron =10, alpha =20,
 W_T , skin, brain = 0.01, liver, bladder, thyroid = 0.04, gonads =0.08, breast, stomach, lung = 0.12.
18. Calculate the thickness of shielding of lead shield for safe storage of 1 Ci of Co-60 sample. Calculate the half value thickness and 10^{th} value thickness. Mean attenuation coefficient for the gamma rays in Lead is $5.87 \times 10^{-2} \text{ cm}^2/\text{g}$.
19. In the above index, calculate the transport index and type of labelling of the package.

(4 × 3 = 12 weightage)