

M.Sc. MEDICAL PHYSICS
SEMESTER -II EXAMINATION, JUNE-2026

(MPCC204) PRINCIPLES OF RADIATION DETECTION AND INSTRUMENTATION

[Time allotted: Three Hours]

[Max Marks: 100]

Note: Read all the instructions carefully

Answer all questions in serial order, Draw suitable diagrams wherever necessary

Q. 1. Objective type questions: (Attempt All)**(10 x 02 = 20)**

(Very short/ Short answer/ MCQ/ One liners/ Fill in the blanks/ True/False)

- a. The basic principle of radiation detection relies on measuring: (PO5 CO1)
 - i. Atomic radius
 - ii. Nuclear half life
 - iii. Interaction of radiation with matter
 - iv. Mass number
- b. Which detector is most suitable for precise dosimetry in routine use? (PO4 CO3)
 - i. GM counter
 - ii. Ionization chamber
 - iii. TLD
 - iv. OSLD
- c. Which of the followings is *not* a function of a preamplifier in a radiation detector circuit? (PO4 CO3)
 - i. Amplifying the weak electrical signals generated by the detector
 - ii. Shaping the signal for further processing
 - iii. Storing detected radiation data for long-term analysis
 - iv. Improving the signal-to-noise ratio before main amplification
- d. What is the range of fano factor? (PO5 CO3)
 - i. 0 to 1
 - ii. $-\infty$ to $+\infty$
 - iii. 0 to ∞
 - iv. -1 to +1
- e. Radiochromic films darken due to: (PO2 CO1)
 - i. Heat
 - ii. Pressure
 - iii. Radiation induced polymerization
 - iv. Moisture
- f. Which has the highest tissue equivalence? (PO4 CO1)
 - i. LiF TLD
 - ii. NaI(Tl)
 - iii. ZnS
 - iv. Silicon
- g. Which gas is commonly used in neutron proportional counters? (PO5 CO4)
 - i. Argon
 - ii. Helium-3
 - iii. Xenon
 - iv. Neon
- h. Which dosimeter has smallest physical size? (PO4 CO4)
 - i. GM tube
 - ii. MOSFET dosimeter
 - iii. TLD
 - iv. Ion chamber
- i. The radius of curvature (R) of a particle's track in a bubble chamber is given by: (PO5 CO1)
 - i. $R = \frac{mv}{qB}$
 - ii. $R = \frac{qB}{mv}$
 - iii. $R = \frac{mv}{mB}$
 - iv. $R = \frac{qV}{B}$
- j. A standard TLD cassette in India usually contains TLD discs. (PO5 CO4)
 - i. 1
 - ii. 2
 - iii. 3
 - iv. 4

Q. 2. Short notes/ Short answer type questions (Attempt any Five)**(05 x 04 = 20)**

- a. Describe the role of quenching gases in GM counters. Explain different types of quenching. (PO4 CO1)
- b. If an optical filter transmits 0.05% of light, then find its optical density. (PO4 CO3)
- c. What is a cloud chamber? Write its basic working principle. (PO5 CO4)
- d. Discuss the importance of RFA in radiation therapy dosimetry. (PO1 CO1)
- e. A GM counter shows a measured count rate of 9500 cps. The dead time of the counter is 100 μ s. What is the true count of the detector in cpm? (PO4 CO1)
- f. Explain the Fricke dosimeter and its application. (PO4 CO4)
- g. Describe how MOSFET dosimeters detect and measure radiation dose. (PO5 CO4)

Q. 3. Structured questions (Attempt any Three)**(03 x 10 = 30)**

- a. Explain the working principle and construction of a gamma-ray spectrometer. How a gamma spectrum is obtained using it? (PO4 CO2)
- b. Explain the working principle of a semiconductor detector. Discuss how charge carriers are generated and collected in a p-n junction detector. (PO4 CO1)
- c. Explain the construction and working principle of Optically Stimulated Luminescence Dosimeters (OSLDs). (PO4 CO4)
- d. What do you mean by photographic film dosimetry? Describe the steps involved in it. (PO5 CO3)

Q. 4. Long Answer/ Essay type questions (Attempt any Two)**(02 x 15 = 30)**

- a. Explain construction and working of gas-filled detectors. Discuss their operating voltage ranges and applications. (PO5 CO1)
- b. Discuss the working mechanism of Thermoluminescent dosimeters. How does the analysis of glow curves help in estimating the absorbed radiation dose? (PO4 CO4)
- c. Explain the principles of neutron dosimetry in detail. Describe the interaction of neutrons with matter. (PO4 CO4)