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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL UNIVERSITY, MANIPAL

DEPARTMENT OF PHYSICS

Sixth Semester B.E (Open Elective)
End Semester Examination - May 2014

PHY 322: Radiation Physics

Time: 3 hrs. **Max. Marks:** 50

Note :
- **Answer any FIVE FULL questions.**
- **Answer all the questions in a continuous sequence.**
- **Write specific and precise answers. Any missing data may suitably be assumed.**
- **Write question number within the margin. Draw neat sketches wherever necessary.**

1. A) With suitable examples discuss the various methods to obtain electromagnetic radiation.
   B) Explain the nature of interaction of heavy charged particles and its stopping power.
   C) The half-life of the radioactive nucleus Ra-226 is 1600 years. a) What is the decay constant for this nucleus? b) If a sample contains 3×10^{16} Ra-226 nuclei at t = 0, then determine its activity in curies at this time.

   (5 + 3 + 2)

2. A) Explain the following terms related to interaction of fast electrons with absorbing medium: (i) Specific energy loss (ii) Electron range and transmission curve (iii) Positron Interaction.
   B) Explain the energy loss of heavy charged particles in thin absorbers.
   C) What is the average absorbed dose in a $40cm^3$ region of a body organ (density = 0.93 g/cm^3) that absorbs 3×10^5 MeV of energy from a radiation field?

   (5 + 3 + 2)

3. A) Discuss the energy loss characteristics and particle range of heavy charged particles.
   B) Sketch the transfer characteristics for an *n*-channel depletion-type MOSFET with I_{DSS} = 10 mA and V_P = - 4 V.
   C) What are the differences between D-MOSFET and E-MOSFET ?

   (5 + 3 + 2)

4. A) Discuss the fabrication, working and characteristics of *n*-channel JFET.
   B) An α-particle point source of 25μCi is placed in contact with one face of a large ionization chamber. The source emits a single α-particle of energy 6.2 MeV. If the α-particles that enter, lose all their energy in the chamber, what is the current produced at the output of the chamber? (Assume 100% efficiency for collecting the charges in the chamber. Average energy needed to produce an ion is 34 eV).
   C) What are the different geometries of gas filled detector? Explain.

   (5 + 3 + 2)

5. A) Explain the construction and working of Gamma ray spectrometer.

   B) A GM counter operates at 1000 V and has a central wire of diameter 0.2 mm. The diameter of the cathode is 2 cm and the tube has a guaranteed lifetime of 10^9 counts. i) What is the maximum field? ii) How long will the counter last if it is used on an average of 30 hrs per week at 3000 counts per minute?

   C) Discuss process of creation of discrete avalanches in proportional counter.

(5 + 3 + 2)

6. A) Describe the method of thickness measurement using nuclear measurement system.

   B) Consider a tank of height 1.5m in a nuclear radiation absorption measurement system. If the tank is empty, a dose meter coupled to a linear detector indicates a voltage of 32 V proportional to the intensity; for a full tank it reads 2V. Let the measurement system be compensated by a voltage of 2V with reverse polarity yielding 0V for empty tank. Determine the level position and the measurement accuracy when the output fluctuation is ±0.5V for mean value of 21V (at unknown level).

   C) Mention the advantages of nuclear measuring systems over conventional methods.

(5 + 3 + 2)

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