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Dr. PKJ

# MANIPAL UNIVERSITY

## DEPARTMENT OF SCIENCES

THIRD SEMESTER MSc END SEMESTER EXAMINATION NOV. – DEC. - 2016

SUBJECT: NUCLEAR PHYSICS I (PHY-707.5)

(CREDIT SYSTEM)

TIME: 3 HOURS MAX. MARKS: 50

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**Answer Any FIVE full questions.**

1. (a) Obtain momentum distribution function for beta decay and hence sketch beta ray spectra. [4+1]

   (b)Explain "Energy Straggling" with help of plots of energy distribution of a beam of initially mono energetic charged particles at various penetration distances. [5]

2. (a) What is "Stopping Time"? Obtain an expression for stopping time for a charged particle in a traversing medium. [1+4]

   (b) What is an ideal scintillator? Explain working principle of organic scintillation radiation detector? [2+3]

3. (a) Explain the predicted response function for a "Large Detector" in gamma ray spectrometer. [5]

   (b) Draw the block diagram of Ge(Li) detector with proper biasing of the junction. Assuming charge collection is complete and that electronic noise is negligible, find the expected energy resolution of a Ge detector for the 662 keV of Cs-137. Given: Energy required for electron-hole pair is 2.96 eV; Fano factor is 0.08. 0.14 %. [2+3]

4. (a) Explain dipole-dipole angular correlation between the directions of emission of two successive gamma-gamma radiations. [5]

   (b) Draw a block diagram of HPGe detector with planar configuration. The Compton edge in a gamma ray spectrum recorded with a Ge detector for a given isotope lies at an angle of 1.16 MeV. Find the incident gamma energy. 1.39 MeV [2+3]

5. (a) Explain mass spectroscopic method of approach to the observation of double beta decay with an example. [5]

(b) How to optimize the active detection volume of a semiconductor detector. The average energy required to produce an ion pair in gas by the energetic radiation is 35 eV. A neutron fission counter is lined with U-235 to detect neutrons by ionizing fission fragments that produces an average energy of 200 MeV. Find the pulse height at a capacitor of capacitance 40pF connected to the collecting cathode. $2.2 \times 10^{-2}$ V [2+3]

6. (a) With relevant nuclear reaction, explain slow neutron detection using $BF_3$ counter. Draw pulse height spectra showing "wall effect". [3+2]

(b) Explain conduction band – valence band model for the exposure phase of thermo luminescence mechanism (TLD). A 2.6 MeV neutron has a collision with hydrogen. If neutron loses 0.75 MeV, at what angle is it scattered. $32.5^{\circ}$ [2+3]

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