Reg. No.										

MANIPAL UNIVERSITY

DEPARTMENT OF SCIENCES

THIRD SEMESTER MSc END SEMESTER EXAMINATION NOV. – DEC. - 2015

SUBJECT: NUCLEAR PHYSICS I (PHY-707.5)

(CREDIT SYSTEM)

TIME: 3 HOURS MAX. MARKS: 50

Answer Any FIVE full questions.

1. (a) What are experimental characteristics of beta ray continuum? [5]

   (b) Describe three major types of interaction mechanism of gamma rays with matter. [5]

2. (a) Derive the expression for kinetic energy transferred to an electron by a heavy charged particle. [5]

   (b) What is scintillation process? What are the requirements of an ideal scintillator? [2+3]

3. (a) Explain the working principle of high purity germanium radiation detector with co-axial configuration. [5]

   (b) Why Ge (Li) radiation detectors have to be kept at liquid Nitrogen temperature. What potential must be developed across the capacitor of capacitance 300 µF in a Si detector, by the absorption of 5 MeV alpha particles which produces one ion pair for each 3.5 eV expended? [2+3]

4. (a) Explain experimental arrangement for neutrino detection. [5]

   (b) What is meant by "energy straggling" for a charged particle in an absorbing medium? Find the approximate energy loss of 1 MeV alpha particles in a thickness of 5 µm of gold. Given: specific energy loss is 380 MeV. $cm^2\ g^{-1}$; density is 19.3 g cm^3. [2+3]

5. (a) Explain scattering interaction and slowing down mechanism, when neutrons traverses through the matter. [5]

   (b) How do we get back scatter peak and Compton edge in a typical gamma spectrum? A scintillation spectrometer has 7 stages PMT. It is designed that a 100 keV beta particle produce a 2 mV pulse in output circuit which has a capacitance of 120×10^{-12} F. What average multiplication per stage is required in PMT. Assume a light collection efficiency unity and a photo cathode efficiency of 0.1. Light yield is about 15 for each 1000 eV of energy deposited. [2+3]

6. (a) What is an activation counter? Explain neutron activation method for neutron flux measurement. [1+4]

(b) What is the significance of mass attenuation coefficient and how it is related to linear attenuation coefficient with reference to gamma ray attenuation? Give a rough estimate the ratio of the probability per atom for photoelectric absorption in Si (Atomic Number is 14) to that of Ge (Atomic number is 32). [2+3]

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