Reg. No.										

Dr. PKS

MANIPAL UNIVERSITY

DEPARTMENT OF SCIENCES

THIRD SEMESTER MSc (PHYSICS) END SEMESTER MAKEUP EXAMINATION - JAN. 2017

SUBJECT: NUCLEAR PHYSICS I (PHY-707.5)

(CREDIT SYSTEM)

TIME: 3 HOURS MAX. MARKS: 50

Answer Any FIVE full questions.

1. (a) Explain the theory of continuous electron momentum distribution function during beta decay. [5]

   (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 power and derive the expression for kinetic energy transferred to an electron by a heavy charged particle with charge Ze. [5]

   (b) What is scintillation process? Explain working principle of inorganic scintillation radiation detector? [2+3]

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

   (b) Si(Li) radiation detector needs to be maintained at liquid nitrogen temperature, Why? Assuming a decay constant of 230 ns, how much time is required for a NaI(Tl) scintillation event to emit 99% of the total light yield? [2+3]

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

   (b) What is the role of activator in inorganic scintillators? A scintillation spectrometer has 15 stages PMT. It is designed that a 10 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]

5. (a) Explain double beta decay process with an example. [5]

(b) How to optimize the active detection volume of a semiconductor detector. Calculate the scintillation efficiency of anthracene if 1Me V of particle energy loss creates 20,300 photons with average wavelength of 447 nm. [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). Estimate the range (in cm) of 1 MeV electrons in aluminium. Given: Range in Si = 0.5 [in mass thickness], density of Al = 2.6 g cm^{-3}, density of Si = 2.32 g cm^{-3}, Atomic weight of Al = 26.98 amu, Atomic weight of Si = 28.0855 amu. [3+2]

****