MANIPAL UNIVERSITY

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Deemed- to -be -University under Section 3 of the UGC Act, 1956

DEPARTMENT OF SCIENCES, III SEMESTER M.Sc. (P/C/M/G))
END SEMESTER EXAMINATIONS, Nov/Dec 2017

SUBJECT: NUCLEAR PHYSICS-I (PHY 707.5)

(REVISED CREDIT SYSTEM)

Time: 3 Hours Date: MAX. MARKS: 50

Note: (i) Answer any **FIVE FULL** questions

(ii) Any missing data may suitably be assumed.

1. (a) With the help of necessary block diagrams, explain how the mean life time of the excited state of a nucleus can be determined using 'Time to Amplitude converter' circuit.
(b) Explain the selection rules for gamma emission (or absorption). Show that for electric quadrupole and magnetic radiation parity of the final state is same as that of the initial sate. (6+4=10)

2. (a) Derive an expression for 'Stopping Power' in the case of interaction of a heavy charged particle with matter.
(b) If the minimum energy imparted to an electron in Compton scattering is 45 keV, what is the wavelength of the incident photon? (6+4=10)

3. (a) Explain the principle and operation of scintillation detector.

(b) Explain how mass attenuation coefficient of a given material can be determined with the help of a scintillation spectrometer. (5+5=10)

4. (a) What are solid state detectors? Describe the working of a surface barrier detector.

(b) What percentage of incident X-ray radiation passes through 5.0mm of material whose linear absorption coefficient is $0.07mm^{-1}$? Find the half value thickness of aluminium if $\mu = 0.07mm^{-1}$ (6+4=10).

5. (a) Write a note on Fermi-Kurie plot.(b) What is 'Energy Straggling' and 'Range Straggling'? (C) What is 'Bragg Kleeman Rule'? (4+3+3=10)

6. (a) Write a note on Solid State Nuclear Track Detectors.

(b) Alpha particles and deuterons are accelerated in a cyclotron under identical conditions. The extracted beam of particles is passed through an absorber. Show that the expected range of deuterons is twice that of α particles. (6+4=10).

General Data:

(i) Avogadro's Number = 6.023×10^{23} (g-mole)$^{-1}$

(ii) Planck's Constant (h) = 6.63×10^{-34} Js

(iii) Boltzmann's Constant (k) = 1.38×10^{-23} JK^{-1}

(iv) Permittivity of free space (ε_0) = 8.85×10^{-12} Fm^{-1}

(v) Charge on an electron (e) = 1.6×10^{-19} C

(vi) Electron mass = 9.11×10^{-31} kg = 5.4858×10^{-4} u = 0.511 MeV / c^2

(vii) Proton mass = 1.6726×10^{-27} kg = 1.0072765 u = 938.280 MeV / c^2

(viii) Neutron mass = 1.6749×10^{-27} kg = 1.008665 u = 939.573 MeV / c^2

(ix) 1 year = 3.156×10^7 s

(x) Speed of light in vacuum (c) = 3×10^8 ms^{-1}

(Xi) 1 unified mass unit (u) = 931.5 MeV / c^2