2018

PHYSICS

PAPER-304

NUCLEAR PHYSICS - II

Full Marks- 80

Time – 3 hours

The figures in the margin indicate full marks for the questions

1. **Answer the following: (any five)** $3 \times 5 = 15$
    (a) Lowest order of electric multipole moments that may arise from non-spherical charge distribution is electric quadrupole moment – Justify the statement.   3
    (b) Mention the advantages of scintillation detector over other detectors.   3
    (c) Write down the properties of ideal scintillation detector   3
    (d) What is density vibration of a nucleus? Why density vibration cannot be associated with the low-lying energy levels of nucleus.   3
    (d) What do you mean by dead time of a particle detector? Why the concept of dead time is important in the context of particle detector?   2+1
    (f) What do you mean by *quenching* mechanism in a gas-filled detector? Mention the characteristics of quenching gas.   2+1

2. **Answer the following: (any five)** $5 \times 5 = 25$
    (a) Write down the success and failures of single particle shell model.
                                                                        5

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(b) For an even-even nucleus, the 2nd excited state of a rotational band of energy level is found to be at 93 KeV. Calculate the energies of 8^+ and 10^+ energy state of the same band.   5

(b) Discuss the properties and classification of quarks.   5

(c) What do you mean by energy resolution? Why solid state detector has better energy resolution than that of gaseous detector? Why energy resolution increases with energy?   2+2+1

(d) What are the different types of nuclear reactions? Describe with examples.   5

(e) Define critical or grazing angle. If a C^{13} of 80 MeV is bombarded on $^{207}_{82}Pb$ nucleus. Find out the possible value of grazing angle.   5

3. Answer the following (any four) $10 \times 4 = 40$

(a) Write down the mechanism by which electromagnetic radiations interact with matter. Discuss the working of a scintillation detector.

                                                                  6+4

(b) What is CN catastrophe of magnetic moment? How the anomaly was resolved? What is Schmidt line?   2+7+1

Given: the experimental values of magnetic moment of $_6C^{13}$ and $_7N^{15}$ are 0.7 μ_N and -0.28 μ_N respectively and also

$$\mu_p = 2.7925 \, \mu_N; \, \mu_n = -1.9128 \, \mu_N.$$

(c) What is quark model? Obtain the quark composition of spin-0 mesons, spin 1/2 and spin 3/2 baryons using the quark model.   1+9

(d) Write two differences between direct and compound nuclear reaction. Describe the compound nucleus theory of nuclear reactions. Give experimental evidences in support of this theory.   2+8

(e) Write short notes on: (*any two*)   5+5

      (i) Standard Model of particle Physics,

      (ii) Cerenkov detector,

      (iii) Surface-barrier detector.

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(f) What do you mean by geometrical & intrinsic efficiency of a particle detector? Why the efficiency of G.M. counter is larger for β-particles than γ-rays? Why operating voltage of a GM counter is always chosen at the middle of GM plateau? What do you mean by avalanche? Why GM counter cannot identify the incoming radiation that fall on it?   2+2+2+2+2

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