Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

M.Sc.(Physics) (2015 & 2017) (Sem.–4)

RADIATION PHYSICS & NUCLEAR ACCELERATION

Subject Code : MPH-401

Paper ID : [A2823]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTIONS TO CANDIDATES :

1. **Attempt FIVE questions in ALL including COMPULSORY questions no. 9.**

1. a) Describe the factors controlling the selection of a particular type of a nuclear reactor. (10)
   b) Give the classification of a nuclear waste. (10)

2. Write a note on **any two** of the following :

   a) Nuclear fuel cycles and its characteristics.

   b) Boiling water reactor.

   c) Cerenkov counters. (10×2=20)

3. a) What is Synchrotron? Discuss the principle, theory and working of a Synchrotron. (14)

   b) In a drift tube portion of a linear accelerator, protons are accelerated from 1 MeV to 10 MeV. The frequency of AC voltage applied is 100 MHz. Find the length of the first and last drift tubes. (6)

4. a) Explain the principle and working of a betatron with the help of a diagram indicating the details of the component/parts involved in its functioning. (14)

   b) A pulse of 108 protons is injected into a Cyclotron and is kept circulating in a stable orbit with application of RF of 10 MHz. Find the mean beam current. (6)

5. a) Why solid state detectors are preferred over the scintillation detectors? On what factors the efficiency of a detector depend? (14)

   b) In a Scintillation detector, the 662 keV photo-peak of ^{137}Cs gamma source is observed at 6.0 V and the full width at half maximum of the photo-peak is 0.72 V. Find out its resolution in percentage (%) and in keV. (6)

6. a) What is nuclear emulsion technique? Explain, how it is useful for measurement of nuclear radiations? (10)

b) Consider Cerenkov radiation emitted at angle θ relative to the direction of a charged particle in a medium of refractive index n. Show that its rest mass energy m_0c^2 is related to its momentum by $m_0c^2=pc(n^2cos^2\ \theta-1)^{1/2}$. (10)

7. Describe the most important biological effects of large acute doses of radiation with respect to humans. Make a clear distinction between early effects and late effects. Where appropriate give values of radiation dose received and its observed effect. (20)

8. a) Explain, how the neutron flux predicted by diffusion theory can be made to match the actual neutron flux within the diffusing medium. Show the relationship between the boundary geometrical dimensions and the diffusion coefficients D. (10)

b) Sketch the thermal neutron flux profile from the centre of the core to the boundary of a bare reactor and of a reflected reactor. Explain why the neutron flux is different for the two cases. (10)

9. Answer briefly :

a) What is UREX?

b) Define closed nuclear fuel cycle.

c) What is breeding in nuclear reactor?

d) Define distribution coefficient.

e) Differentiate between internal conversion and electron capture processes.

f) Effective dose and absorbed dose

g) Define relative and absolute uncertainty

h) Define radiation dose units.

i) Define nuclear spallation.

j) Give the name of a nuclear radiation detector based on image formation. (2×10=20)