

Mid-West University  
**Examinations Management Office**  
Final Examinations-2082

Bachelor level/ B.Sc./7th Semester

Time: 3 hrs.

Subject: Nuclear and Particle Physics (PHY473)

Full Marks: 60

Pass Marks: 30

*Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.*

**Group – A**

**Attempt all long questions**

**[4x6 = 24]**

1. Define magic numbers. What is the evidence for the shell structure of the nuclei? Explain main assumption of shell model of the nucleus and discuss achievements and limitation of it.
2. Discuss the construction and working principle of linear accelerator with its advantages & drawbacks and hence show that, velocity of charged particle for nth tube is directly proportional to the square root of number of tube inside the chamber.
3. Describe about latitude effect, altitude effect and east west effect of cosmic rays.
4. What do you understand by stopping power of  $\alpha$  – particles? Discuss the quantum mechanical treatment of  $\alpha$  – decay and hence calculate reflection coefficient and transmission coefficient of  $\alpha$  – decay.

**OR**

Derive the law of absorption of  $\gamma$  rays in matter. Define the linear absorption coefficient and mass absorption coefficient in relation to the interaction of radiation with matter.

**Group – B**

**Attempt all numerical questions.**

**[6x4= 24]**

5. Calculate the binding energy per nucleon for  ${}^{209}_{83}\text{Bi}$ . Mass of proton= 1.007825 a.m.u., mass of neutron is 1.008665 a.m.u. and mass of  ${}^{209}_{83}\text{Bi}$  is 208.98 a.m.u.
6. The half-life of  ${}^{24}_{11}\text{Na}$  is 15 hours. How long does it take for 93.75 percent of a sample of this isotope to decay?
7. The linear absorption co-efficient of lead for 1MeV gamma rays is 0.74 cm. Calculate the half thickness of lead for these  $\gamma$  – rays and thickness of lead required to reduce the intensity of  $\gamma$  – rays to 1/1000 of its original value.
8. Which of the reactions can occur? Check them on the basis of conservation laws which govern the elementary particle reactions and decay.
  - i.  $p + p = n + p + \pi^+$
  - ii.  $e^+ + e^- = \mu^+ + \pi^-$
9. A reactor is developing energy at the rate of 1500 KW. How many of atoms of  $\text{U}^{235}$  undergo fission per second? How much mass of  $\text{U}^{235}$  would be used in 1000 hours of operation assuming that on an average energy of 200 MeV is released per fission ?

10. Calculate the parity, magnetic moment and electric quadrupole moment of ground state of  $^{17}_8\text{O}$ .

OR

Determine the mass, size and nuclear density of  $^{27}_{13}\text{Al}$ . (Given mass of a nucleon is  $1.67 \times 10^{-27} \text{ Kg}$ ).

Group – C

Answer in brief any six questions.

[6x2= 12]

11. What is meant by nuclear spin?
12. Describe in short, meson theory of nuclear forces.
13. What do you mean by Mossbauer effect?
14. What is carbon -14 dating? Can it be used to measure the age of stone?
15. What are cosmic rays? Write the difference between primary and secondary cosmic rays.
16. A cyclotron is also called resonance device, why?
17. Explain the significance of binding energy per nucleon curve?
18. Although nucleus is a positively charged, how will you explain  $\beta$  –rays coming out of it?

THE END