

Mid-West University
Examinations Management Office

End Semester Examination 2081

Bachelor level/ B. Sc./ 7th Semester

Time: 3 hours

Subject: Nuclear Physics (PHY473)

Full Marks: 100

Pass Marks: 50

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

1. Answer in short **any EIGHT** Questions. **[8x2 = 16]**
- Differentiate between proportional counter and GM counter.
 - Define the term 'Range' and 'Straggling' of charged particles.
 - Define mirror nuclei with examples.
 - Write some characteristics of neutrino hypothesis of beta decay.
 - State the laws of absorption of gamma ray.
 - What are altitude and azimuth effects of cosmic rays.
 - Show that the mean life is equal to the reciprocal of decay constant for radioactive substance.
 - Why are even-even nuclei most stable?
 - Comment on 'Neutrino interact feebly with matter'.
 - Name the physical quantities which are not conserved in nuclear reactions.

Group – B

2. Answer in brief **any SIX** Questions. **[6x6 = 36]**
- Define magnetic dipole and electric quadrupole moment of nucleus. Also derive an expression of electric quadrupole moment of nucleus.
 - Define nuclear fusion reaction and also calculate the energy released in sun.
 - What do you mean by spin parity of nucleus? Determine the spin parity of ${}^7_3\text{N}^{14}$?
 - Describe construction, principle and working of an ionization chamber.
 - What do you mean by cosmic ray showers? How are they produced?
 - What is Compton effect? Explain the Compton shift on the basis of quantum theory.
 - What are elementary particles? Classify them and mention the important elementary particles in each category.

Group - C

- State the assumptions of liquid drop model. Also discuss about the semi-empirical mass formula based on liquid drop model which is useful for the explaining the total binding energy of nucleus. **[9]**
- Explain the quantum mechanical treatment of alpha decay. **[9]**

OR

Explain the Gammow-Condon and Gury theory of alpha decay. **[9]**

- A cyclotron with Dees of radius 90cm has a transverse magnetic field of 0.8T. Calculate the energies to which (i) a proton (ii) deuteron are accelerated.
(mass of proton = $1.67 \times 10^{-27} \text{ kg}$, mass of deuteron = $3.34 \times 10^{-27} \text{ kg}$). **[6]**
- Calculate the activity of 1gm of Bi^{209} with a half-life of 2.7×10^7 years, in curies. **[6]**

7. Calculate the energy generated in KWH when 0.1kg of ${}^7_3\text{Li}$ is converted into ${}^4_2\text{He}$ by proton bombardment. (Given, mass of ${}^7_3\text{Li} = 7.0183\text{amu}$, mass of ${}^4_2\text{He} = 4.004\text{amu}$, mass of ${}^1_1\text{H} = 1.0081\text{amu}$ and $1\text{amu} = 1.66 \times 10^{-27} \text{ kg}$). [6]

OR

A Betatron working on an operating frequency of 60Hz has a stable orbit of diameter 1.6m. Find the energy gained per turn as also the final energy if the magnetic field at the orbit is 0.5T. [6]

8. Estimate the number of ion pairs produced in a proportional counter by a 10 MeV proton if the counter size and pressure are large enough for all proton energy to be absorbed. If the gas multiplication factor is 100, how much charge flows in the counter when the proton is absorbed. If the pulse current flows for 0.002second through output resistor of 10000Ω , find the height of voltage pulse. [6]
9. Photon of energy 1.02eV undergo Compton scattering through 180° . Calculate the energy of the scattered photon. [6]

The End