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**Reg. No. : .....**

**Name : .....**

**Sixth Semester B.Sc. Degree Examination, April 2024**

**First Degree Programme under CBCSS**

**Physics**

**Core Course X**

**PY 1642 : NUCLEAR AND PARTICLE PHYSICS**

**(2018 Admission Onwards)**

Time : 3 Hours Max. Marks : 80



SECTION – A

Answer **all** questions in **one** or **two** sentences. Each question carries **1** mark.

1. Explain the term mass defect.
2. What are magic numbers?
3. ${}_2He^4$ nucleus has no magnetic moment. Why?
4. What are the assumptions on which Shell model is based?
5. What is nuclear reactor?
6. What do you meant by threshold energy in a nuclear reaction?
7. What is natural radioactivity?
8. What are leptons? Name them.
9. What is a betatron?
10. What is an antiparticle? Give an example.

**(10 × 1 = 10 Marks)**

P.T.O.

## SECTION – B

Answer any **eight** questions, not exceeding a paragraph. Each question carries **2** marks.

11. Obtain an expression for radioactive decay.
12. Write a note on gamma decay.
13. What is nuclear magnetic dipole moment?
14. Explain the basic principle of hydrogen bomb.
15. What is the basic difference between alpha and beta decay?
16. Explain differential cross section.
17. Explain the fundamental characteristics of nuclear forces.
18. What are quarks and their types?
19. What are the uses of nuclear reactors?
20. Draw the voltage characteristics of GM counter.
21. What is lepton quantum number? What is its significance?
22. Explain Cherenkov radiation.

**(8 × 2 = 16 Marks)**



## SECTION – C

Answer any **six** questions. Each question carries **4** marks.

23. Compute the Q-value of the reaction $Be^{9}(d,n)B^{10}$.

    Give mass of $Be^{9}$ = 9.012182u, $B^{10}$ = 10.012938u, d = 2.014102u,

    n = 1.008665u.

24. Calculate the energy required to remove the least tightly neutron from $Ca^{40}$ Given mass of $Ca^{40} = 39.962u$, mass of $Ca^{39} = 38.97u$ and mass of neutron = 1.008665u

25. Calculate the half life time and mean life time of the radioactive substance whose decay constant is $4.28 \times 10^{-4}$ per year.

26. A radioactive substance has half-life period of 30 days. Calculate the time taken for ¾ original numbers of atoms to disintegrate.

27. Calculate the energy released by fission of 1 kg of $U^{235}$ in KWH. The energy released per fission is 200 MeV and Avogadro numbers is $6.023 \times 10^{23}$.

28. A cyclotron in which the flux density is 1.4 weber/$m^2$ is employed to accelerate protons. How rapidly should the electric field between the dees be reversed? Mass of the proton = $1.67 \times 10^{-27}$ kg and charge = $1.6 \times 10^{-19}$ C.

29. A positive pion collide with a proton, two protons plus another particles are created. What is the other particle?

30. A muon $(\mu^-)$ collide with a proton, a neutron plus another particle if formed. What is the other particle?

31. Calculate the binding energy per nucleon for the deuteron. Given

$$m_n = 1.675 \times 10^{-27}\, kg;\ m_p = 1.672 \times 10^{-27}\, kg,\ m_D = 3.343 \times 10^{-27}\, kg$$

**(6 × 4 = 24 Marks)**

## SECTION – D

Answer any **two** questions. **Each** question carries **15** marks.

32. Explain the postulates of liquid drop model. Derive Weizsacker semi empirical mass formula.

33. Explain Geiger-Nuttal law. Describe Geiger-Nuttal method for determining the range of $\alpha$ particles.

34. Explain the working a Cyclotron with neat diagram.

35. Explain nuclear fusion reaction. Write a note on magnetic bottles and tokamak.

**(2 × 15 = 30 Marks)**

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