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Reg. No. : .....

Name : .....

**Sixth Semester B.Sc. Degree Examination, March 2021**

**First Degree Programme under CBCSS**

**Physics**

**Core Course X**

**PY 1642 : NUCLEAR AND PARTICLE PHYSICS**

**(2018 Admission Regular)**

Time : 3 Hours Max. Marks : 80

SECTION – A

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

1. What is atomic mass unit?
2. How do you find the radius of a nucleus?
3. What are the merits of liquid drop model?
4. Explain the term mass defect.
5. Define radioactivity.
6. Give two properties of $\alpha$ rays.
7. What are the three types of neutrinos?

8. What are the four types of nuclear reactions?

9. What is a GM counter?

10. What are hadrons?

**(10 × 1 = 10 Marks)**

## SECTION – B

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

11. What is stability of nuclei?

12. Explain nuclear charge density? Does nuclear density depends on mass number?

13. Draw graphically the variation of binding energy per nucleon and mass number and explain its importance.

14. List out the limitations of liquid drop model.

15. Write down the semi empirical mass formula and explain each term.

16. What is meant by positron emission? Give an example.

17. Distinguish between alpha and beta decay.

18. What is nuclear cross section of a nuclear process?

19. Define and explain the term differential cross section.

20. What are the uses of nuclear reactors?

21. What is the basic difference between cyclotron and betatron?

22. Explain the working principle of linear accelerator.

23. Write a note on quarks.

24. What are the advantages and disadvantages of breeder reactors?

25. What is meant by symmetry?

26. A negative kaon collides with a proton, a positive kaon and another particle are formed. What is the other particle?

**(8 × 2 = 16 Marks)**

## SECTION – C

Answer **any six,** each question carries **4** marks.

27. The binding energy of the neon isotope $^{20}_{10}N$ is 160.647 MeV. Find its atomic mass.

28. 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 = 1.008665 u.

29. How long does it take for 60% of a sample of radon to decay? Half-life of radon is 3.82 days.

30. The half-life of radioactive sample is 4 days. What fraction of 1 gram sample will remain after 20 days?

31. Alpha particle of energy 5 MeV pass through an ionization chamber at the rate of 10 per second. Assuming all the energy is used in producing ion pairs, calculate the current produced.(35 eV is required for producing an ion pair and $e = 1.6 \times 10^{-19} C$).

32. A reactor is developing energy at the rate of 3000 kW. How many atoms of $U^{235}$ Undergo fission per second. Assume that an energy of 200 MeV is released per fission.

33. A self-quenched GM counter operates at 1000 volts and has a wire diameter of 0.2 mm. The radius of the cathode is 2 cm and the tube has a guaranteed lifetime of $10^9$ counts. What is the maximum, radial field and how long will the counter last if it is used on an average for 30 hours per week at 3000 counts per minute. Consider 50 weeks to a year.

34. Show that pion decay, muon decay and pair production conserve the lepton numbers $L_e$ and $L_\mu$.

35. 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.

36. Determine the amount of energy released in D-T (deuterium-tritium) fusion reaction.

37. What radius is needed in proton synchrotron to attain particle energies of 10 GeV, assuming that a guide field of 1.8 Wb/$m^2$ is available?

38. A reactor is developing energy at the rate of $32 \times 10^6$ watts. How many atoms of $U^{235}$ undergo fission per second? Assume that on an average energy of 200 MeV is released per fission.

**(6 × 4 = 24 Marks)**

## SECTION – D

Answer **any two** each question; each question carries **15** marks.

39. What are the properties of nuclear forces? Explain meson theory of nuclear forces?

40. Give salient features of nuclear shell model. Describe how shell model accounts for magic numbers and magnetic moment of the nuclei.

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

42. Give an account of the theory, construction and working of a synchrotron. Give its uses.

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

44. Classify the elementary particles in detail?

**(2 × 15 = 30 Marks)**

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