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Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, July 2024

Physics/Physics With Specialization in Nano Science/Physics With Specialization in Space Physics

PH 242/PHNS 541/PHSP 541 : NUCLEAR AND PARTICLE PHYSICS

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. Each question carries **3** marks.

1. Discuss the conservation laws in nuclear reactions.
2. Explain the three lowest vibrational modes of a nucleus.
3. Explain nuclear forces are non-central forces.
4. Briefly explain Lawson criteria.
5. Write down the four-factor formula for a controlled fission reaction. Explain the terms.
6. What are Higgs bosons? Differentiate it from other bosons.
7. Explain quark structure of mesons.
8. Briefly discuss the working principle of scintillation counters.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **three** questions. Each question carries **15** marks.

9. (a) Discuss on low energy Neutron-proton scattering.

   (b) Discuss on low energy proton-proton scattering.

OR

10. (a) Explain how spin-orbit potential give the proper magic numbers.

    (b) Show that shell model was successful in explaining spin and parity of nucleus.

11. (a) Using a neat diagram, explain the working of a fission nuclear reactor.

    (b) Discuss the different types of fission reactors.

OR

12. (a) Explain proton- proton fusion in stellar interiors.

    (b) Discuss the magnetic and inertial confinement in fusion reactors.

13. (a) Define isospin, Strangeness and Baryon number. Is there any relation between them?

    (b) Discuss the conservation laws and selection rules are obeyed for the creation of strange particles.

OR

14. (a) Explain the working of cyclotron accelerators.

    (b) Discuss the mechanism of synchrotrons.

(3 × 15 = 45 Marks)

PART – C

Answer **three** questions. Each question carries **5** marks.

15. What is the distance of closest approach of a 5 MeV proton to a gold nucleus? How does this distance compare with those for a deutron and an α particle of the same energy.

16. Find the spin and parity of the ground state of the following nuclei using shell model. (a) ${}^{13}_{5}B$ (b) ${}^{13}_{6}C$ (c) ${}^{13}_{7}N$.

17. Calculate the energy released in the following fusion reaction ${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$

18. (a) If 0.190 a.m.u. are converted to energy for every nucleus of U-235 that undergoes the fission process, show that the energy released is indeed approximately 0.9 MeV.

    (b) Show that the fission of 1 kg of Uranium-235 releases approximately a million times more energy than the combustion of 1 kg of coal.

19. Check whether the following reactions are allowed and Identity the type of interaction.

    (a) $p + p \rightarrow K^{+} + K^{+} + n + n$.

    (b) $\Sigma^{+} \rightarrow \wedge^{0} + \prod^{+}$

    (c) $\wedge^{0} \rightarrow p + e$

20. In a cyclotron, protons are accelerated by a high frequency voltage. A uniform magnetic field, of flux density 200 mT, causes the protons to follow a circular path that increases in radius as the protons gain kinetic energy. Immediately before the protons leave the cyclotron, the radius of their circular arc is 1.5 m.

    (a) Calculate the speed of the proton

    (b) Calculate the approximate time taken for the proton to travel around the semicircular Dee.

(3 × 5 = 15 Marks)