P416

MSc DEGREE END SEMESTER EXAMINATION MARCH 2016

SEMESTER – **4: PHYSICS**

COURSE: P4PHYT14, NUCLEAR AND PARTICLE PHYSICS

Time: 3 Hours   Max. Marks: 75

Part A

Objective Type, Answer **all** questions, each question carries 1 mark

1. In the β – decay of neutron, $n \rightarrow p + e^- + \bar{v}_e$, the anti-neutrino$\bar{v}_e$, escapes detection. its existence is inferred from the measurement of

   a) Energy distribution of electrons

   b) Angular distribution of electrons

   c) Helicity distribution of electrons

   d) Forward-backward asymmetry of electrons

2. The decay process, $n \rightarrow p^+ + e^- + \bar{v}$ violates

   a) Baryon number   b) Lepton umber   c) Isospin   d) Strangeness

3. According to Shell model, the total angular momentum (in units of ħ) and the parity of the ground state of the $_3$Li nucleus is

   a) 3/2 with negative parity   b) 3/2 with positive parity

   c) 5/2 with negative parity   d) 5/2 with positive parity

4. $\pi^0 + n \rightarrow \pi^- + p$ is

   a) Strong interaction   b) Weak interaction

   c) e-m interaction   d) electro-weak interaction

5. Number of fission/second in a 100MW- Uranium reactor is of the order of

   a) 10^6 b) 10^{12} c) 10^{18} d) 10^{24}

   (1 x 5 = 5)

Part B

Answer **any five** questions, each question carries 2 marks

6. Distinguish between Leptons and Hadrons.

7. Define Isospin associated with elementary particles.

8. Computed and measured energies corresponding to the ground state rotational bands of nuclei are not quite exact. Why?

9. A certain odd-parity shell model state can accommodate up to a maximum of 12 nucleons. What are its j and l values?

(PTO)

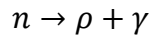10. What is the empirical relation connecting the nuclear radius and the mass number? Obtain the order of magnitude of the density of a nucleus.

11. What are Mirror nuclei? Give examples.

12. Complete the following reactions.

^{27}Al + p $\rightarrow$ _____ +n; ^{32}S + α $\rightarrow$ _____ + γ;

^{197}Au + ^{12}C $\rightarrow$ ^{206}At + _____ ; ^{116}Sn + _____ $\rightarrow$ ^{117}Sn + p;

13. State the conservation principles violated in the following particle interactions

$n \rightarrow \rho + \gamma$ (2 x 5 = 10)
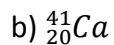
Part C

Answer **any three** questions, each question carries 4 marks

14. Determine the Spin and parity of

a) $^{3}_{2}He$

b) $^{41}_{20}Ca$

15. Explain the exchange force model of Nuclear force.

16. ^{196}Au can decay by β⁻ and β⁺. Find the Q values for the two decay modes.

17. Give the compound nucleus resulting from protons bombarding an Aluminium target and give at least five different ways for the compound nucleus to decay.

18. State and prove CPT theorem?   (4 x 3 = 12)

Part D

(Answer **all** question, 12 marks each)

19. a) Explain the predictions of shell model. How the discrepancies caused in shell model is overcome in collective model.

OR

b) What are the design considerations of the common fission reactor systems? Based on its use how they are categorized?

20. a) Discuss various types of interactions between elementary particles.

OR

b) Explain the quark concept? Describe the quark structure of Mesons and Baryons.

21. a) Discuss in detail the Fermi theory of beta decay. Explain the neutrino hypothesis.

OR

b) Discuss compound nucleus reactions, direct reactions & heavy ion reactions.

22. a) Discuss in detail the neutron-proton scattering at low energies.

OR

b) Explain the properties of nuclear force. Obtain the empirical formula for nuclear radius. Give its importance.

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