E 1693

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B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, MARCH 2015

Sixth Semester

Core Course—NUCLEAR AND PARTICLE PHYSICS

[Common for Model I B.Sc. Physics, Model II B.Sc. Physics, B.Sc. Physics,
B.Sc. Physics-EEM and B.Sc. Physics-Instrumentation]

Time : Three Hours   Maximum Weight : 25

Part A (Objective Type)

Answer **all** *questions.*
Each bunch of four questions carries a weight of 1.

Bunch I

1. Isomers are the atoms having :

    (a) Same mass number.   (b) Same atomic number.

    (c) Same neutron number.   (d) Both (a) and (b).

2. Which of the following nucleus is more stable ?

    (a) Oxygen nucleus.   (b) Xenon nucleus.

    (c) Iron nucleus.   (d) Lead nucleus.

3. Nuclear force is :

    (a) Long range force.   (b) Electrostatic force.

    (c) Short range force.   (d) All of the above.

4. Which of the following decay atomic number remains the same ?

    (a) Beta decay.   (b) Gamma decay.

    (c) Alpha decay.   (d) Both (a) and (b).

Bunch II

5. The nuclear shell model is also named as :

    (a) Electron model.   (b) Independent particle model.

    (c) Atom model.   (d) None.

6. Packing fraction is associated with nucleus in terms of :

    (a) Stability.   (b) Mass defect.

    (c) Nuclear force.   (d) All of the above.

Turn over

7. Ionisation chamber is filled with which of the following gas :

    (a) Methyl bromide.
    (b) Hydrogen.

    (c) Nitrogen.
    (d) None.

8. Gamow's theory of alpha decay depends on :

    (a) Classical physics.
    (b) Quantum physics.

    (c) Both (a) and (b).
    (d) None.

Bunch III

9. The charge of a neutrino is :

    (a) Positive.
    (b) Negative.

    (c) Neutral.
    (d) Either positive or negative.

10. Internal conversion is a :

    (a) Single step process.
    (b) Double step process.

    (c) Either single or double.
    (d) Both (a) and (b).

11. In a nuclear reaction which is conserved :

    (a) Charge.
    (b) Nucleons.

    (c) Parity.
    (d) All of the above.

12. Nuclear fission in a nuclear reactor is :

    (a) Chain reaction.
    (b) Controlled chain reaction.

    (c) Uncontrolled chain reaction.
    (d) All of the above.

Bunch IV

13. In nuclear reactors ———— neutrons are used.

    (a) Slow.
    (b) Fast.

    (c) Very fast.
    (d) Super fast.

14. Which one of the following is a baryon ?

    (a) Photon.
    (b) Electron.

    (c) Sigma.
    (d) Kaon.

15. A meson have how many quarks :

    (a) One.
    (b) Two.

    (c) Three.
    (d) None.

16. The spin value of a baryon is :

    (a) Zero.
    (b) 1/2.

    (c) – 1/2.
    (d) None.

$(4 \times 1 = 4)$

Part B (Short Answer Questions)

Answer any **five** *questions.*
Each question carries a weight of 1.

17. Define mass defect.

18. Write short note on nuclear density.

19. Give few names of nuclear detectors.

20. Define mean life of a radioactive element.

21. State Geiger-Nuttal law.

22. Give one example of artificial radio activity.

23. What is a thermonuclear reaction ?

24. Give the quark model for a proton.

$(5 \times 1 = 5)$

Part C (Short Essay/Problems)

Answer any **four** *questions.*
Each question carries a weight of 2.

25. Give the meson theory of nuclear force.

26. Find the energy release, if two, H^2 nuclei can fuse together to form $^2He_4$ nucleus. The binding energy per nucleon of H^2 and He^4 is 1.1 MeV and 7.0 MeV respectively.

27. Write a note on proton-proton cycle.

28. Calculate the Q-value of the following nuclear reaction in MeV :—

$^7N^{14} + 2He^4 \rightarrow {}_8O^{17} + {}_1H^1 + Q$

Where, $N^{14} = 14.003074$, $He^4 = 4.002604$, $O^{17} = 16.99913$, $H^1 = 1.007825$.

29. Write a note on primary and secondary cosmic rays.

30. Describe about radiation hazards and their disposal.

$(4 \times 2 = 8)$

Part D (Essay)

Answer any **two** *questions.*
Each question carries a weight of 4.

31. Describe the working function of a Bainbridge's mass spectrometer.

32. Give the Gamow's theory of alpha decay and explain it in detail.

33. Discuss the various types of elementary particles in detail.

$(2 \times 4 = 8)$