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(Pages : 2)

Name.....

Reg. No.....

**SIXTH SEMESTER U.G. (CBCSS-UG) DEGREE EXAMINATION, MARCH 2024**

Physics/Applied Physics

PHY6B12/APH 6B 12—NUCLEAR PHYSICS AND PARTICLE PHYSICS

(2019 Admission onwards)

Time : Two Hours

Maximum : 60 Marks

*The symbols used in this question paper have their usual meanings.***Section A – Short Answer type***Answer **all** questions in two or three sentences,  
each correct answer carries a maximum of 2 marks.*

1. Explain the correction in the binding energy formula obtained using liquid drop model.
2. Why do heavy nuclei have more neutrons than protons ?
3. Write a short note on radio isotope production in nuclear reaction.
4. What is the strange behavior of kaons and hyperons ?
5. What is the working principle of an intersecting beam accelerator ?
6. Give the list of leptons. Mention the charge of each particle.
7. What do you mean by quantum chromodynamics ?
8. In general, would you expect fission fragment to decay by positive or negative beta decay ? Why ?
9. Comment on the property of nuclear force.
10. List some similarities and difference between the properties of photons and neutrinos.
11. Explain the working of semiconductor counters.
12. Explain why a fusion reactor requires a high particle density, a high temperature and a long confinement time ?

(Ceiling 20 marks)

**Section B - Paragraph / Problem type***Answer **all** questions in a paragraph of about half a page to one page,  
each correct answer carries a maximum of 5 marks.*

13. Consider a single helium nucleus formed by the fusion of two deuterium nuclei. Mass of  ${}_1\text{H}^2 = 2.014102u$  ; mass of  ${}_2\text{He}^4 = 4.002604u$ . Find out the energy released in fusion.
14. Distinguish between fission and fusion reactions. Explain the fusion process in stars.

**Turn over**

15. Determine whether the following reactions are allowed or forbidden.

- (i)  $p + p \rightarrow n^+ + p + \pi^+$ .
- (ii)  $p + \pi^- \rightarrow \pi^0 + n$ .
- (iii)  $e^+ e^+ \rightarrow \mu^+ + \pi^-$ .

16. Discuss briefly low energy reaction kinematics.

17. The disintegration constant  $\lambda$  of a radioactive element is 0.00231 per day. Calculate its half-life and average life.

18. Discuss the Quark model.

19. A reactor is developing energy at the rate of 3000kW. How many atoms of  $U^{235}$  undergo fission per second ?

(Ceiling 30 marks)

### Section C - Essay type

*Essays - Answer in about two pages, any **one** question.  
Answer carries 10 marks.*

20. Using a neat diagram explain the working principle of Van de Graaff electrostatic generator.

21. Explain the different elementary particle quantum numbers and their conservation laws with examples.

(1 × 10 = 10 marks)