

**B. Sc. DEGREE END SEMESTER EXAMINATION : MARCH 2023****SEMESTER 6 : PHYSICS****COURSE : 19U6CRPHY11 : NUCLEAR, PARTICLE PHYSICS AND ASTROPHYSICS***(For Regular - 2020 Admission and Supplementary - 2019 Admission)*

Time : Three Hours

Max. Marks: 60

**PART A****Answer any 8 (2 marks each)**

1. Write the number of neutrons and protons in the nucleus of  ${}_{88}^{226}\text{Ra}$ .
2. Give the reason behind east west effect.
3. What are mirror nuclei? Give examples.
4. A stars luminosity depends on which of its two factors?
5. Name the four interactions between elementary particles.
6. Comment on the spin magnetic moment orientation, w.r.t the nuclear spin, of a proton and a neutron inside the nucleus.
7. Why a fast breeder reactor is called so?
8. Write the expression for the nuclear spin and explain.
9. Comment on the spins of neutrino and anti neutrino.
10. Plot variation of cosmic ray intensity as a function of altitude.

**(2 x 8 = 16)****PART B****Answer any 6 (4 marks each)**

11. An astronomical object named Cygnus X-1, a strong X-ray source, is found to radiate like a black body with peak wavelength at 1.45 nm. Calculate its temperature. Assume that the constant for Wien's displacement law is equal to  $2.9 \times 10^{-3} \text{mK}$ .
12. 1g of radium got reduced by 2.1 mg in 5 years. Determine the half life period of radium.
13. Write a note on the confinement methods.
14. How much energy in eV does a mass of 1u (unified atomic mass units) correspond to? Prove your answer.
15. Name the conservation law violated in the following decay  
 $\Lambda^0 \rightarrow n + \gamma$
16. Describe the four fundamental interactions between elementary particles, their range, the particles exchanged and their relative strengths.
17. There are two (A and B) stars under observation. Both stars have the same temperature but star A is 10000 times more luminous than star B. Which star is larger and by how much?
18. What is the energy required to remove the last tightly bound neutron from  ${}_{20}^{40}\text{Te}$ . Given mass of  ${}_{20}^{40}\text{Te} = 39.962589u$  and mass of  ${}_{20}^{39}\text{Te} = 38.970691$  also given that  $m_p = 1.00727u$  and  $m_n = 1.00867u$ .

**(4 x 6 = 24)**

### PART C

#### Answer any 2 (10 marks each)

19. Write and explain the five elementary particle quantum numbers by giving an example of proton proton collision process and neutron decay process. Also write about the conservation laws and the symmetry associated with them.
20. Explain the working of a Cyclotron. Also calculate the energy attained by the particle. Discuss its limitations.
21. Explain nuclear fission and fusion, with example reactions. What are its applications.
22. What are quarks? Mention the flavor of quarks, their charge and strangeness number . Also mention about quark color and quark confinement

**(10 x 2 = 20)**