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D6BPH2104

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Reg.No.....

Name:

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2024

(Regular/Improvement/Supplementary)

PHYSICS

GPHY6B13T: RELATIVISTIC MECHANICS AND ASTROPHYSICS

Time: 2 Hours

Maximum Marks: 60

SECTION A: Answer the following questions. Each carries *two* marks.

(Ceiling 20 Marks)

1. State the Lorentz transformation equations.
2. Name the physical quantities that are invariant under Lorentz transformations?
3. Give two examples to show that mass and energy are interconvertible.
4. Explain the principle of equivalence in general theory of relativity.
5. What is Friedmann equation and what are its implications?
6. Explain the term critical density in the context of geometry of the universe?
7. Distinguish between the terms Luminosity and Brightness in astronomy. Provide the relationship between brightness (b) and Luminosity (L).
8. Draw the schematic of Proton-Proton chain reaction in Sun. Provide the net chain reaction equation.
9. What is hydrogen shell burning in the post-main sequence evolution of a star.
10. Briefly explain the reason why a protostar with mass $150-200 M_{\odot}$ or $0.08 M_{\odot}$ cannot evolve into a main sequence star.
11. Distinguish between Population-I and Population-II stars.
12. What is a spiral Galaxy? Mention its features.

SECTION B: Answer the following questions. Each carries *five* marks.

(Ceiling 30 Marks)

13. In a frame S , two events have the space-time coordinates $(0, 0, 0, 0)$ and $(10c, 0, 0, 6)$. Find the space-time interval between them. Calculate the velocity of a frame in which (i) the two events are simultaneous (ii) first event occurs 8 sec earlier than the second, and (iii) the second event occurs 8 sec earlier than the first.
14. The velocity of an object is such that its mass increases by 10 %. (i) By what fraction does its length in the direction of motion decrease? (ii) If its rest energy is W_0 , what is its kinetic energy?
15. With the help of a schematic, explain any two tests of general theory of relativity.

(PTO)

16. Distinguish between Galactic cluster and Globular star cluster. Give few examples each.
17. Describe the helium burning and helium flash stages in the post-main sequence evolution of a star.
18. Explain the post main sequence evolution and nuclear burning of a high mass star with mass greater than $4M_{\odot} < 8M_{\odot}$.
19. What are the Hubble's classification of Galaxies?

SECTION C: Answer any *one* question. Each carries *ten* marks.

20. Derive the Doppler shift in light for two cases: (i) source in motion and (ii) observer in motion.
21. Briefly describe Hertzsprung-Russel diagram (HR) and write a note on the four grouping of stars found from HR diagram. Distinguish between Sun, Sirius B and Betelgeuse based on their location in HR diagram.

(1 x 10 = 10 Marks)