

**SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2025****(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. A galaxy has an observed H $\alpha$  line at 662.9 nm. The rest wavelength of H $\alpha$  is 656.3 nm. Calculate the redshift of the galaxy and its velocity of recession.
2. Explain the process of energy transport from core to the surface of Sun.
3. How does core shrinking of sun leads to the expansion of surface during the main sequence phase.
4. Write down the Lorentz velocity transformation equations.
5. Show that the velocity of a particle having zero rest mass is equal to the velocity of light.
6. What is stellar classification?
7. Write a short note on Galactic cluster or open cluster? Give one example.
8. What is Trumpler classification of stars?
9. What is hydrogen shell burning in the post-main sequence evolution of a star.
10. Briefly explain elliptical Galaxy, irregular Galaxy and lenticular Galaxy.
11. Prove that the photon picture of light can also explain Doppler shift in light. Prove the uniqueness of velocity of light.
12. State Kepler's third law of planetary motion and write down the expression for tangential velocities of stars in a galaxy.

**SECTION B: Answer the following questions. Each carries five marks.****(Ceiling 30 marks)**

13. Write a note on apparent magnitude (m) and absolute magnitude (M) and provide the relation between absolute magnitude and apparent magnitude. Calculate the absolute magnitude of Pollux which is at a distance of 33.72 l.y. and has an apparent magnitude of 1.16 [1 l.y.= 0.306 pc].
14. If a proton is moving with a velocity of 0.995 c, calculate the corresponding relativistic energy and momentum. (rest mass= $1.67 \times 10^{-27}$  kg)

**(PTO)**

15. Write a brief note on cosmic microwave background radiation.
16. What are Blackholes? Define the terms singularity, event horizon and Schwarzschild radius.
17. A rod has a length of 1 m. It is moving in a space-ship moving with a velocity of  $0.4c$  relative to the earth. Calculate its length as measured by an observer (i) on space-ship; (ii) on earth.
18. What is Wien's law? Define Stefan Boltzmann law and provide the relationship between Luminosity and radius of a star. Estimate the peak wavelength using Wien's law and then roughly predict the corresponding region of EM spectrum of the stars having surface temperature:  
(a) Sun: 5800 K (b)  $\alpha$  Canis Majoris: 9200 K and (c) o Ceti: 1900 K.
19. What are Active Galaxies? Explain the features of AGN.

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

20. Describe the Michelson-Morley experiment and discuss the importance of its negative results. Explain how it could be confirmed from Michelson-Morley experiment that the velocity of light is invariant in all possible inertial frames of reference.
21. What are pulsating stars or variable stars? Explain the different type of pulsating stars. Draw the HR diagram of variable stars. Why do stars pulsate?

**(1 x 10 = 10 Marks)**