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Fourth Semester M.Sc. Degree Examination, July 2024

Physics with specialization in space physics

SPECIAL PAPER

PHSP 543 : INTRODUCTION TO ASTROPHYSICS

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

SECTION – A

Answer any **five** questions. Each question carries **3** marks.

1. What is the celestial coordinate system?

2. Why are the dish sizes of radio telescopes typically larger than optical telescope diameters for resolving similar astronomical sources?

3. Describe any method for measuring distance to astronomical sources.

4. The virial theorem for stars implies that gravitational potential energy is not the main source of energy generation in stars. Explain.

5. What is the Stromgren sphere? How does the stromgren radius change with the temperature of a star?

6. The wavelength of Lyman-α the line from a galaxy is received at $152nm$. Compute the speed with which the galaxy moves away from our galaxy due to cosmic expansion. The laboratory frame Lyman - α wavelength is $121.567nm$.

P.T.O.

7. Discuss any observational evidence for the existence of a supermassive black hole at our galaxy center.

8. Write a short note on Hubble's classification scheme for galaxies.

(5 × 3 = 15 Marks)

SECTION – B

Answer any **three** questions. Each question carries **15** marks.

9. (a) Discuss the evolution of stars using an HR diagram. Also mark the position of white dwarfs and giant stars on the HR diagram.

   (b) Define the color index of a star. Can you infer the temperature of the star from its color.

OR

10. (a) Explain the Saha equation. Explain one of its applications in astrophysics. The dominant emission by class O stars is at much higher frequencies than that by class M stars in the Harvard spectral classification system. Why?

    (b) Near-infrared radiation is absorbed by water in the atmosphere. How do astronomers do near-infrared observations in this context?

11. (a) Briefly describe the primary energy generating nuclear reactions in stars.

    (b) Why is the PP cycle the dominant source of energy production in the sun rather than the CNO cycle?

OR

12. (a) Derive the conditions for hydrostatic equilibrium in stars.

    (b) Discuss the conditions for forming white dwarfs and neutron stars.

13. (a) Starting from the Friedman equations, obtain the evolution of scate factor in flat and closed Universes.

    (b) What are the key components of a Milky Way-like galaxy?

OR

14. (a) What are galaxy rotation curves? How would you measure the galaxy rotation curve?

    (b) Describe how galaxy rotation curves can be used to infer the presence of dark matter.

(3 × 15 = 45 Marks)

SECTION – C

Answer any **three** questions. Each question carries **5** marks.

15. Find the effective temperature of a star with twice the radius of the sun and whose bolometric magnitude is the same as that of the sun. The effective temperature of the sun is $5780K$.

16. A star is found to emit most light at a wavelength of about 500 nm. What is the surface temperature of the star?

17. Discuss the important energy transport mechanisms inside a star.

18. What is the condition for the formation of a black hole? The mass and angular momentum of a black hole is doubled. What happens to its Schwarzchild radius?

19. The value of the Hubble parameter at present is given by 70 km/s/Mpc. Assuming that the value of the Hubble parameter does not change with time, obtain an estimate of the age of the Universe, given 1 Mpc = 3.08×10^{22}m.

20. The velocity dispersion (root mean square velocity) of galaxies in a cluster of size 1.2 Mpc is 1500 kmS^{-1}. What is the approximate mass of the cluster in solar mass units? One solar mass is 2×10^{30} kg.

($3 \times 5 = 15$ Marks)