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N – 7228

Reg. No. :

Name :

Fourth Semester M.Sc. Degree Examination, August 2022

Physics with Specialization in Space Physics

Special Paper

PHSP 543 : INTRODUCTION TO ASTROPHYSICS

(2020 Admission)

Time : 3 Hours

Max. Marks : 75

PART – A

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

[$G = 6.67 \times 10^{-11} \text{ Nkg}^{-2}\text{m}^2$, $M_H = 1.66 \times 10^{-27} \text{ kg}$; $1P_C = 3 \times 10^{16}\text{m}$; $1Yr = 3.10^7 \text{ s}$]

1. (a) What is the ecliptic?
(b) Define parsec.
(c) State Wien's law.
2. Argue one advantage of a space-based telescope over a ground-based one.
3. What is the basis of Stellar classification? What are the different stellar spectral classes?
4. What is the concept of the Stromgren sphere?
5. Explain the chandrasekhar limit.

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6. Give any three features which distinguish Population I stars and Population II stars.
7. Briefly describe the three main morphological classes of galaxies.
8. How did the idea of dark energy came about?

(5 × 3 = 15 Marks)

PART – B

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

9. (a) Explain the universal coordinate system and also how the right ascension and declination of a celestial object may be determined.
- (b) Explain how trigonometric parallax method is employed to determine the distances to stars.

OR

10. (a) Explain how absorption and emission spectra arise.
- (b) How does one understand stellar spectra in the light of the Boltzmann equation and the Saha ionization equation?
11. (a) State the characteristics features of black body radiation. Use the black body approximation to obtain a relation between stellar luminosity and surface temperature.
- (b) State the virial theorem. Use it to obtain Jean's criterion for gravitational collapse.

OR

12. (a) What is the energy production mechanism operating in stars? Obtain an expression for the nuclear time scale.
- (b) Draw the HR diagram schematically. What is the understanding about the main sequence?



13. (a) Detail the observations that suggest the existence of dark matter halos for spiral galaxies.
- (b) Detail the arguments that lead to the notion of dark matter in cluster of galaxies.

OR

14. (a) Starting from the equations based on Newtonian Cosmology show the possibility for open/closed/flat models for the Universe.
- (b) What are the observed characteristics of the cosmic microwave background radiation? What is its origin?

(3 × 15 = 45 Marks)

PART – C

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

15. A star of absolute magnitude 5 appears to be of magnitude 10. How distant is the star?
16. A star which has the same surface temperature as the sun is twice as luminous. How much is its radius in solar units?
17. Determine the time scale for star formation in a gas cloud of number density 10^4 H molecules per cc size 0.1 pc and temperature 10^2 kelvin.
18. Consider two stars just before collapsing within their respective event horizons. Mass of star 1 is twice that of star Z. Compare their mean densities at this stage.
19. A spiral galaxy shows a flat rotation curve beyond a radius of 10 kpc with rotation speed 300 km/s in the flat portion. Estimate the mass present within 10 kpc radius. $M_0 = 2 \times 10^{30}$ kg.
20. A galaxy has a recession velocity of 10000 km/s. How much would be the separation in wavelength of the sodium D1 and D2 lines (5890 and 5896 Angstroms) in its spectrum? $H = 70 \text{ kms}^{-1}/\text{Mpc}$.

(3 × 5 = 15 Marks)

