K24P 0327

Reg. No.: .....

Name : .....

IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple.-(One Time Mercy Chance)/Imp.) Examination, April 2024
(2014 Admission Onwards)
PHYSICS
PHY 4E07 : Astrophysics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** the questions (Either **a** or **b**).

I. a) Describe the stellar evolution using an HR diagram. How can one use an HR diagram to find the distance to main-sequence stars ?

OR

b) Discuss various processes of energy generation in stars.

II. a) Explain the mechanism of energy production in active galaxies. Also, describe their e unification scheme.

OR

b) Define scale factor in cosmology. How is it related to cosmological redshift ? Derive the equation for the evolution of scale factor as a function of time using Newtonian gravity. **(2×12=24)**

SECTION – B

Answer **any four** questions (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**).

III. a) Write down the Saha equation. Explain one of its applications in astrophysics.

b) The dominant emission by class O stars is at much higher frequencies compared to that by class M stars in the Harvard system of spectral classification. Why ?

c) A sun-like star is placed at a distance of 2 kilo parsec. Find its magnitude (magnitude of the sun is –26.74 and distance to the sun is 4.79×10^{-6} parsec.

P.T.O.

IV. a) Discuss the conditions for the formation of neutron stars and black holes.

b) Virial theorem suggests that gravitational potential energy is not the main source of energy generation in stars. Explain.

c) Derive the conditions for hydrostatic equilibrium in stars.

V. a) What are contact binaries ?

b) How binary stars are used for directly determining the masses of stars ? Why is it, in general, not possible for single stars ?

c) Obtain the relation between masses, radii, and orbital speeds of binary stars.

VI. a) Write a short note on the classification scheme for galaxies.

b) Most of the mass in a galaxy is not confined within a small central region. Explain this using the galaxy rotation curves.

c) A galaxy cluster typically consists of 10^{71} protons and has a temperature of 10^{8}k. Its X-ray luminosity is 10^{37}W. Show that the hot gas in a galaxy cluster will remain hot by showing that the cooling time of the cluster is greater than the age of the Universe.

VII. a) What is the Robertson-Walker metric of the Universe ? Explain the terms in the expression for the metric.

b) Show, by solving the Friedmann equations, that the scale factor eventually goes to 0 with time in a closed Universe (k = +1).

c) Assume that the universe is filled with a hypothetical component of the matter, whose density remains constant during the expansion of the universe. Show, by solving the Friedmann equations that, the scale factor grows exponentially with time (i.e. $a(t) \alpha e^{kt}$ where k is a constant).

VIII. a) How does the surface density of a disk galaxy vary with the disk radius ?

b) Why are orbital periods of visual binaries larger than those of spectroscopic binaries ?

c) Given the present-day density parameter of matter Ω_M =1 and the Hubble parameter H_0 = 70 km/s/Mpc, obtain the age of the Universe. You are also given I Mpc = 3.08×10^{22} m. **(4x9=36)**