K23P 0211

Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple./Imp.)
Examination, April 2023
(2019 Admission Onwards)
PHYSICS
PHY 4E07 : Astrophysics

Time : 3 Hours

Max. Marks : 60

SECTION – A

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

I. a) Derive equations of stellar structure describing the radial change in mass, pressure luminosity, and temperature of a star.

   OR

   b) Describe in detail the structure and classification of galaxies. Also, explain any method to determine the Hubble parameter (H_0) from observations.

II. a) What is a galaxy rotation curve ? How would you measure it ? Describe in detail how galaxy rotation curves can be used to infer the presence of dark matter.

   OR

   b) Obtain the Friedmann equations of the Universe by assuming a spherically symmetric Universe and considering Newtonian gravity. Also define the critical density of the Universe. **(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) Explain why most of the radiative output of class O stars in Harvard spectral classification is in the ultraviolet range.

   b) How would you use the HR diagrams to compute the distance to main-sequence stars ?

   c) The apparent magnitude of a star at 25 parsecs is –3.5. What is its absolute magnitude ?

P.T.O.

IV. a) Describe with a diagram, the evolution of a sun-like star on the HR diagram.

b) What is the triple-alpha process ? Why is it present only in massive stars ?

c) Prove that the sum of thermal and gravitational potential energy of a star should be negative.

V. a) What are the key features of the *fission theory* of the origin of binary stars ?

b) Explain the nature of the light curves of any two classes of eclipsing binaries.

c) The total mass of a binary system of stars A and B is 5 $M_\odot$, where $M_\odot$ is the mass of the Sun. Star A is twice as far from the center of mass as star B. Compute the mass of each star.

VI. a) Write a short note on the unification scheme of AGNs.

b) Briefly describe the mechanism of energy production in active galactic nuclei.

c) The wavelength of the Lyman-α line from a nearby galaxy is received at 123 nm. Find the approximate distance to the galaxy. The laboratory frame Lyman-α wavelength is 121.567 nm and the Hubble parameter is 70 km/s/Mpc.

VII. a) Distinguish between the evolution of scale factor in an open and closed Universes.

b) Describe how the density of matter and radiation change as a function of scale factor as the Universe expands.

c) Show by solving the Friedmann equations that in a matter-dominated Universe, the scale factor evolves as $a(t) \propto t^{2/3}$.

VIII. a) Distinguish between neutron stars and pulsars.

b) How would you detect eclipsing binaries ?

c) The plasma jet from a quasar travels at a speed of $c/\sqrt{2}$. The transverse speed of the jet with respect to the line of sight is the same as the speed of light. Find the angle that the jet makes with respect to the line of sight.

(4×9=36)

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