PG Even Semester Examination, May 2025

PHYSICS

(4th Semester)

Course No.: PHYCC-653B

(Astrophysics-II)

Full Marks: 70

Pass Marks: 28

Time: 3 hours

The figures in the right margin indicate full marks for the question.
Answer any five questions selecting one from each unit.

UNIT-I

1. (a) What is a nebula? What are different types of nebulae in our galaxy? Make a comparative of different types of nebulae. Which nebula is important for star formation studies and why? 1+5+2=8

   (b) What is external nebula? Discuss the Shapley-Cartis debate and how their distances were calculated? 2+4=6

2. (a) Describe briefly how proto starts are formed. Also describe about the source and the nature of radiation from proto stars. 5

   (b) What are open and globular clusters? Make a comparative study between them. 5

(c) What is IMF? Describe the different types of IMFs. 4

UNIT-II

3. (a) Describe the mass-radius relation for a white dwarf (WD) and the position of the WDs on HR diagram. 7

   (b) Describe electron and neutron degenerate pressures and how compact objects are formed. 7

4. (a) Describe different types of binaries. What is Roche's lobe? How X-Ray emission can take place from some binaries? 7

   (b) Describe how total mass of a binary system can be obtained for photometric and spectroscopic binaries. 7

UNIT-III

5. (a) What is Hubble's Tunning fork diagram? Describe the scheme for morphological classificiation of different galaxies. 7

   (b) What are AGNs? How are they different from normal galaxies? What are the possible sources of radiation for different AGNs? 7

6. (a) What is dark matter? How does one prove its existence in our galaxy? Make an estimate about the amount of dark matter in one galaxy. 8

   (b) Make schematic diagrams, showing the structure of our galaxy. Show the edge on and face on views. Show the arms, bulge and Halo. Comment in which part of the galaxy younger and older stars are distributed? 6

UNIT-IV

7. (a) Derive a metric which describes a homogeneous and isotopic universe. 10

   (b) Define geodesic co-ordinates and explain its significance. 4

8. For the following metric, identify the components of the metric tensor and evaluate the five non-zero Christoffel symbols of second kind.

$$ds^2 = \left(1+\frac{a}{r}\right) c^2dt^2 - \left(1\frac{a}{r}\right)^{-1} d\pi^2$$

$$-r^2 (d\theta^2 + Sin^2\theta d^2G)$$

Write down the necessary and suffcient conditions for the space to be flat. 2+2x5+2

UNIT-V

9. Describe the four stages of Bigbang Nucleosynthesis (BBN). Discuss with a neat diagram how the light elements are synthesized during BBN. 8+6

10. (a) How does one estimate the age of the universe? 6

    (b) Discuss the flatness and horizon problem in brief. 4+4

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