

**November 2025**  
**M.Sc.**  
**Third Semester**  
**DISCIPLINE SPECIFIC ELECTIVE – 02**  
**PHYSICS**  
*Course Code: MPHD 3.21 (A)*  
(Astronomy & Astrophysics)

*Total Mark: 70*  
*Time: 3 hours*

*Pass Mark: 28*

*Answer five questions, taking one from each unit.*

**UNIT-I**

1. (a) Explain the concept of the celestial sphere. Draw and explain the main circles on it (celestial equator, ecliptic, horizon, meridian). 2+4=6
- (b) What are cardinal points and equinoctial points? Discuss their importance in astronomy. 2+2=4
- (c) Define an astronomical triangle and explain its different terms. 4
2. (a) Distinguish between solstices and equinoxes with neat diagrams. 3+3=6
- (b) Differentiate between sidereal time, apparent solar time, and mean solar time. 2+3+3=8

**UNIT-II**

3. (a) A star has apparent magnitude  $m = 10.0$  and absolute magnitude  $M = 5.0$ . Calculate its distance in parsecs and in meters. 3+1=4
- (b) Define flux and luminosity of a star. Derive the relation between apparent magnitude, absolute magnitude, and distance modulus. 2+4=6
- (c) The apparent magnitude of the Sun is  $-26.81$  and that of the star Alpha Centauri is  $-0.27$ . Which one of them is brighter and by how much amount? 2+2=4

4. (a) What is the diffraction-limit angular resolution (in arcseconds) of a telescope with aperture  $D = 2.5$  m observing at  $\lambda = 550$  nm. 4
- (b) Define magnification, light-gathering power, resolving power, and diffraction limit in the context of optical astronomy.  $2+2+2+2=8$
- (c) Discuss how atmospheric windows influence ground-based astronomical observations. 2

### UNIT-III

5. (a) Compare the inner (terrestrial) planets, Jovian (gas giant) planets, and dwarf planets with respect to their physical and orbital characteristics. 8
- (b) Describe the important solar parameters such as mass, radius, luminosity, and effective temperature. Discuss how these parameters determine the Sun's position on the H-R diagram. 6
6. (a) What are the differences between comets and meteors?  $2+2=4$
- (b) Differentiate between meteors and meteorites with examples.  $2+2=4$
- (c) Discuss the structure of the solar atmosphere. Highlight their physical properties and observational features. 6

### UNIT-IV

7. (a) Describe the Hubble classification scheme of galaxies. Compare the characteristics of elliptical, spiral, and lenticular galaxies with neat diagrams. 8
- (b) Discuss the morphology of the Milky Way Galaxy. Explain its different components – disk, bulge, halo, and spiral arms. 6
8. (a) What are binary stars? Discuss different types of binary stars and explain how they help in determining stellar masses.  $2+4+2=8$
- (b) What are variable stars? Explain the Cepheid variable stars and the significance of the period-luminosity relation in determining distances to far away stars and galaxies. 6

## UNIT-V

9. Consider a simple model of a star in which the density decreases linearly with radius,  $\rho(r) = \frac{\rho_c}{\left(1 - \frac{r}{R}\right)}$ , where  $\rho_c$  is the central density and  $R$  is the stellar radius.
- (a) Derive an expression for the total mass of the star in terms of central density and radius  $R$ . 7
  - (b) Using the condition of hydrostatic equilibrium, derive the variation of pressure with radius inside this star. 7
10. (a) Explain the evolution of low stars on the H-R diagram from the main sequence to the red giant and asymptotic giant branch. Also, explain what Hayashi track is. 8+2=10
- (b) What is the Chandrasekhar limit? Explain its significance in determining the fate of a star. 4
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