



5981

23.12.2024(M)

Examination Roll No.

S. No. of Question Paper :

Unique Paper Code :

Name of Paper : **Astronomy and Astrophysics**

Name of the Course : **B. Sc. (H) Physics – DSE**

Semester : **V**

Duration: 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **four** questions in all including Question 1 which is compulsory.

Q1. Attempt any five questions:

(5 x 3)

- (a) Define the components of Geographical coordinates with the help of a relevant diagram.
- (b) Name the different spectral classes in which stars are classified. How does the temperature of stars vary from early type to late type.
- (c) Which transition in III produces a low energy phonon of wavelength of 21-cm and name the telescope which is used to detect signal of this wavelength.
- (d) What is the diffraction limit of resolution of a 20 cm telescope. For wavelength of 500 nm ?
- (e) Why does the temperature in the chromosphere increases with height?
- (f) State Hubble Law. A galaxy has a recessional velocity of 19250 m/s. What is the distance of the Galaxy. Given that $H_0 = 70 \text{ km/s/Mpc}$.

Q2.(a) Explain at least two methods to estimate the stellar radii.

(5)

- (b) (i) Define proper motion of a star. How is it different from the radial motion of a star.
- (ii) Derive an expression for proper motion of star

$$V_p = 4.74 \times \theta \times r$$

where V_p is in Km/s and θ is in arc-sec per year and r is in parsec. (3, 3)

- (c) A star is brought from 40 pc to 5 pc. Calculate the change in its magnitude. (4)

Q3. (a) Define the elements and angles of the Horizon coordinates system and show them on an appropriate diagram. (8)

- (b) Coordinates of stars A and B in the Universal Equatorial System are as follows: Right ascension $\alpha_A = 10^h$, declination $\delta_A = 70^\circ$ and $\alpha_B = 11^h$, $\delta_B = 80^\circ$ respectively, where α is the right ascension and δ is the declination of a star. Find the distance between the two stars. (7)

Q4. (a) A giant refracting telescope at an observatory has an objective lens of focal length 15m. If an eyepiece of focal length 1.0 cm is used, what is the angular magnification of the telescope in normal adjustment. If this telescope is used

to view moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is $3.48 \times 10^6 \text{ m}$ and the radius of the lunar orbit is $3.8 \times 10^8 \text{ m}$. (5)

(b) Calculate the apparent magnitude of a Binary star (system of two stars). Given that the individual apparent magnitude of two stars are 1.0 and 2.0. (5)

(c) What are optical telescopes. Explain different types of optical telescopes, including their relative advantages and disadvantages. (5)

Q5. (a) Using Maxwell's equations, derive the following expression for magnetohydrodynamics

$$\frac{\partial \vec{B}}{\partial t} = \vec{\nabla} \times (\vec{v} \times \vec{B}) + \eta \nabla^2 \vec{B}$$

where the symbols have the usual meaning. (8)

(b) Explain the physical significance of magnetic Reynold number. (2)

(c) Draw labeled Hertzsprung-Russell (H-R) diagram. Write at least three features of H-R diagram. (5)

Q6. (a) Draw Rotation curve for a galaxy and discuss how it explains the concept of dark mass. (8)

(b) In the center of our galaxy, in the intense radio source Sgr A*, there is a black hole with large mass. A team of astronomers measured the angular distance of a star from Sgr A* and its orbital period around it. The angular distance was $0.12''$ and the period was 15 years. Distance between the center of the Milky Way galaxy and the Earth is 8.5 Kpc. Calculate the mass of black hole in terms solar mass. (7)

Q7. (a) Explain how the Cepheid variables are used to estimate astronomical distances. (5)

(b) State and derive Virial theorem for N body system. (7)

(c) Use Virial theorem to estimate the mass of a galaxy cluster whose radius is $R = 2.2 \text{ pc}$ and $\sqrt{\langle v_r^2 \rangle} = 1008 \text{ m/s}$, where v_r is the radial velocity. (3)

Table of Constants:

Mass of Sun	$M_{\odot} = 2 \times 10^{30} kg$
Radius of Sun	$R_{\odot} = 7 \times 10^8 m$
Temperature of Sun	$T_{\odot} = 5800 K$
Luminosity of Sun	$L_{\odot} = 4 \times 10^{26} W$
Solar Constant	$S = 1400 m/m^2$
Boltzmann Constant	$K_B = 1.38 \times 10^{-23} J/K$
Gravitational Constant	$G = 6.6 \times 10^{-11} Nm^2 Kg^{-2}$
Hubble Constant	$H_0 = 70 Km / s / Mpc$

Conversions:

$1AU = 1.5 \times 10^{11} m$
$1Ly = 9.46 \times 10^{15} m$
$1pc = 3 \times 10^{16} m$