Department of Physics & Astrophysics
(University of Delhi)
M.Sc. PHYSICS/III Sem.

PHYS-555
(Astronomy & Astrophysics-I)

Time: 3 Hours Maximum Marks:70

(Write your Roll No. on the top immediately on receipt of the question paper.)
Attempt any four questions. All symbols have their usual meanings.

1. (a) Describe the Ecliptic system of co-ordinates. How would you convert the equatorial co-ordinates of an object to ecliptic co-ordinates?

(b) A star is observed to cross the meridian at an altitude of $+60^0$ at a time when the LST is $+5^h$. If the observer is at a latitude of $+30^0$, what are the right ascension and declination of the star ? What would its altitude be at this time for an observer at latitude -30^0 ?

(c) Show that, when a star of declination δ sets for an observer at latitude ϕ, its hour angle H is given by

$$cos\, H = -tan\, \phi\, tan\, \delta.$$

(d) Explain why northern and southern stars are equally visible for 12 hours for an observer on the equator. $(5, 5, 4, 3\frac{1}{2})$

2. (a) A pulse counting photometer is used to obtain B and V band counts for a star and the values obtained are 2592 and 3087 respectively. What is the color index of the star?

(b) Describe how astronomers use the method of spectroscopic parallax to determine stellar distances.

(c) A galactic cluster has a well-defined main sequence with a turn-off point at $L/L_\odot = 81$. Assuming that the mass-luminosity relation for stars near the turn-off point is $L/L_\odot = (M/M_\odot)^4$, and that the main-sequence lifetime of the Sun is 10^{10} yr, estimate the age of the cluster.

(d) Using Newton's form of the Kepler's third law, how can one find masses of the components of a visual binary system? $(3, 4, 5, 5\frac{1}{2})$

3. (a) Draw the butterfly diagram and list all the characteristics regarding the formation and evolution of the sunspots and the solar activity cycle that the butterfly diagram represents.

(b) Explain the physical meaning of critical point in Parker's solar wind model. Assuming coronal temperature to be 2 million Kelvin, calculate the critical distance r_c and the critical velocity v_c.

(c) Starting with the Harvard classification system, describe the modern stellar spectral classification scheme. What is the Spectral type of the Sun? $(5, 6, 6\frac{1}{2})$

4. (a) Compare the relative advantages and disadvantages of reflecting and refracting telescopes.

(b) What is a charge-coupled device (CCD)? What are the advantages of CCDs over photographic films for recording astronomical images?

(c) The Hubble Space Telescope (HST) has been used to observe the galaxy M100, some 70 million light-years from Earth. If the angular resolution of the HST image is 0.1 arcsec, what is the diameter in light-years of the smallest detail that can be seen in the image of M100?

(d) Discuss the construction and working of a stellar photometer. $(3,4,5,5\frac{1}{2})$

5. (a) Estimate the pulsation period of a variable star by considering how long it would take for a sound wave to cross the diameter of a model star of radius R and mean density $\overline{\rho}$. Explain how variable stars are distributed on the HR diagram in relation to their periods and the mean densities.

(b) The observed period of a Cepheid variable is 20 days and its mean apparent magnitude is m=20. Find the distance of the Cepheid.

(c) The absolute visual magnitude of an RR Lyrae type variable is 0.6 ± 0.3. What is the relative error of distance due to the deviation in the magnitude ?

(d) Describe the concept of air mass for transmission of starlight through the Earth's atmosphere. How can air mass and extinction coefficient be used to estimate the apparent magnitude of a star above the Earth's atmosphere ? $(6, 4, 4, 3\frac{1}{2})$