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3 (Sem-6/CBCS) PHY HE 4

2022

PHYSICS

(Honours Elective)

Paper : PHY-HE-6046

(Astronomy and Astrophysics)

Full Marks : 80

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer **any ten** questions from the following : $1 \times 10 = 10$
 - (a) Write one point of difference between Astronomy and Astrophysics.
 - (b) What is a Celestial Sphere ?
 - (c) What is the declination of the north Celestial Pole ?
 - (d) What is Parsec ?

Contd.

- (e) Which of the following co-ordinates does not change with time ?
- (i) Right ascension
 - (ii) Hour angle
 - (iii) Azimuth
- (f) Write the range of value of the Azimuth of celestial objects.
- (g) What is f -number of a Telescope ?
- (h) Which of the following features does not pertain to a telescope ?
- (i) Light-gathering
 - (ii) Resolution
 - (iii) Dispersion
 - (iv) Magnification
- (i) If the distance of a star is increased by a factor of 2, then write how much the radiation flux received changes.
- (j) Write the sequence of classification of stars.
- (k) Which class of the stars are found in the disc of the Milky Way ?

- (l) Which aspect is not dealt with under cosmology ?
- (i) Origin of the Universe
 - (ii) Evolution of Sun
 - (iii) Evolution of Universe
 - (iv) Ultimate fate of Universe
- (m) What is Chandrasekhar Limit ?
- (n) Which is the catalytic process for the production of energy in the core of a star ?
- (i) PP-chain
 - (ii) CNO cycle
 - (iii) Both PP-chain and CNO cycle
 - (iv) None of the above
- (o) Write the value of mass of a neutron star.
2. Answer **any five** of the following questions :
 $2 \times 5 = 10$
- (a) What are vernal equinox and the right ascension (RA) ?
 - (b) What is the difference between sidereal time and solar time ?

- (c) For what points on the Celestial sphere are both Right ascension and declination equal to zero? What are the astronomical latitudes and longitudes of these points?
- (d) A particular star has apparent and absolute magnitudes as -0.3 and $+4.1$. Calculate the distance in A.U.
- (e) For stars having more mass than $10M_{\odot}$, the luminosity is directly proportional to their masses. Show that their life time on the main sequence is independent of their masses.
- (f) Calculate the ratio of Radiant fluxes received from two stars whose magnitudes differ by 2.5 .
- (g) Draw a schematic ray diagram of a Newtonian reflecting telescope.
- (h) Write the different parts of Milky Way. Draw its schematic diagram showing the parts.

3. Answer **any four** of the following questions : $5 \times 4 = 20$

- (a) What are white dwarf stars? Show that, as the mass of the white dwarf increases, its radius decreases. $1+4=5$
- (b) What is light gathering power of a telescope? Compare the light gathering power of the $8m$ telescope and $0.8m$ telescope. $2+3=5$
- (c) What do you understand by hydrostatic equilibrium in a star? Derive the equation of hydrostatic equilibrium for a star. $2+3=5$
- (d) Describe the sequence of reactions in the carbon-nitrogen cycle for production of energy of a star. 5
- (e) State Hubble's law and explain how Hubble's constant indicates the age of the Universe. $2+3=5$
- (f) Using Stefan-Boltzmann law of radiation, obtain the ratio of radii of two stars in terms of their surface temperatures and absolute magnitudes. 5

(g) Explain the formation of neutron stars and its internal structure. 5

(h) What is resolving power of a telescope? A telescope has a diameter 2.34m and it detected a radiation of wavelength $5500\text{\AA}$. Calculate the resolving power of the telescope. $2+3=5$

4. Answer **any four** questions of the following : $10 \times 4 = 40$

(a) (i) Describe the trigonometric parallax method of determining stellar distances. Mention the limitation of the method. 6

(ii) What is solar corona? Explain why the solar corona is observed only during total solar eclipse. $1+3=4$

(b) What is meant by Hertzsprung-Russell diagram? Discuss what pieces of information about the properties of a star may be gathered from its position in this diagram. $2+8=10$

(c) (i) Explain Hubble's classification of galaxies with Hubble's tuning fork diagram. 7

(ii) Define active galaxy. What is the source of its activity? $1+2=3$

(d) Discuss qualitatively the different stages in the evolution of a star. 10

(e) State the cosmological principle. Derive Friedmann equation used for evolution of a homogeneous universe. $2+8=10$

(f) What are the different types of optical telescopes used for astronomical observations? What is the main difference between them?

What do you mean by magnifying power of a telescope?

Find the magnifying power of a 6 inch, $f/8$ telescope when an eyepiece of 12.5mm focal length is used. How could one increase the magnifying power of this telescope? $2+3+1+3+1=10$

(g) Write short notes on **any two** of the following : $5 \times 2 = 10$

(i) Virial theorem

(ii) Cosmic microwave Background Radiation

(iii) Black holes

(iv) Stellar magnitude scale

(v) Meteorites and Comets

(h) (i) What are apparent and absolute magnitudes of a shining object? Derive a relation between them.

$$1+1+4=6$$

(ii) The Sun has an apparent magnitude $m = -26.5$. Calculate its absolute magnitude.

$$4$$

(i) Write down the sequence of events leading to the formation of a protostar. When does a protostar become a star? Describe briefly the occurrence of helium flash.

$$6+2+2=10$$

(j) What is the basis of spectral classification of stars? Enumerate the special features of Harvard special sequence.

$$4+6=10$$