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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: 1×10=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 :
2×5=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 :

5×4=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 interms 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\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 $m = -26.5m$. 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.

$$4+6=10$$