Q.P. Code – 22632

Sixth Semester B.Sc. Degree Examination, September 2020

(Non-CBCS Scheme)

Physics

Paper VIII (603) – RELATIVITY, ASTROPHYSICS AND NUCLEAR PHYSICS

Time : 3 Hours] *[Max. Marks : 60*

Instructions to Candidates : Answers should be written completely in English.

PART – A

Answer any **FIVE** of the following questions. Each question carries **6** marks : **(5 × 6 = 30)**

1. Derive Lorentz transformation equations on the basis of special theory of relativity. **(6)**

2. (a) Obtain the expression for time dilation.

   (b) Discuss the experimental evidence for time dilation. **(4 + 2)**

3. Derive an expression for mass-energy relation. **(6)**

4. (a) Define Stellar parallax.

   (b) Derive the relation between luminosity and mass of stars. **(1+ 5)**

5. (a) Define absolute magnitude and apparent magnitude.

   (b) Show that life time of a star is inversely proportional to the square of the mass of the star. **(2 + 4)**

6. Deduce the relation between the impact parameter and angle of scattering assuming the path of α – ray to be hyperbola. **(6)**

7. What is β – decay? Explain the different types of β – decay with examples. **(1 + 5)**

8. (a) What is Ionisation detector?

   (b) Describe with neat diagram the construction and working of a Ionisation chamber. **(1 + 5)**

PART – B

Answer any **FOUR** of the following questions. Each question carries **5** marks :

(4 × 5 = 20)

9. In the Michelson-Morley Experiment what is expected fringe shift if the effective length of each path is 11 m and wavelength of light used is 550 nm? Given velocity of earth is 30 km/sec.

10. Calculate the percentage contraction in length of a rod moving with a speed of 0.7 C in a direction at an angle 60° with its own length.

11. The star sirius has a effective surface temperature of 9500 K and its luminosity about 1.02×10^{28} watt. Calculate its radius. Given $\sigma = 5.67 \times 10^{-8}\ Wm^{-2}K^{-4}$.

12. Calculate the gravitational binding energy of a star of mass 1.5 $M_\odot$ and radius $2R_\odot$ according to linear density model. (Given $M_\odot = 2 \times 10^{30}$ kg, $R_\odot = 7 \times 10^8$ m, $G = 6.673 \times 10^{-11}\ Nm^2\ kg^{-2}$)

13. Neptunium – 237 $\left({}_{93}Np^{237}\right)$ emits alpha particles of energy 4.19 MeV. Calculate the alpha disintegration Energy.

14. Calculate the Q-value of the relation ${}_{13}Al^{27}\ (\alpha \cdot n)\ {}_{15}P^{30}$.

    Given :

    M_{Al} = 26.981535 amu

    M_{He} = 4.002604 amu

    m_n = 1.008665 amu

    m_p = 29.978320 amu

PART – C

Answer any **FIVE** of the following questions. Each question carries **2** marks :

(5 × 2 = 10)

15. (a) Can we apply the Special theory of relativity to accelerated systems? Explain.

    (b) A moving clock runs slower than a stationary one. Explain.

(c) The more massive a star, shorter its life time. Justify.

(d) A black hole cannot be seen. Explain.

(e) Is colour of a star directly related to surface temperature? Explain.

(f) How a neutron star attains stability? Explain.

(g) Neutrons are not easily detectable. Why?

(h) Does the Kinetic energy of a charged particle change when it enters a magnetic field? Explain.
