MS – 301

VI Semester B.Sc. Examination, May 2016
(Semester Scheme) (Old Scheme) (Prior to 2013-14)
PHYSICS – VIII
Relativity, Astrophysics and Nuclear Physics

Time : 3 Hours   Max. Marks : 60

PART – A

Answer **any five** of the following .   (5×6=30)

1. a) State the postulates of special theory of relativity.

    b) Obtain Lorentz transformation equations.   (2+4)

2. a) Define Proper length.

    b) Derive Einstein's mass-energy relation.   (1+5)

3. a) Define Astronomical Unit.

    b) Obtain the expression for gravitational potential energy of a star using
        linear density model.   (1+5)

4. a) What is H-R diagram ? How are the Stars in space classified on the basis of
        H-R diagram ?

    b) Explain how surface temperature of a star related to its colour. (4+2)

5. a) Define Absolute magnitude of a Star.

    b) Obtain the distance modulus formula in terms of apparent and absolute
        magnitude of a Star.   (1+5)

6. Obtain the relation between impact parameter and scattering angle assuming
    the path of α-particle to be hyperbola.   6

7. Derive an expression for the disintegration energy of α-particle.   6

8. Describe the working of a cyclotron with a neat diagram and necessary theory. 6

PART – B

Answer **any four** of the following :   (4×5=20)

9. An atomic particle has a rest mass of 3×10^{-25} Kg. Find its total mass energy and when it is travelling with a velocity of 0.8C.

10. A star has a surface temperature of 9800 K and its radius is 1.68×10^6 Km. Calculate its Luminosity. Take $\sigma = 5.67 \times 10^{-8}$ Wm^{-2} K^{-4}.

11. Calculate the core pressure of a star of mass 2×10^{30} Kg, radius 7×10^8 m and $G = 6.67 \times 10^{-11}$ $Nm^2 Kg^{-2}$.

12. Calculate the Q-value of the reaction in which $_{13}Al^{27}$ on bombardment with α-particle converts into $_{15}P^{30}$. Take

$M_{Al} = 26.8154$ u, $M_{He} = 4.0026$ u

$M_n = 1.008665$ u, $M_P = 29.9783$ u.

13. The total energy of a particle is exactly twice its rest energy. Calculate its speed.

14. The length of the object is measured to be exactly $\frac{10}{12}^{th}$ of its actual length. Calculate the speed of the object and time dilation corresponding to one second on the object. Take $C = 3 \times 10^8$ m/s.

PART – C

15. Answer **any five** of the following :   (5×2=10)

   a) Is the mass of an object constant in any frame of reference ? Explain.

   b) Is the speed of light in free space invariant ? Explain

   c) Why was Pauli's neutrino hypothesis proposed in β-decay process ?

   d) What is binary star ? Explain.

   e) Why are neutron stars called pulsars ?

   f) Why combustion reaction is not a possible source of Stellar energy ?