NJR/KS/18/3169

Bachelor of Science (B.Sc.) Semester—VI (C.B.S.) Examination
RELATIVITY, NUCLEAR PHYSICS AND BIO-PHYSICS
Paper—1
(Physics)

Time : Three Hours]   [Maximum Marks : 50

Note :— (1) **ALL** questions are compulsory.

(2) Draw neat diagram wherever necessary.

EITHER

1. (A) What was the aim of Michelson-Morley experiment ? Describe Michelson-Morley experiment and obtain the expected fringe shift.   5

(B) (i) Derive the formula for relativistic variation of mass with velocity, $m = \dfrac{m_o}{\sqrt{1 - \dfrac{v^2}{c^2}}}$.   3

(ii) Calculate the velocity at which electron mass is $\sqrt{3}$ times the rest mass.   2

OR

(C) Explain why does a moving clock with a relativistic speed appears to run slow relative to stationary observer.   2½

(D) What is a frame of reference ? Explain inertial and non-inertial frames of reference with examples.   2½

(E) Derive the laws of addition of relativistic velocities from Lorentz transformation.   2½

(F) A rocket moving with speed 10^8 m/s ejects a projectile in its direction of motion with speed relative to rocket 2×10^8 m/s. Find the speed as measured by an observer on earth.   2½

EITHER

2. (A) What are the assumptions of liquid drop model ? Explain Nuclear fission on the basis of liquid drop model.   5

(B) Derive an expression for length of :

(i) Drift tube in a linear accelerator.   3

(ii) A radio frequency oscillator supplying signal of 10 kV, 10 MHz is connected to linear accelerator. Calculate the time for which accelerating proton remain inside the drift tube and maximum energy acquired by proton if 55 drift tubes are in the accelerator. Given $q = 1.6 \times 10^{-19}$ C.   2

OR

(C) Explain construction and working of Wilson Cloud Chamber.   2½

(D) Explain the construction of Nuclear reactor.   2½

(E) The mass of $_{17}Cl^{35}$ is 34.9800 amu. Calculate the mass defect and binding energy per nucleon. $m_n = 1.008665$ amu and $m_p = 1.007825$ amu.   2½

(F) Compare nuclear fission and fusion process.   2½

EITHER

3. (A) What is Beta decay ? Explain the measurement of energy of Beta Particle by a magnetic spectrograph. 5

   (B) (i) Explain the experimental determination of range of alpha particle. 3

   (ii) Calculate the energy of gamma ray photon of wavelength 4.5×10^{-13} m. Given : $h = 6.624 \times 10^{-34}$Js. 2

OR

(C) Discuss the properties and energy emission of γ-ray photon. 2½

(D) A nucleus $_{11}X^{24}$ undergo β^- and then α-decay process. Find the atomic and mass number of the final daughter nuclei after successive beta and alpha decay. 2½

(E) Write a note on Geiger-Nuttal Law. 2½

(F) Explain α-decay. State the properties of alpha particle. 2½

EITHER

4. (A) Explain the principle and operation of electrocardiogram. 5

   (B) (i) What is centrifugation ? Derive an expression for relative centrifugal force (RCF). 3

   (ii) Find out the revolution per minute (RPM), if the radius of the rotor is 300 mm and relative centrifugal force is 5000. 2

OR

(C) Calculate the pH of 0.01m solution of hydrochloric acid (HCl) assuming complete dissociation. 2½

(D) Explain working mechanism of sonography with block diagram. 2½

(E) What is EEG ? What are its uses ? 2½

(F) Discuss construction and working of single beam spectrophotometer. 2½

5. Attempt any **TEN** :—

   (i) State the postulates of special theory of relativity.

   (ii) State Lorentz Fitzgerald Hypothesis.

   (iii) If 1 kg of a substance is fully converted into energy, how much energy is produced ?

   (iv) Define Packing fraction.

   (v) What is Q value of nuclear reaction ?

   (vi) Calculate mass defect for the deuteron.
   Given :
   $m_n = 1.675 \times 10^{-27}$ kg, $m_p = 1.672 \times 10^{-27}$ kg $M_D = 3.343 \times 10^{-27}$ kg.

   (vii) What is tunneling ?

   (viii) Write three different modes of β-decay.

   (ix) Define end point energy.

   (x) If the transmittance is 65% then find out the value of absorbance.

   (xi) What is Electroretinogram (ERG) ?

   (xii) How are Bio-electric signals generated ? $1 \times 10 = 10$