KNT/KW/16/5202

**Bachelor of Science (B.Sc.) Semester—VI (C.B.S.) Examination**

**PHYSICS**

**Paper—1**

**(Relativity, Nuclear Physics and Bio-Physics)**

Time : Three Hours]                                                                     [Maximum Marks : 50

**N.B. :—** (1) **All** questions are compulsory.

(2) Draw neat and labelled diagrams wherever necessary.

**EITHER**

1. (A) What is a frame of reference ? Explain inertial and non-inertial frames of reference. Obtain the Lorentz transformation equations. 5

   (B) (i) Obtain the expression for time dilation. 3

   (ii) The mean life of $\pi$ meson is $2 \times 10^{-8}$ s. Calculate mean life of a meson moving with a velocity of 0.8 C. 2

   **OR**

   (C) Derive an equation for length contraction of a body moving with velocity approaching velocity of light. 2½

   (D) Obtain an expression for relativistic mass of a moving body. 2½

   (E) Describe the experimental arrangement of Michelson and Morley experiment. 2½

   (F) A particle of mass $10^{-24}$ kg is moving with a speed of $1.8 \times 10^8$ m/s. Calculate its mass when it is in motion. (Give C = $3 \times 10^8$ m/s). 2½

   **EITHER**

2. (A) Explain the construction and working of G.M. counter. What is quenching ? How is it achieved in a G.M. tube ? 5

   (B) (i) Obtain an expression for the operating frequency of a cyclotron. 3

   (ii) A cyclotron with magnetic field of 2Wb/m$^2$ is used to accelerate the protons. At what frequency should it operate ? (Given : $e_p = 1.6 \times 10^{-19}$ C, $m_p = 1.79 \times 10^{-27}$ kg). 2

**OR**

(C) Derive an expression for the lengths of successive drift tubes of a linear accelerator.    2½

(D) What are the assumptions of the Liquid Drop model ? Explain nuclear fission on the basis of Liquid Drop model.    2½

(E) Write a note on the different types of cosmic rays.    2½

(F) Find the threshold energy for the reaction $_7N^{14}$ (n, $\alpha$)$_5B^{11}$.

Given : $m_N$ = 14.003074 u, $m_n$ = 1.008665 u

$m_\alpha$ = 4.002603 u, $m_B$ = 11.009305 u.    2½

**EITHER**

3. (A) What is beta decay ? Explain the measurement of energy of a beta particle by a magnetic spectro-graph.    5

(B) (i) Explain the three modes of beta decay.    3

(ii) A nucleus $_{12}X^{26}$ undergoes $\beta^-$ and then $\alpha$-decay process. Find the atomic and mass number of the final daughter nuclei after successive $\beta^-$ and $\alpha$-decay.    2

**OR**

(C) Derive the expression for energy of $\alpha$-particle using magnetic spectrometer.    2½

(D) Explain the origin of $\gamma$-rays. How do they differ from X-rays ?    2½

(E) Define 'range' of an $\alpha$-particle. What are the factors which affect the range ?    2½

(F) A nucleus is in an excited state of energy 70 keV. It emits a $\beta$ particle first and comes to an energy state of 48 keV and then emits a $\gamma$ photon to come to ground state. What is the end-point energy of $\beta$-decay and energy of the $\gamma$ photon ?    2½

**EITHER**

4. (A) What is the basic principle of Electroretinogram (ERG) ? Explain ERG with diagram.    5

(B) (i) What is centrifugation ? Derive an expression for Relative Centrifugal Force (RCF).    3

(ii) The relative centrifugal force is 20,000 and the rpm speed of the rotor is 7500. Calculate the radius of the rotor.    2

**OR**

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

(D)  Explain  the construction and working of pH meter.                              2½

(E)  Distinguish between colorimeter and spectrophotometer.                          2½

(F)  Calculate pH of 0.001M $H_2SO_4$ assuming complete dissociation.               2½

5.  Attempt any **ten** :

   (i)    State the postulates of Special theory of Relativity.

   (ii)   Write the inverse Lorentz transformation equations for position and time.

   (iii)  A particle is moving with a speed of 0.5 C. Calculate the ratio of the rest mass and the mass while in motion.

   (iv)   What are magic numbers ?

   (v)    Give the classification of elementary particles.

   (vi)   Binding energy of $_{28}N^{64}$ is 654.53 MeV. Calculate its binding energy per nucleon.

   (vii)  Write the Geiger-Nuttal relation.

   (viii) Define end point energy.

   (ix)   What is $\alpha$-particle tunnelling ?

   (x)    What are action potentials of human body ?

   (xi)   What is an electrocardiogram ?

   (xii)  If the transmittance is 0.2, find the absorbance.                          $1\times10$