Bachelor of Science (B.Sc.) (Physics) Semester–VI

(C.B.S.) Examination

RELATIVITY, NUCLEAR PHYSICS AND BIO–PHYSICS

Paper—1

Time—Three Hours] [Maximum Marks—50

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

(2) Draw neat and labelled diagrams wherever necessary.

EITHER

1. (A) Show that the mass of a particle moving with speed v is given by :

$$m = \frac{m_o}{\sqrt{1 - v^2/c^2}}$$

A particle is moving with speed 0.5 c. Calculate the ratio of the rest mass to its mass in motion. 5

(B) (i) Obtain Lorentz transformations for space and time co-ordinates. How are they superior to Galilean transformations ? 3

(ii) State the postulates of special theory of relativity. 2

OR

(C) A clock in motion ticks slower than a Stationary Clock. Explain. 2½

(D) Derive the equations for relativistic addition of velocities from Lorentz transformations. 2½

(E) A substance of mass 1 kg is fully converted into energy. Calculate the energy produced. (Given : $c = 3 \times 10^8$ m/s). 2½

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

EITHER

2. (A) What is a linear accelerator ? Explain construction and working of linear accelerator. 5

(B) (i) What is a Nuclear reaction ?

Obtain an expression for Q-value of nuclear reaction. 3

(ii) Calculate the Q-value of the reaction :

$${}_1^2H + {}_1^2H \rightarrow {}_0n^1 + {}_2^3He.$$

[Given : Mass of ${}_1^2H = 2.0141$ amu

Mass of ${}_2^3He = 3.01603$ amu

Mass of ${}_0^1n = 1.008665$ amu. 2

OR

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

(D) Explain nuclear fission on the basis of the liquid drop model. 2½

(E) Calculate Binding Energy for the Deuteron.

Given : Mass of neutron = 1.675×10^{-27} kg,

Mass of proton = 1.672×10^{-27} kg,

Mass of deuteron = 3.343×10^{-27} kg.

2½

(F) Explain the p-p cycle of fusion reaction. 2½

EITHER

3. (A) What is α-decay ? Explain.

Obtain an expression for Q-value in α-decay process.

State the characteristics of α-decay process. 5

(B) (i) Explain experimental determination of range of α-particle. 3

(ii) Calculate the binding energy of an alpha particle if its mass is 4.001265 amu.

(Given : 1 amu = 931.5 MeV, m_p = 1.007277 amu, m_u = 1.008666 amu) 2

OR

(C) Explain β-decay process. 2½

(D) Explain the measurement of energy of β-particle by a magnetic spectrograph. 2½

(E) Calculate energy and mass equivalence of gamma ray of wavelength 4.5×10^{-11} cm.

Given : $h = 6.624 \times 10^{-34}$ J.s.

$c = 3 \times 10^{8}$ m/sec. 2½

(F) Explain Pauli's neutrino hypothesis and state the properties of a neutrino. 2½

EITHER

4. (A) Define pH.

What is principle of working of pH meter ?

State application of pH meter.

Calculate the pH of 0.01 M solution of Hydrochloric Acid (HCl) assuming its complete dissociation. 5

(B) (i) Draw the block diagram of EMG and explain its working. 3

(ii) What are the uses of EMG ? 2

OR

(C) What are the different uses of sonography ? 2½

(D) What are action potentials of human body ? 2½

(E) What is Electroretinography (ERG) ? Explain its different components. 2½

(F) A solution of concentration 10^{-4} M in a cell of thickness 1 cm absorbs 20% of incident radiation. Find molar extinction coefficient. 2½

5. Attempt any **TEN** of the following :

(i) State the result of Michelson-Morley experiment.

(ii) Draw a graph showing variation of mass of body with its speed.

(iii) The length of a rocket ship is 100 m on the earth. When it is moving with velocity V, its length observed is 99 m, calculate its velocity.

(iv) Why is fusion called a thermo-nuclear reaction ?

(v) State any two properties of neutrons.

(vi) A neutron breaks into a proton and an electron. Calculate mass defect.

Given : $m_e = 9.1 \times 10^{-31}$ kg,

$m_p = 1.6725 \times 10^{-27}$ kg,

$m_n = 1.6747 \times 10^{-27}$ kg

(vii) State Geiger-Nuttal law.

(viii) State the differences between α-decay and β-decay.

(ix) What are the nuclear isomers ?

(x) State any two applications of ECG.

(xi) What are the uses of colorimeter ?

(xii) If the transmittance is 0.2, find the absorbance.

1×10