

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 :

$$m = \frac{m_0}{\sqrt{1 - v^2/c^2}}$$

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



(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

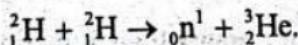
(F) **What is a frame of reference ? Explain inertial and non-inertial frames of reference with examples.** 2½

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 :**



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

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

Mass of ${}_0^1\text{n} = 1.008665$ 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. 2½

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 :

- State the result of Michelson-Morley experiment.
- Draw a graph showing variation of mass of body with its speed.
- 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.
- Why is fusion called a thermo-nuclear reaction ?
- State any two properties of neutrons.
- 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

- State Geiger-Nuttal law.
- State the differences between α -decay and β -decay.
- What are the nuclear isomers ?
- State any two applications of ECG.
- What are the uses of colorimeter ?
- If the transmittance is 0.2, find the absorbance.

1×10