No. of Printed Pages : 8

PHE-11

BACHELOR OF SCIENCE (B.Sc.)

Term-End Examination

June, 2013

PHYSICS

PHE-11 : MODERN PHYSICS

Time : 2 hours *Maximum Marks : 50*

Note : *Attempt **all** questions. The marks for each question are indicated against it. Symbols have their usual meanings. You **may use** log tables and non-programmable calculators. The value of physical constants have been given at the end.*

1. Answer **any five** parts : **5x4=20**

(a) Calculate the mass of the electron when it is moving with a K.E. of 10 MeV. Calculate its de Broglie wavelength.

(b) With what velocity should a particle move so that the increase in its mass may be 25% of its rest mass ?

(c) Write down the Lorentz transformation equations. Show that the Lorentz transformation reduces to the Galilean transformation when $v << c$.

(d) State the selection rules for transitions in hydrogen - like atoms. State giving reasons whether the following transition is allowed :

$3^2P_{3/2}$ to $2^2S_{1/2}$.

(e) Write down any four applications of radio - isotopes in daily life.

(f) The mean half life of a radioactive element is 16 days. Calculate the time required for 60% of the element to decay.

(g) Give the charge, spin and baryon number of proton and neutron.

2. Answer **any one** part :

(a) Derive the relativistic velocity addition formula. 5

(b) An observer on earth measures the wavelength of light emitted by a galaxy to be 6840 Å. If the wavelength of light emitted in the galaxy is 4000 Å, calculate the velocity of the galaxy with respect to the earth. 5

3. The wave function of a particle is given by $e^{-\alpha x^2}$. Obtain the value of its normalization constant and the expectation value of the K.E. of the particle. 3+7

OR

IGNOU ASSIGNMENT GURU

Prove Ehrenfest theorem : 10

$$\frac{d\langle x\rangle}{dt} = \frac{1}{m} \langle px \rangle$$

$$\frac{d\langle px\rangle}{dt} = \left\langle -\frac{\partial v}{\partial x} \right\rangle .$$

4. What is the probabilistic interpretation of the wave function ? The ground state wave function of hydrogen atom is given by 3+7

$$\psi_{100}(r) = \frac{1}{\pi a_o^3} e^{-2r/ao}.$$

Obtain the most probable value of r for this state.

OR

State Hund's rules and use them to find the ground state of an atom with $Z = 14$. 3+7

5. Answer **any one** part :

(a) Calculate the Binding energy per nucleon in ${}_6C^{12}$. Masses of proton, neutron and electron are 1.007276 u, 1.008665 u and 0.00055 u, respectively. The mass of ${}_6C^{12}$ atom is 12.000000 u. 5

IGNOU ASSIGNMENT GURU

(b) Draw a properly labelled schematic diagram of a nuclear reactor. Explain the role of a moderator in a nuclear reactor. Name any two moderators. **3+1+1**

Physical constants

$h = 6.626 \times 10^{-34}$ Js

$m_e = 9.109 \times 10^{-31}$ kg

$m_p = 1.672 \times 10^{-27}$ kg

$m_n = 1.674 \times 10^{-27}$ kg

IGNOU ASSIGNMENT GURU