B. Sc. (Sem. V) (CBCS) Examination

June - 2022

Physics : P-502

(Electrodynamics & Spectroscopy) (New Course)

Faculty Code : 003

Subject Code : 2015026

Time : $2\frac{1}{2}$ Hours]   [Total Marks : 70

Instructions : (1) Attempt any five questions.

(2) Numbers of right side indicate marks.

(3) Symbols have their usual meaning.

1   (a)   Answer the following questions : (1 mark each)   4

   (1)   Charges are redistributed and atomic (or molecular) dipole is produced, such substance is called _____.

   (2)   There are actually two principal mechanisms by which electric fields can distort the charge distribution of a dielectric atom or molecule _____ and _____.

   (3)   Two forces in atom, electrons-nucleus attractive force and in opposite direction, the external field force (if it is weaker than internal field) will become in equilibrium soon. In such condition atoms is said to be polarized. (True or False)

   (4)   Dipole moment is proportional to the external field E (True or False)

   (b)   If Hydrogen atom is placed in an electric field of 5×10^5 2
         N/C and its polarizability is 7.34×10^{-30} C^2N/m. Find its dipole momentum.

   (c)   Explain force on dipole due to non-uniform external electric   3
         field.

   (d)   Discuss the physical interpretation of bound charge.   5

2 (a) Answer the following questions : (one mark each)   **4**
   (1) Define paramagnetic.
   (2) Torque on rectangular loop, when applied uniform magnetic field is given by _____.
   (3) Magnetic dipole moment per unit volume is called _____
   (4) Differential form of Ampere's law in Magnetized material is _____
   (b) Define linear media.   **2**
   (c) Explain the magnetization of material.   **3**
   (d) Give the physical interpretation of bound current.   **5**

3 (a) Answer the following questions : (one mark each)   **4**
   (1) Write Ohm's law for electrodynamics.
   (2) Electromotive force is given by _____
   (3) Write flux rule for motional emf.
   (4) The integral form of Ampere's law is _____
   (b) Find the self-inductance of a long solenoid having 'n' numbers of turn per unit length. The radius is r.   **2**
   (c) Explain continuity equation in electrodynamics.   **3**
   (d) Explain Poynting's theorem.   **5**

4 (a) Answer the following questions : (one mark each)   **4**
   (1) Write Faraday's law in differential form.
   (2) Write Ampere's law with Maxwel's correction.
   (3) Write Poynting's vector formula.
   (4) Write Lorentz's force law.
   (b) A solenoid of radius 2 cm has self-inductance 100 mH. If current flowing through is 1A. Find the energy stored in magnetic field of solenoid.   **2**
   (c) Discuss Maxwell's modification in Ampere's law.   **3**
   (d) Discuss "Energy in magnetic field".   **5**

5 (a) Answer the following questions : (one mark each)   **4**
   (1) What is wave ?
   (2) Complex wave function is given by _____
   (3) $\left(\dfrac{\partial f}{\partial z}\right)_{z=0^-} = \left(\dfrac{\partial f}{\partial z}\right)_{z=0^+}$ is called _____ for reflection and transmission waves.
   (4) What is transverse waves ?

(b) Explain complex notation for wave equation.   2

(c) Deduce the equation for E and B in vacuum.   3

(d) Formulate wave equation for stretched string.   5

6 (a) Answer the following questions : (one mark each)   4

      (1) Wave equation for stretched string is given by _____

      (2) The wave number 'K' is given by _____.

      (3) Angular frequency 'ω' is given by _____

      (4) In sinusoidal wave equation, δ is indicate the _____.

(b) Amplitude A_3 is given by $A_3 e^{i\delta_3} = A_1 e^{i\delta_1} + A_2 e^{i\delta_2}$. Determine A_3.   2

(c) Discus polarization of wave.   3

(d) Formulate wave equation for sinusoidal wave.   5

7 (a) Answer the following questions : (1 mark of each)   4

      (1) Write the names of two types of emission spectra.

      (2) The dark lines of Sun's absorption spectra is called _____.

      (3) Frank Hertz's experiment gives confirmation that electron occupied _____ energy level.

      (4) Bohr's theory of atomic model also predicts about the intensity of spectral line. (True or False ?)

(b) Calculate the wavelength of light emitted by an atom, excited to higher state by applying 2V.   2

(c) Explain continuous spectra.   3

(d) Explain Bohr's theory. (Postulates only)   5

8 (a) Answer following objective questions : (1 mark of each)   4

      (1) To cover the complexity of spectra line, Uhlenbeck and Goudsmith extended the Somerfield model is known as _____.

      (2) Famous hypothesis of electron spin is put forward by _____.

      (3) The orbits having l values 0,1,2,3..... is labelled as ____,____,____ and ____.

      (4) The projection of orbital quantum number l on magnetic field gives _____

(b) Under uniform magnetic field of 4 Webers/meter^2; find Δv for normal Zeeman splitting.   2

(c) Explain Paschen-back effect.   3

(d) Explain Frank-Hertz's experiment.   5

9   (a)   Answer following questions : (1 mark of each)   **4**

         (1)   Molecular spectra is discontinuous spectra. (True or False ?)

         (2)   Electronics band spectra is falls on _____ $\overset{o}{A}$ to _____ $\overset{o}{A}$.

         (3) $E_e \ll E_v \ll E_r$ (True or False?)

         (4)   In molecular spectra, vibrational energy is given by E_v = _____.

     (b)   In rotational spectrum of CO gas, the spacing is observed between the spectral line is 3.84 cm^{-1}. Calculate the moment of inertia of CO molecule.   **2**

     (c)   Give the brief review on radiation source of experimental setup of Raman effect.   **3**

     (d)   Explain pure rotational spectra.   **5**

10   (a)   Answer the following questions : (1 mark of each)   **4**

         (1)   Frequency difference between incident radiation and scattered radiation from molecule is called _____.

         (2)   For Stokes lines, Δv is negative. (True / False)

         (3)   Write the range of intensity of Raman scattered light, with respect to intensity of incident light.

         (4)   On both side of exciting line in Raman spectra, we can observe equidistance lines, that is pure rotational spectra. (True/False)

     (b)   Vibration transition occurs with energy change of 1.6×10^{-20} erg/mol, calculate the frequency of radiation.   **2**

     (c)   Give the difference between Raman spectra and Fluorescence spectra.   **3**

     (d)   Discuss salient feature of Raman effect.   **5**