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BT-202 Roll No. 12176

B. TECH (CSE, IT, ECE, MAE, CE, E & EE, E & IE, AE, NST, S & AE), B. TECH (MAE) + M. TECH AUTOMOBILE ENGINEERING (DD), B. TECH (CSE, ECE, MAE, CE) + MBA DUAL DEGREE, B. TECH + M. TECH (NS & T) – DD & B. TECH (AE) + M. TECH (A) – DD

SECOND SEMESTER END TERM EXAMINATION

APRIL – 2013

APPLIED PHYSICS – II – MODERN PHYSICS

Time : 3 Hrs. *Maximum Marks : 0*

Note: ***Attempt questions from all sections as directed.***

SECTION – A (30 Marks)

Attempt any **5** *questions.*

Each question carries **6** *marks.* 243234 25

1. (a) Explain relativistic length contraction on the basis of special theory of relativity. (3)

   (b) What was the negative result in Michelson – Morley experiment ? How you will explain that result with the help of ether drag hypothesis. (3)

P.T.O.

2. (a) What do you understand by matter waves? Obtain an expression of de-Broglie wavelength of matter waves. (1+2)

(b) Calculate the de- Broglie wavelength of an α - particle accelerated by a potential difference of 25000 volts. Given mass of proton = 1.67×10^{-27} kg. Planck's constant = 6.62×10^{-34} joule-second. (3)

3. (a) What is Bragg's law for X-ray diffraction? Discuss the importance of X-ray. (3)

(b) A set of lattice plane reflects X-ray of wavelength 1.32 Å at a glancing angle 60°. Deduce the possible spacing of the set of planes for first order. (3)

4. (a) What do you mean by normalization and orthogonality of a wave function? (3)

(b) Find the uncertainty in determination the position of an electron moving with velocity 2×10^{-5} ms^{-1}, when its velocity is measured to an accuracy of 0.002%. (3)

5. (a) Explain the terms "optical pumping" and "population inversion". (2)

(b) Discuss Einstein's coefficients. Derive the relation between them. (4)

6. (a) What is the superconductivity ? Distinguish between type I and type II superconductor. (4)

(b) Describe Meissner effect. (2)

SECTION – B (20 Marks)

Attempt any **two** *questions.*
Each question carries **10** *marks.*

7. (a) Show that when electrons are accelerated through a potential difference V, their wavelength taking relativistic correction into account is

$$\lambda = \frac{h}{\sqrt{2m_0eV\left(1+\frac{eV}{2m_0c^2}\right)}}$$

where e and m_0 are charge and rest mass of electrons, respectively. c is speed of light. (5)

(b) Show that $x^2 + y^2 + z^2 = c^2t^2$ remain invariant under Lorentz transformation. (5)

8. Differentiate between normal and anomalus Zeeman effect. Obtain expression for Zeeman splitting of lines in a normal Zeeman pattern and draw the energy level diagram to show corresponding transitions. (3+4+3)

9. (a) Calculate the expectation value of p and p^2 for the normalized wave function

$$\psi(x) = \sqrt{2/L}\sin\left(\frac{\pi x}{L}\right)$$

in the region $0 < x < L$

and $\psi(x) = 0$ and $x > L$ and $x < 0$ (7)

(b) Describe the V-I characteristics of p-n junction diode. (3)

SECTION – C (20 Marks)

(Compulsory)

10. (a) Derive the expression for relativistic variation of mass with velocity. (6)

(b) A particle of energy E is incident on a potential step of heigh V. If the transmission coefficient is 0.5. Find the value of E/V. (5)

(c) What is fermi energy ? Show that the average energy of an electron in an electron gas at absolute zero is $\frac{3}{5}E_F(0)$ where $E_F(0)$ is Fermi energy. (5)

(d) Energy of a particle at absolute temperature T is of the order of k_BT. Calculate the wavelength of thermal neutrons at 27°C. Given : $m_n = 1.67 \times 10^{-27}$ kg, $h = 6.60 \times 10^{-34}$ Js and $k_B = 8.6 \times 10^{-15}$ eV/°C. (4)

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