Final Assessment Test – November 2018

VIT
Vellore Institute of Technology

Course: PHY1701 - Engineering Physics
Class NBR(s):0934 / 1040 / 1060 / 1066 / 2432 / 2435 / 5647 / 5666 / 5683 / 5755
Time: Three Hours

Slot: C2+TC2

Max. Marks: 100

General Instructions :
1. Make use of the following constant values(wherever necessary)
(Mass of the electron, $m_e = 9.1 \times 10^{-31}$ kg; Charge of the electron, $e = 1.602 \times 10^{-19}$ C ; Planck's constant, $h = 6.626 \times 10^{-34}$ Js ; Velocity of light, $C = 3 \times 10^8$ ms^{-1}; Boltzmann's constant, $K_B = 1.38 \times 10^{-23}$ JK^{-1})
2. Draw diagrams wherever necessary.

Answer any TEN Questions

(10 X 10 = 100 Marks)

1. Derive the Compton shift for X-rays after colliding with the rest surface electron on a nickel target. What will be the shift if X-rays collide with rest atom on the surface of the target. **[10]**

2. Set up the one dimensional time dependent and independent Schrodinger wave equation. **[5+5]**

3. a) Derive Eigen function and Eigen values for a particle in one dimensional potential well. **[7]**
   b) A particle is moving in one-dimensional potential box of with 50 Å. Calculate the probability of finding the particle within an interval of 10 Å at the center of the box when it is in its state of least energy. **[3]**

4. What are CNTs? Discuss the types of CNTs. Mention any three properties of CNTs and two applications. **[10]**

5. a) Describe the construction and working of He-Ne laser with necessary diagrams. **[7]**
   b) Calculate the population ratio in two states in He-Ne laser that produces light of wavelength 6000Å at 300K. **[3]**

6. a) Define population inversion and two methods of achieving it. **[6]**
   b) Calculate the energy and momentum of a photon of CO_2 laser beam of wavelength 10.6 µm. **[4]**

7. a) Mention the Maxwell's equations in integral as well as differential form. **[4]**
   b) Explain the Maxwell's correction to Ampere's law in detail. **[6]**

8. a) Derive electromagnetic wave equation travelling in an isotropic homogeneous dielectric medium. **[5]**
   b) Phase velocity of ocean waves is $\sqrt{\frac{\lambda g}{2\pi}}$. Here, 'g' is the acceleration due to gravity and 'λ' is the wavelength. Find the group velocity of ocean waves. **[5]**

9. a) Derive an expression for the acceptance angle of an optical fiber. **[5]**
   b) An optical fiber has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Determine: (i) the acceptance angle for the fiber in water which has a refractive index of 1.33. (ii) the critical angle at the core-cladding interface. **[5]**

10. a) Bring out an expression for the time lapse of a relativistic object moving in a relativistic frame of reference. **[5]**
    b) An observer on a spacecraft moving at 0.700 c relative to the earth finds that a car takes 40.0 min to make a trip. How long does the trip take to the driver of the car? **[5]**

11. a) Define and discuss various characteristics of laser. **[5]**
    b) What is the coherence length of the laser in vacuum if the bandwidth of the laser is 30 MHz? **[5]**

12. a) What is Tunnel effect? State the limitations of STM. **[6]**
    b) Electrons with energies of 0.400 eV are incident on a barrier 3.00 eV high and 0.100 nm wide. Find the approximate probability for these electrons to penetrate the barrier. **[4]**

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