

Final Assessment Test – November 2018



VIT
Vellore Institute of Technology
(An ISO 9001:2015 Certified Institute)

Course: PHY1701 - Engineering Physics

Class NBR(s): 0934 / 1040 / 1060 / 1066 / 2432 / 2435 /
5647 / 5666 / 5683 / 5755

Slot: C2+TC2

Time: Three Hours

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 width 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 6000 Å 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 CO₂ 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. [5]
(ii) the critical angle at the core-cladding interface.
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]

