VIT UNIVERSITY
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Final Assessment Test - November 2016

Course: PHY1001 - Engineering Physics
Class NBR(s): 7341 / 7349 / 7357 / 8719
Time: Three Hours

Slot: C2+TC2
Max. Marks: 100

Physical constants:
Mass of the electron, $m_e=9.109\times10^{-31}$kg; Planck's constant, $h=6.626\times10^{-34}$J s; Velocity of light, $c=3\times10^{8}$ m/s; Boltzmann's constant, $k_B=1.38\times10^{-23}$ J K^{-1}; Permittivity of free space, $\varepsilon_0=8.85\times10^{-12}$farad/m and Permeability of free space, $\mu_0=4\pi\times10^{-7}$ N A^{-2}

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. a) Derive the expression for the change in the wavelength of radiation, when it is scattered by matter. [7]
   b) Determine the wavelength associated with an electron having energy 100 eV. [3]
2. Describe in detail the Davisson and Germer experiment for the confirmation of the de-Broglie hypothesis. [10]
3. Apply the schrodinger wave equation for one dimensional potential well problem. [10]
4. Discuss the classification and applications of carbon nanotube. [10]
5. a) Derive Einstein's relation for stimulated emission and hence, explain the stimulated emission. [7]
   b) Describe how transitions occur in Nd:YAG laser. [3]
6. a) Calculate the efficiency of a He-Ne laser, if it produces an output of 5 mW and it is operated with a current of 10 mA at 3 kV. [5]
   b) A laser beam emits an output power of 1.0 mW. If it is focused as a spot having a diameter of 1 micrometer, calculate the intensity of the laser beam. [5]
7. a) Using Gauss divergence theorem and Stokes theorem derive the integral form of Gauss law of electricity and Faraday's law of induction from differential form. [5]
   b) Calculate the velocity of an electromagnetic wave which is travelling through water having permeability of 1.256×10^{-6} H/m and permittivity 710×10^{-12} $C^2N^{-1}m^{-2}$. [5]
8. Define group velocity and group index. Derive the expression to determine group velocity and group index. [10]
9. a) Describe the basic principle of optical fibers. Derive the expression for acceptance angle and numerical aperture. [7]
   b) A silica optical fiber with a core considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine the critical angle at the core-cladding interface and the numerical aperture (NA) for the fiber. [3]
10. Discuss the working of fiber optical communication system with a block diagram. [10]
11. a) What is the length contraction in special theory of relativity?. Deduce an expression for length contraction, in regard to the interval between two lengths measured from two different inertial frames. [6]
    b) A certain particle called micro mesons has a life time 2×10^{-6} s and velocity 2.994×10^{10} cm/s. What distance would be travelled without relativistic effects? [4]
12. a) A particle with a mean proper life time of 2 micro sec moves through the laboratory with a speed of 0.9 c. Calculate its life time as measured by an observer in the laboratory. [5]
    b) Write a note on simultaneity. [5]

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