Final Assessment Test – April 2019

VIT
Vellore Institute of Technology

Course: PHY1701 - Engineering Physics
Class NBR(s): 4283 / 4305 / 4306 /4307 / 4316 / 4317 / 4537 Slot: C1+TC1
Time: Three Hours Max. Marks: 100

Answer any TEN Questions

(10 X 10 = 100 Marks)

1. a) X-ray of wavelength $\lambda_0 = 0.200\ nm$ are scattered from a block of material. The scattered X-rays are observed at an angel of 78°. Calculate their wavelength. Find the fraction of energy lost by X-ray photon in this collision. [5]

   b) The human eye is most sensitive to 560-nm light. What is the temperature of a black body that would radiate most intensely at this wavelength? [5]

2. a) Arrive at the general wavefunction for a particle confined to a one-dimensional infinite potential box. [5]

   b) Plot the first three allowed stationary states and the probability density for a particle confined to a one-dimensional potential well. [5]

3. a) The speed of an electron is measured to be 5.00×10^3 m /s to an accuracy of 0.00300%. Find the minimum uncertainty in determining the position of this electron. [5]

   b) A proton is confined to moving in a one-dimensional box of width 0.200 nm. (a) Find the lowest possible energy of the proton, (b) What is the lowest possible energy of an electron confined to the same box? [5]

4. What is quantum confinement? What are quantum wells, quantum wires and quantum dots? Explain in detail. [10]

5. a) What are metastable states ? Discuss their role in the lasing action. [5]

   b) Explain in detail the process of spontaneous emission and stimulated emission. Why is the production of high frequency laser is difficult to manufacture? [5]

6. Enumerate the types of lasers based on active medium. Describe the energy levels, the construction and working of Nd : YAG laser. [10]

7. The height of a certain hill (in meters) is given by [10]
   $h(x,y) = 10(2xy - 3x^2 - 4y^2 - 18x + 28y + 12)$ where y is the distance north and x, the distance east of Vellore.
   i. Where is the top of the hill located?
   ii. How high is the hill?

8. a) Write down the Maxwell's equations and explain the significance of each of them. [5]

   b) Using Maxwell's equations, prove that the electromagnetic radiation is transverse in nature in a charge free space. Prove that both the $\vec{E}$ field and $\vec{B}$ field are in-phase to each other. [5]

9. a) Explain the single mode and multimode optical fibers in detail. [5]

   b) Write an overview of attenuation of optical signal in optical fibers. Explain different types of attenuation processes occurring in an optical fiber. [5]

10. With neat schematic diagram explain the construction and working principle of $p-n$ junction as a photon detector. [10]

11. The speed of a GPS satellite relative to a point on the Earth's surface is typically $V = 3.9 \times \frac{10^3 m}{sec}$. [10]
    Assume that the clock on a GPS satellite is synchronized with the clocks of the Earth's reference frame at one instant. By how much do they differ 1.0 hour later? What is the corresponding distance error for a radio signal?

12. a) Explain the postulates of special theory of relativity. [5]

    b) Prove that the Newton's 2nd law of motion is invariant under the Galilean transformation. [5]

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Possession of Mobile Phone in the exam hall even in switched off condition is a malpractice.