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Vellore Institute of Technology
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School of Advanced Sciences
DEPARTMENT OF PHYSICS

Mid Term Test (MTT)

B.Tech – Fall Semester-2020-21, C1/TC1

Course: PHY1701- Engineering Physics

Time: 90 mins **Max Marks: 60 (10×6 = 60)**

Answer all Questions

Mass of proton = 1.67×10^{-27} kg, Mass of electron = 9.1×10^{-31} kg, Planck's constant = 6.62×10^{-34} J.s, Boltzmann constant = 1.38×10^{-23} J/K

1. What is ultraviolet catastrophe? Write the Planck's radiation formula and explain the frequency dependence of spectral energy density. Can you explain the ultraviolet catastrophe using the Planck's radiation formula?
2. Discuss the Heisenberg uncertainty principle. If the uncertainty in the position of a particle is on the order of its de Broglie's wavelength, then what will be the uncertainty in its momentum?
3. Find the de Broglie wavelength of (a) a 5-MeV proton; (b) a 50-GeV electron; (c) an electron moving with the velocity 1.00×10^{6} m/s. ()
4. Using the quantum particle in a 1D infinite box model, find how the possible energies of the particle are related to the principal quantum number.
5. A particle is trapped in an infinite one-dimensional well of width L. If the particle is in its ground state, evaluate the probability to find the particle (a) between x = 0 and x = L/3; (b) between x = L/3 and x = 2L/3; (c) between x = 2L/3 and x = L.
6. Draw suitable diagrams to illustrate the following conditions in an optical fiber (also give a brief description):
   (a) Actual angle of incidence is less than the specified critical angle of incidence
   (b) Actual angle of incidence is equal to the specified critical angle of incidence
7. What is meant by pulse-width dispersion? How can you propagate the signal through optical fiber with least pulse dispersion?
8. A step-index optical fiber has an acceptable angle of 20° in air medium. It has a relative refractive index difference value of 3%. Determine the critical angle at the core-cladding interface and numerical aperture of the fiber.
9. Suppose you have a pn- photodiode which can detect the light with 10 % efficiency. If you want to increase the detection efficiency of pn-photodiode what kind of modification will you do and why? Explain it using the proper diagrams.
10. The energy bandgap of GaAs semiconductor is 1.42 eV. Determine the primary wavelength of photons generated due to electron–hole recombination. The emitted wavelength falls in which region of electromagnetic radiation?