Y/D/TY

Reg. No:

Final Assessment Test – April 2025

VIT
Vellore Institute of Technology

Course: BPHY101L - Engineering Physics
Class NBR(s): 5522 / 5524 / 5525
Time: Three Hours

Slot: C1+TC1
Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions
(10 X 10 = 100 Marks)

1. Derive a wave equation for a transverse wave travelling on a stretched string with constant tension T.

2. Derive a Maxwell's correction for Ampere's equation. Show that the corrected equation obeys both symmetry principle and scalar triple product.

3. Explain Davisson-Germer experiment with schematic diagram. Validate the results with a diffraction condition.

4. What are the physical parameters of materials modified with size in nanomaterials? Classify nanomaterials based on electron motion confinement with schematic geometries and their respective energy levels/bands.

5. Explain the construction and working principle of an He-Ne laser with schematic experimental setup: along with He-Ne energy level diagram.

6. Derive the rules for light propagation by total internal reflection in step-index optical fibers.

7. Explain the construction and working of a diode laser used in single mode optical fiber communication.

8. a) Calculate Einstein's A/B coefficients' ratio at room temperature for a radiation with angular frequency 1.5×10^{14} s^{-1} rad/s.
   b) In a GaAs diode laser, the reflection coefficients $R_1 = 0.9$, $R_2 = 0.7$ for uncoated mirror facets, and the material absorption coefficient (α) is 10 cm^{-1}. Calculate the threshold gain coefficient γ_{th} for a laser diode of wavelength 500 μm.

9.a) i) X-rays of wavelength 2 Å are incident on a graphite target. Calculate the kinetic energy (in eV) of the recoiled electron, when the photon is scattered at right angle. [5+5]

ii) Determine the velocity, kinetic energy, and potential energy of a free neutron (mass = 1.0087 amu) moving with de Broglie wavelength of 1 Å.

[OR]

9.b) i) A free particle motion is confined to a width of 3 Å while it has free motion along another 2 dimensions. It is found that when the energy of the particle is 210 eV, its eigenfunction has 4 antinodes. Calculate the mass and velocity of the particle. [5+5]

ii) An electron with 1 eV energy has a transmission probability of 10^{-4} through a potential barrier of hight 9 eV and thickness 't'. Calculate the width (thickness) of the potential barrier.

10.a) i) A 5 km long step-index multimode optical fiber with a core refractive index of 1.6 and relative refractive index difference of 1 % carries a light. Calculate the maximum time delay between fundamental mode and critical mode of light propagation. [5+5]

ii) A multimode step-index optical fiber with a core-diameter of 70 μm and relative refractive index difference of 1.4 % is allowing 850 nm laser. If the core refractive index is 1.45, calculate the V number and mode volume of the fiber.

[OR]

10.b) i) Find out the energy gap of two direct band gap semiconductor materials (in eV), when the emitted photons from these materials have wavelengths of (a) 650 nm (b) 950 nm? [5+5]

ii) Photons with an average frequency of 5×10^{14} Hz are falling on a photodiode having a responsivity 0.5 A/W. Calculate the quantum efficiency of the photodiode.

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