VIT

Vellore Institute of Technology

Final Assessment Test – June 2023

Course: BPHY101L - Engineering Physics

Class NBR(s): 4916 / 4918 / 4920 / 4922 / 4924 / 4926 / 4928 / 4930 / 4932 / 4950

Slot: B2+TB2

Time: Three Hours

Max. Marks: 1

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN "OFF" POSITION IS TREATED AS EXAM MALPRACTI

Answer any TEN Questions

(10 X 10 = 100 Marks)

1. Obtain the one-dimensional wave equation for a transverse wave propagating in a string. Also, derive the relationship between the linear mass density, wave velocity and impedance of a string.

2. a) Give an example each of a transverse wave and a longitudinal wave. Graphically represent the direction of disturbance and propagation of wave in each case. [5]

   b) A transverse sinusoidal wave of amplitude 3.0 cm and wavelength 25 cm travels along a string of linear density 1 gm cm^{-1}, which is joined to a heavier string of linear density 4.0 gm cm^{-1}. The joined strings are held under constant tension. Calculate the wavelength and amplitude of the wave as it travels along the heavier string. [5]

3. Give a detailed explanation of the mathematical derivation and physical principles underlying the fundamental aspect of electromagnetism that governs the behavior of electromagnetic waves propagating through free space.

4. Elaborate on the de Broglie concept of matter waves. How did Planck obtain the correct formula for the spectral distribution of radiation from a black body?

5. a) Write down the Schrödinger's time dependent wave equation and explain the significance of the Hamiltonian operator. [5]

   b) Thermal neutrons are incident on a crystal whose principal Bragg plane spacing is 2.0 Å. If a first-order Bragg reflection from the planes is found at 30°, what is the kinetic energy of the thermal neutrons? [5]

6. Differentiate between the bulk and the nanostructured materials. What happens to the energy levels of a nanostructured material?

7. What is quantum mechanical tunnelling? How does the tunnelling probability vary with the strength and the width of the potential barrier? Describe the construction and working of scanning tunnelling microscope (STM) highlighting its applications in materials science.

8. Explain the construction of CO_2 laser and with the help of energy level diagram explain the lasing action in CO_2 laser. What is the role of nitrogen in CO_2 laser?

9. a) What is the minimum number of energy levels required for lasing action and why? [5]

   b) Consider a laser source which emits laser light of wavelength 632.8 nm. At what temperature will the ratio N_2/N_1 become 1.2×10^{-33}? Here, N_1 and N_2 represent the number of atoms in the lower and upper energy levels respectively. [5]