VIT
Vellore Institute of Technology

Reg. No. :

Final Assessment Test (FAT) - JUNE/JULY 2023

Programme	B.Tech.	Semester	Winter Semester 2022-23
Course Title	ENGINEERING PHYSICS	Course Code	BPHY101L
Faculty Name	Prof. Rajasekarakumar Vadapoo	Slot	F1+TF1
		Class Nbr	CH2022232300036
Time	3 Hours	Max. Marks	100

Useful constants:
$e = 1.6 \times 10^{-19}$ C; $m_e = 9.1 \times 10^{-31}$ kg; $h = 6.626 \times 10^{-34}$ Js; $k_B = 1.38 \times 10^{-23}$ J/K

Section A (10 X 10 Marks)
Answer any 10 questions

01. Derive the equation of a standing wave in a string vibration fixed at both the ends. Determine the expression for Eigen frequency. [10]

02. (i) Assume that a thin copper wire held under a tension of 6 N/m is supporting the propagation of wave with a velocity of 36 m/s. What should be the tension in the string if the velocity of the wave reduces to one-half of the initial? [10]

(ii) Consider that strings of 2 alloys which vary slightly in their linear mass densities are connected smoothly at a point and are maintained at a constant tension T. If a wave is generated at one end of the string, discuss what will happen to its propagation at the point where the strings are connected. What will happen if the connection point becomes the end point for one string with rigid boundary?

03. (i) Find the curl and divergence of the following function: [10]

$$y = x\,\vec{i} + xz^3\vec{j} + zy^3\vec{k}$$

(ii) Using Maxwell's equations in vacuum, prove that light is an EM wave.

04. (i) If the frequency of the incident photon is 6×10^{17} Hz in Compton experiment, then calculate the wavelength of the scattered photon at 45° and 90°. [10]

(ii) A nonrelativistic particle is moving three times as fast as an electron. The ratio of de Broglie wavelength between particle to electron is 1.813×10^{-4}. Identify the particle.

05. (i) Derive the Time Independent Schrodinger equation for an electron. [10]

(ii) Without any assumptions, show that for a free particle the uncertainty relation can also be written as $\Delta\lambda\Delta x \geq \lambda^2/4\pi$.

06. (i) What is meant by Quantum confinement? Explain various structures that will be obtained due to confinement. [10]

(ii) Consider a particle with energy 0.1 eV moving along the positive x-direction. It is obstructed in its path by a 0.2 nm wide barrier with energy 4 eV. If the particle is considered to be an electron, what will be the probability of it to be found on the other side of the barrier?

07. (i) Derive the relation between Einstein's A and B coefficients. [10]

(ii) Consider 2 mirrors (M_1 and M_2) placed at the ends of a 1 m long cavity with the following properties: M_1–Absorbance = 0.2%; Transmission = 0% and M_2-Absorbance = 0.8%;

Transmission = 1%. Calculate the volume loss in the cavity if the threshold gain coefficient is 1.5.

08. With neat energy level diagram, discuss the principle and working of the He-Ne laser. [10]

09. (i) Derive the condition for light propagation in a step index optical fiber. [10]

(ii) For a step index multimode fiber with n_1=1.49, relative index (Δ) = 0.03 and operating at 1550 nm, calculate the pulse widening for 1 km length of the fiber.

10. Write a short note on the factors contributing to losses in an optical fiber. Is it possible to eliminate intermodal dispersion? [10]

11. Compare LED with Laser diode. With a neat diagram, explain the principle and working of a LED. [10]

12. (i) Discuss the principle and working of a p-i-n photodetector. Give its advantages over p-n detector. [10]

(ii) The responsivity of a pin photodiode is 0.5 A/W for photons of wavelength 1064 nm while incident at a rate of 2×10^9 s^{-1}. Calculate quantum efficiency of the photodiode.