VIT

Vellore Institute of Technology

Final Assessment Test (FAT) – June 2022

Programme	B.Tech	Semester	Winter Semester 2021-22
Course Title	ENGINEERING PHYSICS	Course Code	BPHY101L
Faculty Name	Prof. Caroline Ponraj	Slot	F2+TF2
		Class Nbr	CH2021222300550
Time	3 Hours	Max. Marks	100

Part-A (10 X 10 Marks)

Answer any 10 questions

1. (i) In an attempt to get your name in Guinness World Records, you build a bass viol with strings of length 5.00 m between fixed points. One string, with linear mass density 40.0 g/m is tuned to a 20.0 Hz fundamental frequency. Calculate (a) the tension of this string, (b) the frequency and wavelength on the string of the second harmonic [10]

(ii) A transverse wavefunction on a string is y(x,t) = 4 Sin[5(0.5x – 50t)]. Find: a) amplitude, b) wavelength, c) frequency, and d) velocity of the wave.

2. Calculate the divergence and curl of the following [10]

(a) $\vec{y}_1 = xzy\vec{i} + 2zyx^2\vec{j} + 3x^2z^4\vec{k}$

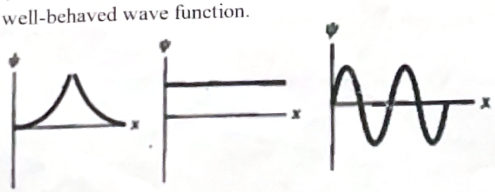
(b) $\vec{y}_2 = yz^2\vec{j} - 4zx^3\vec{k}$

(c) $\vec{y}_3 = Cos3x\vec{i} + yz^2\vec{j} - 4zx^3\vec{k}$

3. (i) Explain what happens when an X-ray photon hits a graphite target in Compton experiment. What would happen if instead of X-Rays a green light is used? Write down the formula for Compton shift explaining the terms therein. [10]

(ii) The position and momentum of a 250 eV electron are simultaneously determined. If its position is located to within 0.3 nm, what is the percentage of uncertainty in its momentum?

4. (i) Which of the above wave function is a well-behaved wave function? Give the properties of well-behaved wave function. [10]



(ii) Find the speed and kinetic energy of a proton with de Broglie wavelength λ = 2 Å.

5. (i) Calculate the probability of finding the particle between x = 0.15L and x = 0.85L, if it is confined in a 1-D box of length L. [10]

(ii) Write down three properties of nanomaterial that makes it more advantageous than its bulk counterpart. Give any two applications of nano materials.

6. (i) An electron with total energy E strikes a finite potential barrier V (V>E). Interpret this phenomenon classically and quantum mechanically with appropriate diagrams. Name an instrument based on this phenomenon. [10]

(ii) The energy of an electron confined to a one-dimensional box of length 3.0 Å is 9.554×10^{-17} J. Find the order of the excited state. Also, calculate the velocity of this electron.

7. (i) Derive the threshold gain coefficient required to obtain lasing transition in a cavity of length 'L' enclosed between two mirrors M_1 and M_2 and R_2 respectively. [10]

(ii) A laser system has four energy levels E_1, E_2, E_3 and E_4, at 0 eV, 1.2 eV, 2.59 eV and 2.78 eV respectively. Evaluate the wavelengths of the pumping source and emitted laser?

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

9. (i) With suitable diagram, derive the conditions for light propagation in the optical fiber and explain the terms there in. [10]

(ii) Calculate the refractive index of a core and cladding of an optical fiber that has a relative index of 0.04 and numerical aperture 0.36

10. (i) Briefly explain the types of dispersion that occurs in a single mode fiber. [10]

(ii) Obtain an expression for pulse dispersion in a step index multimode fiber.

(iii) Explain why intermodal dispersion in a graded index fiber is reduced compared to a step index multimode fiber.

11. (i) Based on the electrical properties, identify which category of materials are more suitable for acting as optoelectronic devices. Why? Identify the charge carriers present in them. [10]

(ii) What do you understand by direct and indirect band gap semiconductors

12. (i) Define responsivity of a photodiode. A Si PIN photodiode has a quantum efficiency of 0.7 at a wavelength of 0.85×10^{-6} m. Calculate its responsivity [1

(ii) Discuss the principle and working of a p-i-n photodetector. What are the operational differences between the photo detectors and sources used in fiber optic communications.

⇔⇔⇔