BLC1316

VIT
Vellore Institute of Technology

Continuous Assessment Test I – Nov 2022

Programme	:	**B. Tech**	Semester	:	**Fall 2022-23**
Course	:	**Engineering Physics**	Code	:	**BPHY101L**
Faculty	:	**Dr. Satyanarayana Kumar**	Slot	:	**D1+TD1**
Time	:	**90 minutes**	Class Number		**CH2022231700331**
			Max. Marks :		**50**

Check both sides of the question paper

Answer any FIVE Questions (5 x 10 = 50)

1.	a.	Write down the one-dimensional wave equation satisfied by the function $y(x,t)$ with wave speed c. Mention the two general solutions of a wave traveling along the $+x$ and $-x$ directions respectively.	3
	b.	Check whether the function $g(x,t) = 2e^{x}sin(t)$ represents a viable solution of the one-dimensional wave equation with speed of the wave being equal to 1. Support your answer with appropriate steps.	7
2.	a.	The equation of a mechanical wave is given by $f(x,t) = 0.1\,sin(2\pi t - 0.1\pi x)$. What are the values of frequency, speed, wavelength, wavenumber and amplitude of the wave? What is the direction of propagation of the wave ?	6
	b.	Consider two strings of linear mass densities ρ_1 and ρ_2 joined with each other and stretched with tension T. A traveling transverse wave approaches the boundary where the two strings are in contact. If $\rho_1/\rho_2 = 1/2$, find the fraction of incident amplitude that is reflected and transmitted at the boundary.	4

3.		Neatly draw and write down the expression $f(x)$ for the standing wave configuration corresponding to the 3rd harmonic for a string of length $L = 1\,m$. $f(0) = 0$ and $f(L) = 0$. The amplitude of the standing wave is $10\,cm$. Identify and write down the location of all the nodes and antinodes. Show that $f(x)$ is a standing wave eigenmode of $\frac{d^2}{dx^2}$ and find the wavenumber and frequency. Take the wave speed, $c = 1\,m/s$.	10
4.		The x, y and z components of a vector field are $F_x = 2[x^2 + y^2 z\,sin(xz)]$, $F_y = p\,y\,cos(xz) + qz$ and, $F_z = 2xy^2\,sin(xz) + 4y$. Find the numerical values of the constants p and q such that the curl of this vector field vanishes. What is the value of $p + q$?	10
5.		Write down the equations for Gauss's law, Faraday's law and Ampere's law (with the correction-term) in their differential form. Applying these equations in vacuum, demonstrate that the electric field satisfies the wave equation.	10
6.	a.	Below are given the direction of electric field ($\vec{E}$) and propagation direction ($\hat{k}$) for a plane electromagnetic wave in free space. What is the direction of the magnetic field in each of the following cases ? (i) $\vec{E}$ is along positive x-direction, $\hat{k}$ is along negative y-direction (ii) $\vec{E}$ is along negative x-direction, $\hat{k}$ is along positive z-direction (iii) $\vec{E}$ is along negative y-direction, $\hat{k}$ is along positive x-direction (iv) $\vec{E}$ is along negative y-direction, $\hat{k}$ is along positive y-direction	4
	b.	In your own words, briefly explain the principle and the significance of the Hertz experiment. Use a neat diagram to support your answer.	6