VIT
Vellore Institute of Technology

22BLC1351

Continuous Assessment Test I – Nov 2022

Programme	: B.Tech	Semester	:	Fall 22-23
Course	: Engineering Physics	Code	:	BPHY101L
Faculty	: Dr. S. Karthikeyan Dr. M. C. Ramkumar	Slot & Class	:	D2+TD2
		Number		CH2022231700388 CH2022231700366
Time	: 1½ Hours	Max. Marks	:	50

Answer any FIVE Questions (5 x 10 = 50)

1. Derive the standing wave equation for a string of fixed length *l* which has infinite impedance at both ends. Also. 10
   a. Write down the expression for Eigen frequency.
   b. Draw the diagram for nodes and antinodes in a stretched string between two points vibrating in third harmonic.

2. Consider a standing waves moving at 130 m/s on a 2.5 m long string 10
   a. What is the fundamental frequency of this wave?
   b. What is the frequency of third harmonic?
   c. How many nodes and antinodes are present in the wave of the third harmonic?
   d. What is the frequency of the 5^{th} overtone?
   e. What is the wavelength of the 3^{rd} overtone?

3. Draw the figure representing the incidence, reflection and transmission of waves at boundary with two strings having different linear mass density. Also write down the following 10
   a. equation for incident, reflected and transmitted waves
   b. reflection & transmission coefficient of the amplitudes in terms of z
   c. reflection & transmission coefficient of the amplitudes in terms of k and ρ

4. a. A temperature gradient will occur after switching on the AC in the closed room. If temperature distribution is given by the scalar function $T = 2xy^2z^3$, then calculate the change in temperature at a point (1,-2,1). What will be the direction of maximum change in temperature in the room? 10

   b. If $\vec{A} = x^2\, y\, z\, \hat{x} + 3\, y^2\, \hat{y} - x\, z\, \hat{z}$,
   Find $\vec{\nabla} \cdot \vec{A}$ and $\vec{\nabla} \times \vec{A}$

5. Using Maxwell's equation in free space, derive the plane electromagnetic wave (EM) equation for free space in terms of electric and magnetic field vectors. Also show how to arrive at the velocity of EM waves. 10

6. a. Discuss the working principle and construction of hertz experiment with neat sketch. 10
   b. Write down the applications of Maxwell's equation

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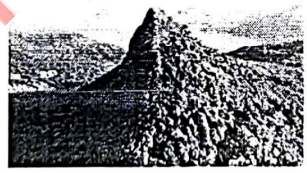
Programme	: B.Tech.	Semester	: Fall 2022-2023
Course	: Engineering Physics	Code &	: BPHY101L
		Slot	: D2+TD2
Faculty	: Caroline Ponraj, C Justin Raj, M G Shalini, Rishab Antosh B, Uthiram C	Class number	: CH2022231700409, CH2022231700383, CH2022231700394, CH2022231700380, CH2022231700562
Time	: 90 minutes	Max. Marks	: 50

Answer any FIVE Questions only (5 x 10 = 50)

Q.No	Questions	Marks
1	Considering a string with length L clamped at both ends, derive the equation for the standing wave produced. Find also the frequency and wavelength for different modes.	10
2	While walking in a forest, you are assigned the task of tying a string between the trunks of two trees. The length of the string tied is about 1m with a mass 2×10^{-2} kg. Suddenly your friend perturbs the string at the centre and finds a transverse displacement in the string given by the equation $$y(x,t) = 0.2\sin\left(\frac{2\pi x}{3}\right)\cos(40\pi t)$$ where x & y are in metres and t in seconds. Answer the following i) Write down the equation of the individual waves that gives rise to the above stationary wave. ii) Determine the wavelength, frequency and speed of each wave. iii) Evaluate the tension in the string.	10
3	Discuss the concept of reflection and transmission of wave on two strings connected smoothly at the boundary. Justify the answers with neat diagram and all necessary equations. Also explain how the impedance influences the coefficients of amplitude.	10
4	You could see this hill which is at few miles distant from the terrace of your house.  The height of the hill is given by $$h(x,y) = 20(6xy - 12x^2 - 18y^2 - 22x + 38y + 48)$$ where x & y are the distance in miles in north and east direction from your place. Using the concept of the gradient of a function, determine the location of the hill top and the height of the hill.	10
5	Write and explain Maxwell equations in differential forms and discuss the implications of applications in regular life.	10
6	Discuss the following. (a) Physical significance of divergence and curl. (b) Displacement current (c) Write down only the plane electromagnetic wave equations in free space.	10

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22BCE1351

Continuous Assessment Test I – March 2023

Programme	:	B.Tech.	Semester	:	Win22-23
Course	:	Engineering Physics	Code	:	BPHY101L
Faculty	:	B. Ajitha, Caroline Ponraj, R.D. Eithiraj, N. Manikandan, M.C. Ramkumar, M.G. Shalini	Slot/ Class Numbers	:	E1/ CH2022232300026, CH2022232300028, CH2022232300024, CH2022232300022, CH2022232300040, CH2022232300042
Time	:	1½ Hours	Max. Marks	:	50

Answer any FIVE Questions (5 x 10 = 50)

1. Derive the equation of a standing wave and find the Eigen frequenciesin a string fixed at both the ends. 10

2. (i) Assume that a thin copper wire held under a tension of 4 N/m is supporting the propagation of a wave at 32 m/s. If the velocity needs to be reduced to one-fourth of the initial, how should the tension in the string be changed? 10

   (ii) Show that $f(x, t) = x^2 + v^2t^2$ is a solution of standard wave equation.

3. (i) If you are given a wave of the form $y = 10 \cos(3\pi x - 8\pi t)$, then calculate the wavelength, frequency and speed of the wave. 10

   (ii) Find the curl and divergence of the following function: $y_1 = y\vec{i} + xz^2\vec{j} + xy^3\vec{k}$

4. (i) Find the curl of the gradient of a function $F = 2x^2 + y^3 + z^2$. 10

   (ii) A wave is allowed to propagate in a string made of aluminium of diameter 0.9 mm that is connected to another string of 1 mm diameter. What will happen to the wave as it moves from thinner to thicker string at the interface of different thickness strings? Write down the equations corresponding to the phenomena occurring at the interface.

5. Using Maxwells equations, mathematically prove the electromagnetic wave nature of light. 10

6. (i) Give a comparative conceptual analysis of Maxwells equations in a medium and in free space. 10

   (ii) What is the significance of Gauss law of electrostatics and magnetostatics?