



# VIT

Vellore Institute of Technology  
(Deemed to be University under section 3 of UGC Act, 1956)

## Continuous Assessment Test (CAT - I), August 2024

Programme	: B.Tech.	Semester	: Fall 2024-2025
Course Title	: Engineering Physics	Course Code	: BPHY101L
School	: School of Advanced Sciences	Slot	: C+TC1
Duration	: 90 mins	Max. Marks	: 50
Class No	: 5995, 6901, 5979, 6231, 6234, 6244, 5971, 6002, 8074		

### Part – A (5 x 10 = 50) Answer ALL Questions

Sl. No	Questions	Max Marks	CO	BL
1	An infinitely long stretched elastic string having a mass per unit length, $\rho$ , and is under a uniform tension, $T$ . If a transverse disturbance (wave) is produced in that string, then prove that the velocity of the wave is $v = \sqrt{\frac{T}{\rho}}$ , using the proper approximations and clear diagram. (5+3+2 marks)	10	CO1	BL2
2	(a) Show that the harmonic wave $y(x, t) = 15 \text{ cm Sin}(\kappa x - \omega t)$ satisfy the wave equation. (5 marks) (b) If the above harmonic wave passes through the junction of strings of two different linear mass densities with velocities $100 \text{ ms}^{-1}$ and $80 \text{ ms}^{-1}$ , respectively, then compute the reflection and transmission coefficient of the waves and also write the mathematical expression of the reflected wave. (2+2+1 marks)	5+5	CO1	BL3
3	(a) Describe standing waves and explain why they look stationary. Plot the resultant standing-wave patterns produced on a string by two identical waves of time period $T$ , traveling in opposite directions at different times, (i) $t = 0$ , (ii) $t = T/4$ , and (iii) $t = T/2$ with mentioning the nodes and antinodes. (2+3 marks) (b) A string of 70.0 cm long and a mass of 1.20 g vibrates in its first fundamental mode with a frequency of 220 Hz. Calculate the tension ( $T$ ) in the string. Also, determine the wavelength and frequency of vibration when the string vibrates in third harmonics. (3+1+1 marks)	5 5	CO1	BL3
4	Write down the four Maxwell's equations in their differential form and explain their physical significance. Using the above Maxwell's equations, derive the wave equation for the electric field component of the EM waves in free space and show that the EM wave travels at the speed of light. (Given that: $\mu_0 = 1.256 \times 10^{-6} \text{ N/A}^2$ , $\epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$ ) (4+4+2 marks)	10	CO1	BL2
5	(a) What is the divergence of a vector field? Explain how a positive charge and negative charge behave as a source and sink for the electric field in terms of the divergence with proper diagram. (2+3 marks) (b) What is displacement current. Explain how Maxwell modify the Ampere's law using the concept of displacement. (1+4 marks)	5 5	CO1	BL2