VIT
Vellore Institute of Technology

Continuous Assessment Test (CAT - I), November 2022

Programme	: B.Tech.	Semester	:	FALL 2022-23
Course Title	: Engineering Physics	Course Code	:	BPHY101L
School	: School of Advanced Sciences	Slot	:	B2+TB2
Duration	: 90 mins	Max. Marks	:	50
Class No	: 2685, 5666, 5678, 5686			

Part – A (5 x 10 = 50)

Answer ALL Questions

Sl. No	Questions .	Max Marks
1	An infinitely long stretched elastic string having a mass per unit length, ρ, and is under a uniform tension, T. If a transverse disturbance (wave) is produced in that string, then derive the wave equation and show that the velocity of the wave is $v = \sqrt{\frac{T}{\rho}}$ using the proper approximations and clear diagram. (5+1+2+2 marks)	10
2	a) Prove that the superposition of two identical harmonic progressive waves travelling in the same medium with opposite directions is a non-progressive wave. (5 marks) b) A string of length 1m with a linear mass density of 0.1g/cm is fixed at both ends and is under a uniform tension of 10 N. If a standing wave of amplitude 10 cm with 3 antinodes is formed on the string, then calculate the wavelength and Eigen frequency of the standing wave. (2+3 marks)	10
3	a) Consider an interface between two different elastic mediums of impedance Z_1 and Z_2. Using the boundary conditions at the interface, derive the expression for the reflection and transmission coefficient. (7 marks) b) Prove that, if the second medium offers huge impendence, the incident wave is completely reflected with a phase change of π (180°). (3 marks)	10
4	a) Derive the first Maxwell's equation in differential form using the divergence theorem from Gauss's law of electrostatics and explain its physical significance. (4+1 marks) b) Show that the vector field, $\vec{F}(x,y,z) = 2xy\hat{i} + (x^2 + z^2)\hat{j} + 2zyk$ is irrotational. (5 marks)	10
5	Using Maxwell's equation in free space, derive the electromagnetic wave equation. Note that: for a vector Field A, $\nabla \times (\nabla \times A) = \nabla(\nabla . A) - \nabla^2 A$	10