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

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	:	B1+TB1
Duration	:	90 mins	Max. Marks	:	50
Class No	:	2684, 5663, 5675, 5683, 5707			

Part – A (5 x 10 = 50)

Answer ALL Questions

Sl. No	Questions	Max Marks
1	Consider a transverse wave on an infinitely long stretched elastic string of mass per unit length μ and under the uniform tension T. Stating the approximations (2 marks) and showing in a diagram the forces on a string element responsible for wave propagation (3 marks), derive the one-dimensional transverse wave equation, and deduce the velocity of the wave. (4+1 marks)	10
2	a) Consider two strings of different mass per unit length (string 1: μ_1 and string 2: μ_2) are connected with a mass-less ring and are kept under tension T. Write down the transmission and reflection coefficients for a harmonic wave propagating from string 1 to 2 (3 marks). Show under what conditions the disturbance produced in that string will be completely reflected. (2 marks) b) Show that $y(x, t) = \sin k(x - vt)$ represents a one-dimensional travelling wave moving with constant velocity v and without any shape change along the positive direction of x. (5 marks)	10
3	a) Using suitable sketches and expressions, explain how progressive waves differ from standing waves. (5 marks) b) A wave displacement is given by $y = \sin 2\pi (0.2x - 5t)$ (in mks units) Find (i) the amplitude of the wave, (ii) the magnitude of the propagation vector, (iii) the wavelength, (iv) the time period, and (v) the wave velocity. (5 marks)	10
4	Considering a case of charging capacitor, explain the incompleteness of Ampere's Law with appropriate diagrams (5 marks) Write down the full Maxwell's equation in differential form, defining all the parameters (5 marks).	10
5	a) A scalar field is given by $f = e^x \sin(y) \ln(z)$, compute $\vec{\nabla} \cdot (\vec{\nabla} f)$. (5 marks) b) Can electric and magnetic monopoles exist in a medium with finite volume charge density? (2 marks) Support your answer with appropriate tools and reasoning. (3 marks)	10