

### Continuous Assessment Test (CAT - I), September 2023

Programme	: <b>B.Tech</b>	Semester	: <b>Fall 2023-2024</b>
Course Title	: <b>Engineering Physics</b>	Course Code	: <b>BPHY101L</b>
School	: <b>School of Advanced Sciences</b>	Slot	: <b>C2+TC2</b>
Duration	: <b>90 mins</b>	Max. Marks	: <b>50</b>
Class No	: <b>5776, 5780, 5784, 5788, 6676 and 6682</b>		

**Part – A (5 x 10 = 50)**

**Answer ALL Questions**

Sl. No	Questions	Max Marks
1	Consider a string of mass density $\rho$ and length $L$ fixed at both ends under tension $T$ . Derive the one dimensional wave equation for the transverse waves on the stretched string and discuss about the general solutions of the equation.	10
2	A string of length $L$ is stretched between two supports to produce a tension $T$ . Calculate the frequency of the first three modes. Represent these three modes graphically.	10
3	(a) What is characteristic impedance ( $Z$ ) of a string? Consider a transverse wave traveling from one medium to another with impedance $Z_1$ and $Z_2$ respectively. Discuss mathematically the reflection and transmission coefficients when (i) $Z_1 = Z_2$ and (ii) $Z_2 = \infty$	5
	(b) A string with a tension of 7.0 N allows transverse waves to travel through it with a speed of 20.0 m/s. Estimate the tension required if the speed of the wave is (a) 15.0 m/s and (b) 30.0 m/s?	5
4	Derive the electromagnetic wave equation in free space from Maxwell's equation for both electric and magnetic field. Compare them with classical wave equation and show that light is a form of EM wave.	10
5	(a) Explain the major contribution of Maxwell in correcting the Ampere's circuital law?	5
	(b) Calculate the divergence of a vector field $\mathbf{G}(x,y,z) = \frac{4y}{x^2} \mathbf{i} + \sin(y) \mathbf{j} + 3 \mathbf{k}$	5