

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086
(For candidates admitted during the academic year 2023 – 2024 & thereafter)

M.Sc., DEGREE EXAMINATION NOVEMBER 2024

PHYSICS

THIRD SEMESTER

COURSE : MAJOR CORE

PAPER : ELECTROMAGNETIC THEORY

SUBJECT CODE : 23PH/PC/ET34

TIME : 3 HOURS

MAX. MARKS : 100

Q. No.	SECTION A (10 x 3=30 marks)	CO	KL
ANSWER ALL QUESTIONS			
1.	What is Poisson's equation? When does it become Laplace's equation?	CO1	K1
2.	Find electric field due to a dipole.	CO1	K1
3.	Tell the effect of a magnetic field on atomic orbits.	CO1	K1
4.	What are cavity resonators?	CO1	K1
5.	Contrast Biot-Savart law with Ampere's law.	CO2	K2
6.	Outline the significance of Lienard-Wiechert potential.	CO2	K2
7.	Summarize Lorentz and Coulomb Gauge.	CO2	K2
8.	Demonstrate polarization with a neat diagram.	CO2	K2
9.	Make use of relativity to briefly explain the structure of space time.	CO3	K3
10.	What is the meaning of covariance? How will you interpret the term "covariant of electrodynamics"?	CO3	K3
Q. No.	SECTION B (8 x 5=40 marks)	CO	KL
Part - A			
ANSWER ANY TWO QUESTION (2 x 5=10 marks)			
11.	An electric dipole consists of two equal and opposite charges ($\pm q$) separated by a distance d . Find the approximate potential at points far from the dipole.	CO3	K3
12.	Apply Biot-Savart law to calculate the magnetic field at a distance s from a long straight wire carrying a steady current I . Determine magnetic field if length of a wire is infinitely long.	CO3	K3
13.	R is the reflection coefficient and T is the transmission coefficient: they measure the fraction of the incident energy that is reflected and transmitted respectively, confirm that $R + T = 1$.	CO3	K3
Part - B			
ANSWER ANY SIX QUESTIONS (6 x 5 = 30 marks)			
14.	Analyze the potential due to a localized charge distribution.	CO4	K4
15.	Derive an expression for energy stored in the magnetic field.	CO4	K4
16.	Derive Larmor formula for power.	CO4	K4
17.	By assuming the concept of electromagnetic waves in vacuum, arrive at the wave equation for E and B .	CO4	K4
18.	Derive the relation between relativistic energy and momentum and examine them.	CO4	K4

19.	Using Lorentz transformation equation show that Maxwell equations are invariant.	CO4	K4
20.	Examine propagation of TE waves in a rectangular wave guide and hence explain cutoff frequency.	CO4	K4
21.	Estimate the forces that act on a dielectric.	CO4	K4
	SECTION C (2 x 15 = 30 marks) ANSWER ANY TWO QUESTIONS	CO	KL
22.	Evaluate Laplace equations in 1D, 2D and 3D.	CO5	K5
23.	What do you understand about the boundary conditions on B. Discuss the methods of solving boundary value problems in magnetostatics.	CO5	K5
24.	Prove and justify the statement that, “the work done on the charges by the electromagnetic force is equal to the decrease in energy remaining in the fields, less the energy that flowed out through the surface”.	CO5	K5
25.	Formulate Lagrangian and Hamiltonian for a relativistic charged particle in an electromagnetic field.	CO5	K5
