LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

FIRST SEMESTER – **NOVEMBER 2023**

PPH1MC02 – ELECTRODYNAMICS

Date: 03-11-2023   Dept. No.   Max. : 100 Marks
Time: 01:00 PM - 04:00 PM

SECTION A – K1 (CO1)

	Answer ALL the questions	(5 x 1 = 5)
1	**Fill in the blanks**	
a)	The electric scalar potential is governed by _ _ _ _ _ _ equation.	
b)	The two common gauges are the _ _ _ _ _ and the Lorentz gauge.	
c)	Larmor formula provides for the rate at which energy is radiated by an accelerated charged _ _ _ _.	
d)	In coaxial cables TEM waves have _ _ _ _ _ electric and magnetic field components.	
e)	The covariant form expresses Maxwell's equation in a manner that is consistent with _ _ _ _ _ _ _.	

SECTION A – K2 (CO1)

	Answer ALL the questions		(5 x 1 = 5)
2	**Match the following**		
a)	Divergence and Curl of B	i.Tensor algebra	
b)	Energy and momentum in electromagnetic waves	ii loss of guided waves as they propagate	
c)	Radiation reaction	iii. Poynting's theorem	
d)	Attenuation in wave guides	iv. Energy in the magnetic fields	
e)	Four vectors	v. Particle response to emitted radiation	

SECTION B – K3 (CO2)

	Answer any THREE of the following	(3 x 10 = 30)
3	Determine the power flow of a plane wave using the Poynting theorem.	
4	Explain the laws of conservation for relativistic energy and discuss the corresponding Compton scattering.	
5	**a.** Calculate the percentage concentration of a rod moving with a velocity 0.8 c in a direction inclined at 60° to its own length. **b.** Find the velocity at which the mass of a particle is double its rest mass. (6+4)	
6	Verify that the retarded potentials meet the requirements of the Lorentz gauge condition.	
7	Solve for the approximate potential at points far from an electric dipole consisting of two equal and opposite charges (+q and –q) separated by a distance d	

SECTION C – K4 (CO3)

	Answer any TWO of the following	(2 x 12.5 = 25)
8	Point out that TEM waves cannot occur in a hollow wave guide. Also show that a coaxial transmission line of inner and outer radius a and b respectively admit waves with $E_z = 0$ and $B_z = 0$	

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9	Find the potentials of a point charge moving with a constant velocity.
10	(a) Establish the relation between the relativistic momentum and relativistic energy. (b) Show by direct application of Lorentz transformation $x^2 + y^2 + z^2 - c^2t^2$ is invariant. (6 + 6.5)
11	Discuss the Lorentz transformation and 4-vectors, and elucidate the concept of the invariant interval.

SECTION D – K5 (CO4)

	Answer any ONE of the following	**(1 x 15 = 15)**
12	Appraise and prioritize the importance of Gauge Transformations and their interconnection with Electromagnetic Potentials. Reframe the Concepts of Coulomb Gauge and Lorentz Gauge, Giving priority to their significance.	
13	Derive an expression for the cut-off frequency of a rectangular waveguide.	

SECTION E – K6 (CO5)

	Answer any ONE of the following	**(1 x 20 = 20)**
14	Design an explanatory framework for the multipole expansion theory of electrostatic potential, represented as a series of powers of (1/r).	
15	State and prove first and second uniqueness theorems.	