LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2022**

UPH 3501 – ELECTRICITY AND MAGNETISM

Date: 24-11-2022   Dept. No.   Max. : 100 Marks
Time: 09:00 AM - 12:00 NOON

	SECTION A		
Q. No.	**Answer ALL questions**		
1	**MCQ** (5 x 1 = 5)		
(a)	Electric field intensity at a point varies as r^{-1} for: (a) a point charge (b) an electric dipole (c) a plane infinite sheet of charge (d) a line charge of infinite length	K1	CO1
(b)	A capacitor of 80 μF is charged to a potential difference (p.d.) of 250 V. The charge acquired by it is (a) 0.2C (b) 0.4C (c) 0.02C (d) 0.3C	K1	CO1
(c)	The magnetic field outside an infinitely long solenoid is (a) Maximum (b) Minimum (c) Infinite (d) zero	K1	CO1
(d)	When current in a coil changes from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The self-inductance of the coil is (a) 1.67H (b) 6H (c) 3H (d) 0.67H	K1	CO1
(e)	The pointing vector S of an electromagnetic wave is: (a) S = E × H (b) S = E × B (c) S = E + H (d) S = E - H	K1	CO1
2	**Define the following** (5 x 1 = 5)		
(a)	Electric Dipole.	K1	CO1
(b)	Polarization.	K1	CO1
(c)	Gauss's law in magnetostatics.	K1	CO1
(d)	Ampere.	K1	CO1
(e)	Henry	K1	CO1
3	**Match the following** (5 x 1 = 5)		
(a)	Mutual inductance Electromagnetic Induction	K2	CO1
(b)	Electric field Tesla	K2	CO1
(c)	Faraday's law C/Kg	K2	CO1
(d)	Magnetic Induction Henry	K2	CO1
(e)	Gyromagnetic ratio N/C	K2	CO1
4	**State True or False** (5 x 1 = 5)		
(a)	A parrot comes and sits on a high-power line, it will experience a fatal shock.	K2	CO1
(b)	The relation between three electric vectors E, D and P is $D = \varepsilon_0 E + P$.	K2	CO1

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(c)	The force experienced by a charged particle moving in a magnetic field is independent of strength of magnetic field.		K2	CO1
(d)	The number of electric lines passing through a surface area normally is called magnetic flux.		K2	CO1
(e)	The energy transported by electromagnetic field per unit time per unit area is called Poynting vector.		K2	CO1

SECTION B

Answer any TWO of the following **(2 x 10 = 20)**

5.	Apply Gauss's law to find the electric potential at a vertical distance 'r' due to an infinitely long charged wire.	K3	CO2
6.	Derive an expression for the equivalent capacitance of n capacitors connected in (i) series and (ii) parallel.	K3	CO2
7.	Interpret mutual induction. Derive an expression for the mutual-inductance of two long co-axial solenoids.	K3	CO2
8.	Using Maxwell's equations, deduce the equation for the propagation of the plane electromagnetic waves in free space.	K3	CO2

SECTION C

Answer any TWO of the following **(2 x 10 = 20)**

9.	(i) Distinguish between polar and non-polar molecules (2) (ii) Two-point charges q_1 = +0.2 C and q_2 = 0.4 C are placed 0.1 m apart. Calculate the electric field strength at (a) the mid-point between the charges and (b) a point on the line joining q_1 and q_2 such that it is 0.05 m away from q_2 and 0.15 m away from q_1. (8)	K4	CO3
10.	Explain electronic polarization and derive an expression for electronic polarizability of an atom.	K4	CO3
11.	Apply Ampere circuital law to find the magnetic field at any point (i) on (ii) inside and (iii) outside a toroid.	K4	CO3
12.	Analyse the motion of a charged particle in a uniform magnetic field. Under which conditions the charged particle executes helical motion?	K4	CO3

SECTION D

Answer any ONE of the following **(1 x 20 = 20)**

13	Compare electric field with electric potential. Derive an expression for electric field and potential due to an electric dipole. Also discuss its special cases.	K5	CO4
14	Use the principle of Biot-Savart's law and find the magnetic field (a) at a point due to a straight-line conductor (b) along the axis of a circular coil. (10+10)	K5	CO4

SECTION E

Answer any ONE of the following **(1 x 20 = 20)**

15	(i) Write a detailed note on the construction and theory of Helmholtz coil. (12) (ii) State and prove Gauss's theorem for a dielectric medium. (8)	K6	CO5
16	Formulate Maxwell's equations in differential form.	K6	CO5

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