LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2024**

UPH 3501 – ELECTRICITY AND MAGNETISM

Date: 08-11-2024 Dept. No. Max. : 100 Marks

Time: 09:00 am-12:00 pm

	SECTION A - K1 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
1.	**MCQ**	
a)	The force of attraction or repulsion between charges follows i) Square law (ii) Inverse square law (iii) both (i) and (ii) (iv) none of (i) and (d)	
b)	Which statement influences the capacity of a capacitor? i) area of the plates, thickness of the plates and rate of charge ii) area of the plates, dielectric and rate of charge iii) distance between the plate, dielectric and thickness of the plates iv) distance between the plates, area of the plates and dielectric.	
c)	The direction of induced emf in a circuit is given by i) Lenz ii) Fleming's left hand rule (iii) Faraday's law (iv) None of the above.	
d)	If a charged particle moves in an uniform magnetic field, the acceleration is maximum when (i) the angle between $\vec{v}$ and $\vec{B}$ is zero (ii) the angle between $\vec{v}$ and $\vec{B}$ is 45° (iii) the angle between $\vec{v}$ and $\vec{B}$ is 90° (iv) None of the above	
e)	Which of the following is correct? i) $D=\varepsilon E$ ii) $\nabla V=-E$ iii) $J=\sigma E$ iv) All are correct	
2.	**Fill in the blanks**	
a)	The principle, which shows that electric force due to charges can be added vectorially to get the total force on any charge, is called the ----------.	
b)	The amount of work done in bringing a unit charge from infinity to the sphere of charge q is ----------	
c)	A coil that does not consume any power should be ----------.	
d)	The total force acting on any charge Q, in an electric and magnetic field is given by ----------.	
e)	The Gauss's law gives the relationship between ---------- and ----------.	
	SECTION A - K2 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
3.	**True or False**	
a)	The creation of positively charged particle without simultaneous creation of negatively charged particle has never been observed.	
b)	The capacitance of a capacitor decreases if dielectric is placed between the plates.	
c)	The relation between mutual and self-inductance between two coils is given by $M_{12}^2=\sqrt{L_1}\sqrt{L_2}$.	
d)	The CRO uses electromagnetic focussing.	
e)	A plane electromagnetic waves follows the laws of reflection just like light radiations.	

4.	**Match the following**
a)	Poisson equation $\nabla \times E = \frac{-\partial B}{\delta t}$
b)	The unit of D is: Watt/m^2
c)	Dimension of induction: Coulomb/m^2
d)	Faraday's law: $\nabla^2 V = \frac{-\rho}{\varepsilon_0}$
e)	The unit of Pointing vector: Flux / current
	SECTION B - K3 (CO2)
Answer any TWO of the following.	**(2 x 10 = 20)**
5.	Obtain an expression for potential and field due to an electric dipole.
6.	Derive an expression for energy and force of attraction between parallel plate capacitor.
7.	(i)Find an expression for the magnetic induction at the centre of a circular current loop. (ii) Two long parallel wires separated by 2 cm in air carry current of 100 Amp. Find the force on one metre length of a conductor. (6 + 4)
8.	(i) Show that gain in kinetic energy of a charged particle in an electric field is equal to qV where V is the potential difference between its initial and final positions. (ii) Write the Maxwell's equations.
	SECTION C – K4 (CO3)
Answer any TWO of the following in 100 words each.	**(2 x 10 = 20)**
9.	Trace the Electric field due to a finite line of charge.
10.	State and prove the Gauss's law for parallel plate capacitor filled with a dielectric. Hence find the capacity of parallel plate capacitor.
11.	(i)Give the theory and working of Helmholtz coil. (ii) Discuss Gyromagnetic ratio.
12.	Write short notes on (a) solenoid (b) toroid.
	SECTION D – K5 (CO4)
Answer any ONE of the following in 250 words	**(1 x 20 = 20)**
13.	(i)AB is a line charge of length L which is uniformly charged and carries a total charge Q. A point charge q is located at the point C, situated at a distance R along the right bisector of AB. Calculate the electric force on the point charge due to the line charge. (ii) Discuss the mechanism of interaction between the molecules and electric field for polar and non-polar dielectrics. (iii) Find the relation between E, P and D. Hence deduce Gauss's law for a dielectric
14.	(i) Write short notes on motional EMF. (ii) State and explain Faraday's law in differential form. (iii) State Maxwell's equations in non-polarisable and polarisable media.
	SECTION E – K6 (CO5)
Answer any ONE of the following in 250 words	**(1 x 20 = 20)**
15.	(i) Define principle of superposition. (2 marks) (ii) Find an expression for continuous charge densities of the following (a) Linear charge density for finite and infinite length (b) surface charge density (c) Volume charge density (10 marks) (iii) A point charge q is placed at the centre of a dielectric sphere of radius R. Find the electric potential both inside and outside the sphere. (8 marks)

16.	i) Obtain an expression for force acting on a charge Q , moving in an electric and magnetic field.	(10 marks)
	ii) State and explain ampere circuital law.	(5 marks)
	iii) Describe the propagation of EM wave in homogenous conducting medium.	(5 marks)

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