Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Electricity and Magnetism (PHYS 1016) **Semester: I**

Programme: BSc (H) Chemistry & Mathematics (Generic Elective)

Time: 03 hrs. **Max. Marks: 100**

Instructions: Use suitable diagrams/illustrations whenever you think they will be required. All questions are compulsory. Question no 9 and 11 have internal choices. Bold face letters in the question are vector quantities.

SECTION A

S. No.		Marks	CO
Q 1	Using Gauss's Law, derive the expression of electric field intensity due to infinite sheet of charge having constant surface charge density (σ).	[4]	**CO1**
Q 2	A parallel plate capacitor has circular plates of 8.22 cm radius and 1.31 mm separation. (a) Calculate the capacitance. (b) What charge will appear on the plates if a potential difference of 116 V is applied?	[4]	**CO3**
Q 3	State Biot-Savart's Law and Ampere's Circuit Law for a current carrying element and write down their merits and demerits.	[4]	**CO1**
Q 4	Find the value of the magnetic field that will cause a maximum force of 7.0×10^{-3} N on a 20.0 cm straight wire carrying a current of 10.0 A.	[4]	**CO3**
Q 5	A square coil of side 16 cm has 200 turns and rotates in a uniform magnetic field of magnitude 0.05 T. If the peak emf is 12 V, what is the angular velocity of the coil?	[4]	**CO2**

SECTION B

Q 6	Show that $\nabla . f A = \nabla f . A + f(\nabla . A)$ where f is a scaler field and $\boldsymbol{A}$ is a vector field.	[10]	**CO1**
Q 7	Derive the expression of electric field intensity inside uniformly charge solid sphere of radius R.	[10]	**CO2**
Q 8	Magnitude of an average electric field normally present in the earth atmosphere just above the surface of the earth is 150 N/C directed downward. What is the total net charge carried by the earth? Assume the earth to be a solid sphere conductor of radius 6.4×10^{6} m.	[10]	**CO3**
Q 9	Define the terms self-inductance and mutual inductance and hence derive the	[10]	**CO4**

	expression for the mutual-inductance of two coils of different radii R_1 and R_2.		
	OR		
	State the Poynting's theorem (work-energy theorem for electrodynamics). Derive this expression ($\nabla . J = \frac{-\partial \rho}{\partial t}$) of the continuity equation (based on conservation of charge). Where ***J*** is current density and ρ is volume charge density.	[10]	**CO4**
SECTION-C			
Q 10	a) Define capacitance and hence derive the formula for the capacitance of a coaxial cylindrical shape capacitor.	[10]	**CO2**
	b) Derive the expression for energy density per unit volume stored in an electrostatic electric field using a simple parallel plate capacitor.	[10]	**CO2**
Q 11	a) Using Ampere's circuit law, derive the expression for the magnetic field at point P, which is a distance R away from a long straight wire carrying a steady current I.	[10]	**CO3**
	b) Convert the following points to Cartesian coordinates: (i) P_1 (5, 120^o, 0), and (ii) P_2 (3, 30^o, 240^o).	[10]	**CO3**
	OR		
	a) Using Ampere's circuit law, derive the expression for the magnetic field at point P, which is at a distance R away from the centre of a circular coil of radius R carrying a steady current I.	[10]	**CO3**
	b) Convert point P (1, 3, 5) from cartesian to cylindrical and spherical coordinates.	[10]	**CO3**

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SECTION A

S. No.		Marks	CO
Q 1	Using Gauss's Law, derive the expression of electric field intensity due to infinite line of charge having constant liner charge density (λ).	[4]	**CO1**
Q 2	An infinite line of charge produces a field of 4.52×10^4 N/C at a distance of 1.96 m. Calculate the linear charge density of line charge.	[4]	**CO3**
Q 3	Differentiate among the paramagnetic and diamagnetic substances.	[4]	**CO1**
Q 4	A power line 10.0 m high carries a current 200 A. Find the magnetic field of the wire at the ground.	[4]	**CO3**
Q 5	A pair of adjacent coils has a mutual inductance of 0.75 H. If the current in the primary changes from 0 to 10 A in 0.025 s, what is the average induced emf in the secondary coil?	[4]	**CO2**

SECTION B

Q 6	Show that $\nabla \times f\,A = f(\nabla \times A) + (\nabla f \times A)$ where f is a scaler field and $\boldsymbol{A}$ is a vector field.	[10]	**CO1**
Q 7	Find out the expression of electric field intensity outside solid sphere of charge.	[10]	**CO2**
Q 8	Nucleus of an Fe atom has radius 4×10^{-15} m and contains 26 protons. What electric repulsive force act between them in such a way that they are separated by a distance of one radius. (charge on one proton=$+1.6\times10^{-19}$ C)	[10]	**CO3**
Q 9	Write a note on Ferromagnetic Substances. Also describe its different types.	[10]	**CO4**

	OR		
	Write down all four generalized Maxwell equations in their differential and integral form.	[10]	**CO4**
	SECTION-C		
Q 10	a) Define the significance of term capacitance. Derive the formula for the capacitance of a spherical shape capacitor.	[10]	**CO2**
	b) Define is an electric dipole. Derive the expression for electrical potentail at any point P due to an electic dipole.	[10]	**CO2**
Q 11	a) Using Ampere's circuit law, derive the expression for the magnetic field inside a solenoid of radius R carrying a steady current I.	[10]	**CO3**
	b) Convert point P(1, 3, 5) from cartesian to cylindrical and spherical coordinates.	[10]	**CO3**
	OR		
	a) Using Ampere's circuit law, derive the expression for the magnetic field at point P, which is at a distance R away from the centre of a circular coil of radius R carrying a steady current I.	[10]	**CO3**
	b) Convert the following points to Cartesian coordinates: (i) P_1 (5, 120^o, 0), and (ii) P_2 (3, 30^o, 240^o).	[10]	**CO3**