MIDSEM EXAMINATION JUNE -2022

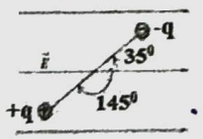
University Physics: Electricity and Magnetism (PHY 2001)

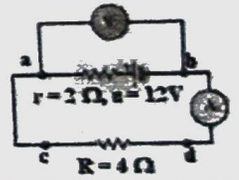
Programme: B. Tech **Semester: 2nd**
Full Marks: 30 **Time: 2 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
UPEM/ a, e	L_1, L_2, L_3	1	6
UPEM/ a, e, g	L_1, L_2, L_3	2	6
UPEM/ a, e	L_1, L_2, L_3	3	6
UPEM/ a, e	L_1, L_2, L_3	4	6
UPEM/ a, e, g	L_1, L_2, L_3	5	6

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1.	(a)	An electric dipole is placed in a uniform electric field E. Derive an expression for potential energy stored when the dipole is rotated by an angle θ.	2
	(b)	Write the condition for stable equilibrium position. Where do you get stable equilibrium in (a). What is the torque and potential energy stored at stable equilibrium position.	2
	(c)	An electric dipole is placed in a uniform electric field of magnitude 5.0×10^5 N/C that is directed parallel to the plane of the figure. The charges are $\pm 1.6 \times 10^{-19}$ C; both lie in the plane and are separated by 0.125 nm = 0.125×10^{-9} m. Find the magnitude and direction of the torque and the potential energy of the system in the position shown. 	2
2.	(a)	A total positive charge 'q' is placed on a solid conducting sphere with radius R. Find electric field at any point inside and outside the sphere.	2
	(b)	Calculate the electric flux associated with a flat square surface with area $\vec{A} = (3.0\ m^2)\hat{i} + (7.0\ m^2)\hat{j}$ in a uniform electric field $\vec{E} = (4.0\ N/C)\hat{i} - (2.0\ N/C)\hat{j}$	2

	(c)	A disk of radius 0.10 m is oriented with its normal unit vector $\hat{n}$ at 30^0 to a uniform electric field $\vec{E}$ of magnitude 2.0×10^3 N/C. What is the electric flux through the disk?	2
3.	(a)	Electric charge Q is distributed uniformly around a thin ring of radius 'a'. Find the potential at a point on the ring axis at a distance 'x' from the center of the ring.	2
	(b)	From 3(a) find the expression for potential (i) at the center of the ring and (ii) at a position if x>>a.	2
	(c)	If the electric potential at a certain point is zero, does the electric field at that point have to be zero? Justify your answer with suitable example.	2
4.	(a)	Derive an expression for the electric potential energy stored in a charged capacitor.	2
	(b)	Derive the expression for energy stored in a capacitor with the space between the plates being air. If a dielectric is inserted in between the plates keeping the charge on each plate constant, how will the stored energy be affected?	2
	(c)	You want to connect a 4 μF capacitor and an 8 μF capacitor. In which type of connection will the 4 μF capacitor have a greater amount of energy than that of 8 μF capacitor? Justify your answer.	2
5.	(a)	Derive the expression for current density in a conducting wire in terms of drift velocity of moving charges.	2
	(b)	A copper wire of diameter 1mm carries a current of 1.75 A to a 200-W lamp. The free electron density in the wire is 8.5×10^{28} per cubic meter. Find (i) the current density; and (ii) the drift velocity.	2
	(c)	What are the voltmeter and ammeter readings in the above given circuits? 	2