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SARDAR PATEL UNIVERSITY

IV Semester

Course Code: US04CELC01

Electrodynamics

Date: 11/10/2022, Time: 12:30pm to 2:30 noon

TOTAL MARKS 70

Q. 1 Multiple Choice Questions:

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1. Unit of Permittivity of free space is _____
 - i) m/F
 - ii) N/m
 - iii) F/m
 - iv) All
2. What is the expression for a line charge distributed over an infinite length of a line?
 - i) $E = \frac{\rho_L}{2\pi\epsilon_0} \hat{a}_r$
 - ii) $E = \frac{\rho_L}{\pi\epsilon_0 r} \hat{a}_r$
 - iii) $E = \frac{\rho_L}{2\epsilon_0 r} \hat{a}_r$
 - iv) $E = \frac{\rho_L}{2\pi\epsilon_0 r} \hat{a}_r$
3. Coulomb's law is defined by _____
 - i) $F = \frac{kQ_1Q_2}{R^2}$
 - ii) $F = \frac{R^2}{kQ_1Q_2}$
 - iii) $F = \frac{kR^2}{Q_1Q_2}$
 - iv) None of all
4. Maxwell's first equation is
 - i) Differential form of Gauss's Law.
 - ii) Integral form of Gauss's law.
 - iii) Differential form of Coulomb's law.
 - iv) Integral form of Coulomb's law
5. The vector of operator ∇ is
 - i) $\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}$
 - ii) $\frac{\partial}{\partial x} \hat{a}_x + \frac{\partial}{\partial y} \hat{a}_y + \frac{\partial}{\partial z} \hat{a}_z$
 - iii) $\frac{d}{dx} \hat{a}_x + \frac{d}{dy} \hat{a}_y + \frac{d}{dz} \hat{a}_z$
 - iv) None of the above
6. Work done in moving a unit charge in an electric field is given by

i) $W = -Q \int_{initial}^{final} \vec{E} dl$

$$\text{ii) } W = - \int_{\text{initial}}^{\text{final}} \vec{E} \cdot d\vec{l}$$

$$\text{iii) } W = - \int_{\text{initial}}^{\text{final}} \vec{E} \times d\vec{l}$$

iv) All of the above

7. At infinity the potential is

- i) Zero
- ii) Infinite
- iii) Finite
- iv) Constant

8. The conductor surface is _____

- i) Equipotential surface
- ii) Non Equipotential surface
- iii) Non-conductive
- iv) None of above

9. The work done on equipotential surface is

- i) Infinite
- ii) Finite
- iii) Zero
- iv) Constant

10. Dipole moment is a

- i) Scalar Quantity
- ii) Tensor Quantity
- iii) Vector Quantity
- iv) Free Quantity

Q2: True or False

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1. Value of $\epsilon_0 = \frac{1}{36\pi} * 10^{-9}$.
2. Coulomb's Law is force between two charged particles.
3. The expression for Displacement density D is $\vec{D} = \epsilon_0 \vec{E}$.
4. Gauss law is Integral form of Maxwell's first equation.
5. Electric flux density is a vector quantity.
5. The unit of dipole moment is coulomb-meter.
6. The dipole is defined as two charges equal in magnitude and opposite in charge, separated by a small distance.
7. The static electric field intensity inside a conductor is zero.
8. For ferromagnetic materials the relationship between P and E is linear.

Q3: Answer any 10 questions out of 12 questions briefly.

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1. Explain in short "The experimental law of Coulomb".
2. Calculate the force exerted on Q2 by Q1. Q1 = $3 * 10^{-4}$ C at M(1,2,3) and Q2 = -10^{-4} C at N(2,0,5) in a vacuum.
3. Define Electric Field Intensity with its various units.

4. Define Divergence theorem.
5. Give the mathematical form of Gauss law.
6. Starting from Gauss Law derive Maxwell's equation.
7. Define Potential difference and state its unit.
8. Define conservative field.
9. Define equipotential surface.
10. Explain the nature of dielectric materials.
11. Explain polar and non-polar molecules.
12. Summarize the principles which apply to conductors in electrostatic fields

Q4: Answer any 4 questions out of 8 questions elaborately.

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- 1 Derive an expression for electric field intensity due to infinite sheet of charge?
- 2 Derive an expression for electric field intensity for a line charge distributed over an infinite length of a line?
- 3 Give the detail account of Gauss's law.
- 4 Explain any two applications of Gauss's law.
- 5 Obtain an expression for potential and electric field intensity due to dipole.
- 6 Explain conservation of charge in an electrostatic field.
- 7 Explain capacitance and hence derive an expression for energy stored in a capacitor.
- 8 Derive the boundary conditions for conductors.
