B.Sc. F.Y. (C.B.C.S. Pattern) Sem-II

USPHT03 - Physics Paper-I (Vector Analysis and Electrostatics)

P. Pages : 3 **GUG/S/19/11590**

Time : Three Hours * 3 4 8 5 * Max. Marks : 50

Notes : 1. All questions are compulsory.
2. Draw well labelled diagram wherever necessary.

1. Either :

a) i) Define vector product of two vectors. State its important characteristics. **3**

ii) Obtain an expression for vector product of two vectors in terms of their rectangular components and express it in determinant format. **4**

iii) If $\vec{A} = (3\vec{i} + 2\vec{j} - \vec{k})$ and $\vec{B} = (4\vec{i} + 2\vec{j} - 3\vec{k})$ find (a) $\vec{A} \times \vec{B}$ and (b) $\vec{A} \cdot \vec{B}$. **3**

OR

b) a) Show that Scalar product of two perpendicular vectors is zero. **2½**

b) Define Curl of a vector and show that curl of a vector field is a vector. **2½**

c) Show that $\vec{\nabla} \cdot (\vec{A} + \vec{B}) = \vec{\nabla} \cdot \vec{A} + \vec{\nabla} \cdot \vec{B}$ where $\vec{A}$ & $\vec{B}$ are differential vector function. **2½**

d) Two adjacent sides of a parallelogram are represented by two vector given by $\vec{A} = 4\vec{i} - \vec{j} + \vec{k}$ and $\vec{B} = \vec{i} - 3\vec{j} + 2\vec{k}$. Find the area of parallelogram. **2½**

2. Either :

a) i) Define electric field and electric field potential. **2**

ii) Obtain an expression for electric field intensity at a point far away due to an electric dipole. **6**

iii) Show that electric field intensity at a point on its axis is double as that of point on equator at same distance. **2**

OR

b) a) State Coulomb's law of electrostatics and show that it is a special case of Gauss's theorem. **2½**

b) Show that electric field is a negative gradient of potential. **2½**

c) Obtain an expression for torque acting on a electric dipole in uniform electric field. **2½**

d) Calculate the intensity of electric field at a distance of 2Å due to the Helium Nucleus. **2½**
$\left(\in_0 = 8.85 \times 10^{-12}\ C^2 / Nm^2\right)$

3. Either :

a) i) State the Gauss's theorem of electrostatics and express it in differential form. **2**

ii) Using Gauss's theorem obtain an expression for electric field due to spherical shell at point (a) out side the shell (b) on the surface of shell and (c) inside the shell. **6**

iii) Find the total charge enclosed by a closed surface if the number of lines entering the surface is 20×10^3 and emerging out is 45×10^3. $\left(\text{Given } \in_0 = 8.85\times10^{-12}\ \text{C}^2/\text{Nm}^2\right)$ **2**

OR

b) a) Using Gauss theorem obtain an expression for electric field intensity due to an infinite charge conductor. **2½**

b) Obtain an expression for electric potential due to a point charge. **2½**

c) Show that the electric field at any point near the charge conductor is $1/\in_0$ times the charge density. **2½**

d) A total charge of $1\mu\text{C}$ is uniformly distributed over the volume of sphere of radius 10 cm. Calculate the electric field strength at a point outside the sphere at a distance 20 cm from center. **2½**

4. Either :

a) i) Define capacity of a capacitor. State and define its SI unit. **2**

ii) Obtain an expression for capacity of a parallel plate capacitor (a) with free space (b) completely filled with dielectrics. **5**

iii) Show that capacity of capacitor with dielectric is greater than without dielectric. **1**

iv) Capacitance of parallel plate separated by 1 mm in air is $1\mu\text{F}$. Find the area of each plate. **2**

OR

b) a) Distinguish between polar and non – polar molecule with examples. **2½**

b) Derive an expression for energy per unit volume of a charged capacitor. **2½**

c) Obtain the relation between three electric vectors $\vec{D}, \vec{E}$ and $\vec{P}$. **2½**

d) A parallel plate capacitor is partially filled with an ebonite plate of thickness 6 mm having dielectric constant 3. The area of each plate is $2\times10^{-2}\ \text{m}^2$ and distance between them is 10 mm. Find the capacity of capacitor. **2½**

5. Attempt **any ten** of the following.

a) Define unit vector and zero vector. **1**

b) Define line integral. **1**

c) State Stoke's theorem of vectors. **1**

d) Define electric quadrupole. **1**

e) Define electric flux. **1**

f) What is conservative electric field? **1**

g) What is Gaussian surface? **1**

h) State the equation for electric potential due to a short electric dipole at point : **1**

i) on the axis and ii) on the equator

i) State Gauss theorem in integral form. **1**

j) Define dielectric constant. **1**

k) Define displacement vector $\vec{D}$. **1**

l) Find the capacity of an isolated charged sphere of radius $8\times10^{9}\,m$. **1**

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