

B.Sc. (CBCS Pattern) Semester-II
USPHT03 - Physics Paper-I - Vector Analysis and Electrostatics

P. Pages : 2

Time : Three Hours



GUG/W/24/11590(S)

Max. Marks : 50

Either :

1. i) State Gauss Divergence Theorem. 1
ii) Deduce an expression for vector product of two vectors in terms of their rectangular components and obtain an expression for the angle between two vectors. 6
iii) If $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ & $\vec{B} = \hat{i} + 3\hat{k}$, Find 3
i) $\vec{A} \cdot \vec{B}$ ii) $\vec{A} \times \vec{B}$ iii) $2\vec{A} + 4\vec{B}$

OR

- a) What are Scalar and Vector Field? Give one example of each. 2½
b) Two constant forces $2\hat{i} + 2\hat{j} + 5\hat{k}$ and $3\hat{i} - 5\hat{j} - 4\hat{k}$ act together on a particle which is displaced from the point $2\hat{i} + 4\hat{k}$ to the point $20\hat{i} + 17\hat{j} - 3\hat{k}$. Calculate the work done by the forces. 2½
c) Define the curl of the vector field. Explain its physical significance. 2½
d) Explain with example the volume integral of a vector field. 2½

Either :

2. i) Define Electric field intensity and Electric potential. 2
ii) Derive an expression for electric field intensity due to electric dipole at a point on an axial line and on equatorial line. 5
iii) Calculate the work done in bringing a charge of $5 \times 10^{-2} \mu\text{C}$ from infinity to a point 34cm from charge $10 \times 10^{-2} \mu\text{C}$. 3

OR

- a) Show that the electric field intensity is equal to the negative potential gradient. 2½
b) Explain the electrostatic potential energy of charges and write the equation for it. 2½
c) Obtain the expression for the work done in rotating an electric dipole in an electric field. 2½
d) The radius of nucleus of silver (atomic no. $z = 47$) is $3.4 \times 10^{-14} \text{ m}$. Calculate the electric potential on the surface of nucleus. 2½

Either :

3. i) Define electric potential. 1
ii) Derive an expression for the Electric potential due to an electric dipole on axial and equatorial line. 5
iii) Calculate the potential and field due to a short dipole of dipole moment $2 \times 10^{-27} \text{ Cm}$ at a point distant 1cm from it (a) on its axis and (b) on its perpendicular bisector. 4

OR

- a) Show that the electric field strength E at a point p is inversely proportional to radius r of a long charged wire. 2½
- b) Obtain an expression for the electric field due to a charged spherical shell using Gauss law. 2½
- c) Obtain the relation between Coulombs law and Gauss law. 2½
- d) Calculate the electric flux through the faces of a cube of side of 1m, if the charge of 5 C is placed at its centre. 2½

Either :

- 4. i) What will be the capacitance of an isolated spherical conductor of the radius 'R'. 4
- ii) Calculate the capacitance of a spherical conductor (say earth) if its radius is 6400K. 2
- iii) Obtain an expression for capacity of the Cylindrical Capacitor and give its example of practical importance. 4

OR

- a) Derive an expression for the energy density in an electrostatic field. 2½
- b) Capacitance of parallel plate separated by 1mm in air is $1\mu\text{F}$. Find the area of each plate. 2½
- c) What do you mean by polarization of a dielectric? 2½
- d) Obtain the relation between dielectric constant and susceptibility. 2½

5. Answer any ten question.

- a) What is cross product of two vectors? 1
- b) Define Del operator. 1
- c) Define volume integral of vector field. 1
- d) Define S.I Unit of Charge 'Coulomb'. 1
- e) State the physical significance of Electric field. 1
- f) Define electric dipole & dipole moment. 1
- g) State Gauss Theorem of Electrostatics. 1
- h) Write expression for electric potential due to point charge. 1
- i) What is equipotential surface? 1
- j) What is dielectric? Define dielectric constant. 1
- k) Define capacitance and write its unit. 1
- l) If the dielectric constant of the material is 3. Calculate the capacitance when the material is inserted between the parallel plate capacitor, if the original capacitance is 5×10^{-9} . 1
