End Semester Examination

PH - 3202, 5-5-2019

Answer all questions, marks = 3

Q.1 (a) Explain with an example the fundamental theorem for gradients [1.0]

(b) Explain with an example the fundamental theorem for divergences [1.5]

(c) Compute $(\vec{A} \times \vec{B}) \cdot (\vec{C} \times \vec{D})$ using properties of Levi-Civita tensor [2]

(d) Find the divergence of the function, $\vec{v} = s(2 + \sin^2\phi)\hat{s} + s \sin\phi \cos\phi \hat{\phi} + 3z\hat{z}$, where $x = s\cos\phi$, $y = s\sin\phi$ and $z = z$ [2.5]

Q.2 (a) What is the advantage of potential formulation in electrostatics ($\vec{E} = -\vec{\nabla} V$) [1.5]

(b) Find the potential and electric field for a uniformly charged spherical shell of radius R. Justify the same using image charge concept.

Find the energy, when the test charge = q. [3]

(c) Explain with example the averaging effect of Laplace equation. [2.5]

(2)

Q.3 (a) The potential is specified $V_0(\theta) = k \sin^2\theta/2$. on the surface of a hollow sphere of radius R find the potential inside the sphe [3]

(b) For the case, when total charge is zero, show the effect of the choice of origin on the dipole moment. [1]

(c) Show that the average field inside a sphere of radius R, due to all the charges within the sphere, is

$$\vec{E}_{ave} = -\frac{1}{4\pi\epsilon_0}\frac{\vec{p}}{R^3}$$ [3]

(d) Explain the boundary conditions for $\vec{D}$ and $\vec{H}$ [2]

Q.4 (a) Find $\vec{A}_{dip}(\vec{r})$ interms of the magnetic dipole moment $\vec{m}$ [2]

(b) Explain why magnetic monopole term is zero in the multipole expansion [2]

(c) Derive the wave equations for $\vec{E}$ and $\vec{B}$ and provide a Lorentz related invariant quantity. [3]