MID SEMESTER EXAMINATION

PH - 3202 , 18-02-2019 (1)

3.30 PM - 5 PM

Answer all questions, Marks = 100, [Indicated in Square bracket]

Q.1 (a) A rigid body is being acted upon by three forces, with magnitudes 3, 4 and 8 Newtons respectively. Considering all possible angles between the forces, describe the state of the rigid body, [5]

(b) Explain the physical relevance of the direction and magnitude of $\vec{\nabla}\phi$, where ϕ is a scalar function [10]

(c) Calculate the divergence of the vector,

$$\vec{V} = y^2\hat{x} + (2xy + z^2)\hat{y} + 2yz\hat{z}$$ and

[15]

compute $\vec{\nabla}T \times \vec{\nabla}S$, indicating when it can vanish,

(d) find $\vec{\nabla}\times\vec{\nabla}\times\vec{\nabla}\times\vec{A}$ [10]

Q.2 (a) In three dimension, consider two point charges, $+q$ at $[0,0,d]$ and $-q$ at $[0,0,-d]$, find the potential $V(x,y,z)$. $\boxed{15}$

Show that $V=0$, when $z=0$ and $V\to 0$, if $x^2+y^2+z^2 \gg d$.

Here $[0,0,d]$ stands for the location $[x,y,z]$.

(b) For a volume charge density $\rho(x,y,z)$, find out the stored energy of the charge distribution in terms of the electric field, assume that the potential vanishes at infinity. $\boxed{15}$

Q.3 Find out the transformation of $\vec{E}$ and $\vec{B}$ under Lorentz transformation, of your choice. Find out $\vec{E}'$ if $\vec{B}=0$ in moving frame in the rest frame and vice-versa [

Show that, the Lorentz transform fields are invariant under $\vec{E}/c \to \vec{B}$ and $\vec{B} \to -\vec{E}/c$

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