Formula Sheet PHYS305 Mid-term Exam Sem211

$$\vec{\boldsymbol{A}} \times (\vec{\boldsymbol{B}} \times \vec{\boldsymbol{C}}) = \vec{\boldsymbol{B}}(\vec{\boldsymbol{A}}.\vec{\boldsymbol{C}}) - \vec{\boldsymbol{C}}(\vec{\boldsymbol{A}}.\vec{\boldsymbol{B}})$$

$$\begin{pmatrix} \overline{A}_x \\ \overline{A}_y \\ \overline{A}_z \end{pmatrix} = \begin{pmatrix} R_{xx} & R_{xy} & R_{xz} \\ R_{yx} & R_{yy} & R_{yz} \\ R_{zx} & R_{zy} & R_{zz} \end{pmatrix} \begin{pmatrix} A_x \\ A_y \\ A_z \end{pmatrix};$$

$$\overline{A}_i = \sum_{j=1}^{3} R_{ij} A_j \,; \vec{\nabla} = \left(\frac{\partial}{\partial x}\right)\hat{\imath} + \left(\frac{\partial}{\partial y}\right)\hat{\jmath} + \left(\frac{\partial}{\partial z}\right)\hat{k}$$

$$\vec{\nabla}(fg) = f\vec{\nabla}g + g\vec{\nabla}f$$

$$\vec{\nabla}(\vec{A}.\vec{B}) = \vec{A} \times (\vec{\nabla} \times \vec{B}) + \vec{B} \times (\vec{\nabla} \times \vec{A}) + (\vec{A}.\vec{\nabla})\vec{B} + (\vec{B}.\vec{\nabla})\vec{A}$$

$$\vec{\nabla}.(f\vec{A}) = f(\vec{\nabla}.\vec{A}) + \vec{A}.(\vec{\nabla}f)$$

$$\vec{\nabla}.(\vec{A} \times \vec{B}) = \vec{B}.(\vec{\nabla} \times \vec{A}) - \vec{A}.(\vec{\nabla} \times \vec{B})$$

$$\vec{\nabla} \times (f\vec{A}) = f(\vec{\nabla} \times \vec{A}) + \vec{A} \times (\vec{\nabla}f)$$

$$\vec{\nabla} \times (\vec{A} \times \vec{B}) = (\vec{B}.\vec{\nabla})\vec{A} - (\vec{A}.\vec{\nabla})\vec{B} + \vec{A}(\vec{\nabla}.\vec{B}) - \vec{B}(\vec{\nabla}.\vec{A})$$

$$\nabla^2 T = \left(\frac{\partial^2 T}{\partial x^2}\right) + \left(\frac{\partial^2 T}{\partial y^2}\right) + \left(\frac{\partial^2 T}{\partial z^2}\right)$$

$$\nabla^2 \vec{v} = \left(\frac{\partial^2 v_x}{\partial x^2}\right)\hat{\imath} + \left(\frac{\partial^2 v_y}{\partial y^2}\right)\hat{\jmath} + \left(\frac{\partial^2 v_z}{\partial z^2}\right)\hat{k}$$

$$\vec{\nabla} \times (\vec{\nabla}T) = 0 \,;\ \vec{\nabla}.(\vec{\nabla} \times \vec{v}) = 0$$

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{v}) = \vec{\nabla}(\vec{\nabla}.\vec{v}) - \nabla^2 \vec{v}$$

$$\int_a^b (\vec{\nabla}T).dl = T(b) - T(a)$$

$$\int_a^b (\vec{\nabla}.\vec{v})d\tau = \oint \vec{v}.\overrightarrow{da}$$

$$\int_a^b (\vec{\nabla} \times \vec{v}).\overrightarrow{da} = \oint \vec{v}.\overrightarrow{dl}$$

$x = r\sin\theta\cos\phi\,;\ y = r\sin\theta\sin\phi\,;\ z = r\cos\theta$

$dl_r = dr\,;\ dl_\theta = r\,d\theta\,;\ dl_\phi = r\sin\theta\,d\phi$

$$\overrightarrow{\nabla T} = \frac{\partial T}{\partial r}\hat{r} + \frac{1}{r}\frac{\partial T}{\partial \theta}\hat{\theta} + \frac{1}{r\sin\theta}\frac{\partial T}{\partial \phi}\hat{\phi}$$

$$\vec{\nabla}.\vec{v} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 v_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial \theta}(\sin\theta\ v_\theta) + \frac{1}{r\sin\theta}\frac{\partial v_\phi}{\partial \phi}$$

$$\vec{\nabla} \times \vec{v} = \frac{1}{r\sin\theta}\left[\frac{\partial}{\partial \theta}(\sin\theta\ v_\phi) - \frac{\partial v_\phi}{\partial \phi}\right]\hat{r} + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial v_r}{\partial \phi} - \frac{\partial}{\partial r}(r v_\phi)\right]\hat{\theta} + \frac{1}{r}\left[\frac{\partial}{\partial r}(r v_\theta) - \frac{\partial v_r}{\partial \theta}\right]\hat{\phi}$$

$$\nabla^2 T = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial T}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta\frac{\partial T}{\partial \theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 T}{\partial \phi^2}$$

$x = s\cos\phi\,;$ y= $s\sin\phi\,;$ z=z

$dl_s = ds\,; dl_\phi = s\,d\phi\,; dl_z = dz$

$$\overrightarrow{\nabla T} = \left(\frac{\partial T}{\partial s}\right)\hat{s} + \frac{1}{s}\left(\frac{\partial T}{\partial \phi}\right)\hat{\phi} + \left(\frac{\partial T}{\partial z}\right)\hat{z}$$

$$\vec{\nabla}.\vec{v} = \frac{1}{s}\frac{\partial}{\partial s}(s v_s) + \frac{1}{s}\frac{\partial}{\partial \phi}(v_\phi) + \frac{\partial v_z}{\partial z}$$

$$\vec{\nabla} \times \vec{v} = \left(\frac{1}{s}\frac{\partial v_z}{\partial \phi} - \frac{\partial v_\phi}{\partial z}\right)\hat{s} + \left(\frac{\partial v_s}{\partial z} - \frac{\partial v_z}{\partial s}\right)\hat{\phi} + \frac{1}{s}\left(\frac{\partial}{\partial s}(s v_s) - \frac{\partial v_s}{\partial \phi}\right)\hat{z}$$

$$\nabla^2 T = \frac{1}{s}\frac{\partial}{\partial s}\left(s\frac{\partial T}{\partial s}\right) + \frac{1}{s^2}\left(\frac{\partial^2 T}{\partial \phi^2}\right) + \frac{\partial^2 T}{\partial z^2}$$

$\vec{\nabla}.\frac{\hat{r}}{r^2} = 4\pi\delta^3(\vec{r})$; $\vec{E}(\vec{r}) = \frac{1}{4\pi\varepsilon_o}\sum_{i=1}^{n}\frac{q_i}{r_i^2}\hat{r}_i$

$\vec{\nabla}.\vec{E} = \frac{\rho}{\varepsilon_o}$; $V(r) = \frac{1}{4\pi\varepsilon_o}\sum_{i=1}^{n}\frac{q_i}{r_i}$;

$W = \frac{1}{4\pi\varepsilon_o}\sum_{i=1}^{n}\sum_{\substack{j=1 \\ j>i}}^{n}\frac{q_i q_j}{\xi_{ij}}$; $W = \frac{\varepsilon_o}{2}\int E^2 d\tau$