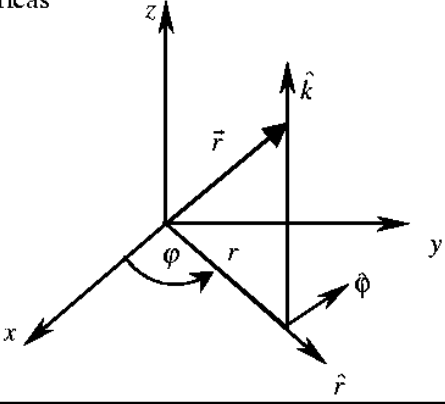
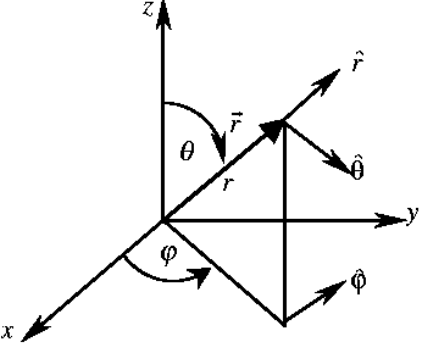


Formulario Matemático de Electromagnetismo

<div>C. Cilíndricas</div> <div></div> <div>$\vec{r} = r\hat{r} + z\hat{k}$$x = r \cos \varphi$$y = r \sin \varphi$$z = z$</div>	<div>C. Esféricas</div> <div></div> <div>$\vec{r} = r\hat{r}$$x = r \sin \theta \cos \varphi$$y = r \sin \theta \sin \varphi$$z = r \cos \theta$</div>
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1. Gradientes

<div>Cartesianas</div> $\nabla \phi = \frac{\partial \phi}{\partial x} \hat{i} + \frac{\partial \phi}{\partial y} \hat{j} + \frac{\partial \phi}{\partial z} \hat{k}$	<div>Cilíndricas</div> $\nabla \phi = \frac{\partial \phi}{\partial r} \hat{r} + \frac{1}{r} \frac{\partial \phi}{\partial \varphi} \hat{\varphi} + \frac{\partial \phi}{\partial z} \hat{k}$	<div>Esféricas</div> $\nabla \phi = \frac{\partial \phi}{\partial r} \hat{r} + \frac{1}{r} \frac{\partial \phi}{\partial \theta} \hat{\theta} + \frac{1}{r \sin \theta} \frac{\partial \phi}{\partial \varphi} \hat{\varphi}$
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2. Divergencias

<div>Cartesianas</div> $\nabla \cdot \vec{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$	<div>Cilíndricas</div> $\nabla \cdot \vec{A} = \frac{1}{r} \frac{\partial (rA_r)}{\partial r} + \frac{1}{r} \frac{\partial A_\varphi}{\partial \varphi} + \frac{\partial A_z}{\partial z}$
<div>Esféricas</div> $\nabla \cdot \vec{A} = \frac{1}{r^2} \frac{\partial (r^2 A_r)}{\partial r} + \frac{1}{r \sin \theta} \frac{\partial (\sin \theta A_\theta)}{\partial \theta} + \frac{1}{r \sin \theta} \frac{\partial A_\varphi}{\partial \varphi}$	

3. Rotores

<div>Cartesianas</div> $\nabla \times \vec{A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ A_x & A_y & A_z \end{vmatrix} = \left(\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} \right) \hat{i} + \left(\frac{\partial A_z}{\partial x} - \frac{\partial A_x}{\partial z} \right) \hat{j} + \left(\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} \right) \hat{k}$
<div>Cilíndricas</div> $\nabla \times \vec{A} = \frac{1}{r} \begin{vmatrix} \hat{r} & r\hat{\varphi} & \hat{k} \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \varphi} & \frac{\partial}{\partial z} \\ A_r & rA_\varphi & A_z \end{vmatrix} = \frac{1}{r} \left\{ \left(\frac{\partial A_z}{\partial \varphi} - \frac{\partial (rA_\varphi)}{\partial z} \right) \hat{r} + r \left(\frac{\partial A_z}{\partial r} - \frac{\partial A_r}{\partial z} \right) \hat{\varphi} + \left(\frac{\partial (rA_\varphi)}{\partial r} - \frac{\partial A_r}{\partial \varphi} \right) \hat{k} \right\}$
<div>Esféricas</div> $\nabla \times \vec{A} = \frac{1}{r^2 \sin \theta} \begin{vmatrix} \hat{r} & r\hat{\theta} & r \sin \theta \hat{\varphi} \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial \varphi} \\ A_r & rA_\theta & r \sin \theta A_\varphi \end{vmatrix}$ $= \frac{1}{r^2 \sin \theta} \left\{ \left(\frac{\partial (r \sin \theta A_\varphi)}{\partial \theta} - \frac{\partial (rA_\theta)}{\partial \varphi} \right) \hat{r} - \left(\frac{\partial (r \sin \theta A_\varphi)}{\partial r} - \frac{\partial A_r}{\partial \varphi} \right) \hat{\theta} + \left(\frac{\partial (rA_\theta)}{\partial r} - \frac{\partial A_r}{\partial \theta} \right) r \sin \theta \hat{\varphi} \right\}$

4. Laplacianos

Cartesianas	Cilíndricas
$\nabla^2\phi=\frac{\partial^2\phi}{\partial x^2}+\frac{\partial^2\phi}{\partial y^2}+\frac{\partial^2\phi}{\partial z^2}$	$\nabla^2\phi=\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial\phi}{\partial r}\right)+\frac{1}{r^2}\frac{\partial^2\phi}{\partial\varphi^2}+\frac{\partial^2\phi}{\partial z^2}$
Esféricas	
$\nabla^2\phi=\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial\phi}{\partial r}\right)+\frac{1}{r^2\operatorname{sen}\theta}\frac{\partial}{\partial\theta}\left(\operatorname{sen}\theta\frac{\partial\phi}{\partial\theta}\right)+\frac{1}{r^2\operatorname{sen}^2\theta}\frac{\partial^2\phi}{\partial\varphi^2}$	

5. Elementos diferenciales

De línea		
Cartesianas $d\vec{l}=dx\hat{i}+dy\hat{j}+dz\hat{k}$	Cilíndricas $d\vec{l}=dr\hat{r}+rd\varphi\hat{\varphi}+dz\hat{k}$	Esféricas $d\vec{l}=dr\hat{r}+rd\theta\hat{\theta}+r\operatorname{sen}\theta d\varphi\hat{\varphi}$
De superficie		
Cartesianas $d\vec{s}=dydz\hat{i}+dxdz\hat{j}+dxdy\hat{k}$	Cilíndricas $d\vec{s}=rd\varphi dz\hat{r}+drdz\hat{\varphi}+rdrd\varphi\hat{k}$	Esféricas $d\vec{s}=r^2\operatorname{sen}\theta d\theta d\varphi\hat{r}+r\operatorname{sen}\theta drd\varphi\hat{\theta}+rd\theta dr\hat{\varphi}$
De volumen		
Cartesianas $dv=dxdydz$	Cilíndricas $dv=rdrd\varphi dz$	Esféricas $dv=r^2\operatorname{sen}\theta drd\varphi d\theta$

donde:

en cartesianas

$\vec{A}=A_x\hat{i}+A_y\hat{j}+A_z\hat{k}$

en cilíndricas

$\vec{A}=A_r\hat{r}+A_\varphi\hat{\varphi}+A_z\hat{k}$

en esféricas

$\vec{A}=A_r\hat{r}+A_\varphi\hat{\varphi}+A_\theta\hat{\theta}$

6. Identidades Vectoriales

$\nabla\times(\nabla\phi)=0$

$\nabla\cdot(\nabla\times\vec{A})=0$

$\nabla\times(\nabla\times\vec{A})=\nabla(\nabla\cdot\vec{A})-\nabla^2\vec{A}$

$\nabla(\phi\psi)=\phi\nabla\psi+\psi\nabla\phi$

$\nabla\cdot(\phi\vec{A})=\phi\nabla\cdot\vec{A}+\vec{A}\cdot\nabla\phi$

$\nabla\times(f(\mathbf{r})\mathbf{r})=0$

$\nabla\left(\frac{1}{r}\right)=-\frac{\vec{r}}{r^3}\qquad(\operatorname{con}|\vec{r}|=r)$

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

$\nabla\cdot\vec{r}=3\qquad\nabla\times\vec{r}=0$

$\nabla(\vec{A}\cdot\vec{r})=\vec{A}$

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

$\nabla(\mathbf{r}^n)=n\mathbf{r}^{n-2}\vec{r}$

$\nabla^2\left(\frac{1}{r}\right)=\delta(\vec{r})$

$\nabla^2\left(\frac{1}{r}\right)=0\qquad(\operatorname{para}\qquad r\neq0)$

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

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