$\nabla . E = \frac{\rho_v}{\varepsilon_0}$ $\quad \varepsilon E$

$\nabla . D = \rho_v$ $\quad \rightarrow$ electric flux

195

Chapter 5

* Two basic equation of the electrostatic model

$$\nabla . D = \rho_v$$

$$\nabla \times E = 0$$

if the medium linear and isotropic, we have relation "$\underline{\vec{D} = \underset{\downarrow}{\varepsilon} \vec{E}}$"

$\underline{\text{scalar}}$

Manisa = Magnesia

* Electric Intensity defined in terms of force on a stationary charge

$$\boxed{\underbrace{F_e}_{\text{electric force}} = qE \ (N)}$$

* Magnetic flux density defined in terms of force experienced by a moving charge

$qu \times B$

$$\underbrace{F_m}_{\text{magnetic force}} = q\underset{\downarrow}{u} \times \underbrace{B}_{\text{magnetic flux density}} \ (N)$$

u → velocity of moving charge (m/s)

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B measured in webers per square meter (wb/m^2) or tesla (T)
total magnetic force on a charge q is then $F = F_e + F_m$ ve lorentz's force equation olarak bilinir.

*Lorentz's force equation

$$\boxed{F = q(E + u \times B) \quad (N)}$$

$q(E + u \times B)$

Magnetic Flux density also called magnetic induction. $\rightarrow \Phi = BA\cos\theta$
charges in motion produce a current that, creates a magnetic field.

Fundemental Postulates Of Magnetostatics In Free Space

*Divergence of B vanishes

$$\boxed{\nabla \cdot B = 0}$$

current density
*Curl of static B in nonmagnetic media

$$\boxed{\nabla \times B = \mu_0 J} \quad \text{(in nonmagnetic media)}$$

permeability of free space

$\mu_0 = 4\pi \times 10^{-7}$ (H/m)

* $\boxed{\nabla \cdot J = 0}$ Divergence of the curl of any vector field is zero.

* There are no magnetic flow sources (no isolated magnetic charge)

$$\boxed{\oint_S B \cdot ds = 0}$$

also expression for law of conservation of magnetic flux.

There are no magnetic flow sources, and the magnetic flux lines always close upon themselves

$$\int_S (\nabla \times B) \cdot ds = \mu_0 \int_S J \cdot ds$$

☆ $$\boxed{\oint_C B \cdot dl = \mu_0 I}$$ (in nonmagnetic media)

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Postulates Of Magnetostatics In nonmagnetic Media	
Differential Form	Integral Form
$\nabla \cdot B = 0$	$\oint_S B \cdot ds = 0$
$\nabla \times B = \mu_0 J$	$\oint_C B \cdot dl = \mu_0 I$
! $\nabla \times H = J$, $B = \mu_0 H$, $H = \frac{\vec{B}}{\mu_0}$	

Vector Magnetic Potantial

*Partial definition of vector magnetic potantial $\underline{A}$

$$\boxed{B = \nabla \times A \quad (T)}$$

$\nabla \times \nabla \times A = \mu_0 J$ } B'nin curlü

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

$\nabla^2 A = a_x \nabla^2 A_x + a_y \nabla^2 A_y + a_z \nabla^2 A_z$

Bu durum diğer koordinat sistemleri içinde geçerlidir.

verify for cartesian coordinates.

$$\nabla(\nabla . A) - \nabla^2 A = \mu_0 \tilde{J}$$

* coulomb condition for divergence ~~of~~ A

$$\boxed{\nabla . A = 0}$$

This equation become

$$\boxed{\nabla^2 A = \mu_0 \tilde{J}}$$ operator form of vector Poisson's equation

kartezyen koordinatlarda

$$\left.\begin{aligned} \nabla^2 A_x &= -\mu_0 \tilde{J}_x \\ \nabla^2 A_y &= -\mu_0 \tilde{J}_y \\ \nabla^2 A_z &= -\mu_0 \tilde{J}_z \end{aligned}\right\} \equiv \nabla^2 V = -\frac{\rho_v}{\varepsilon_0}$$

Scalar Poisson's equation in electro-static

Denkleminin çözümü

$$A_x = \frac{\mu_0}{4\pi} \int_{v'} \frac{\tilde{J}_x}{R} dv'$$

denkleminin çözümü

$$V = \frac{1}{4\pi\varepsilon_0} \int_{v'} \frac{\rho_v}{R} dv'$$

potansiyel

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Finding vector magnetic potential from current density

$$\boxed{A = \frac{\mu_0}{4\pi}\int_{V'} \frac{J}{R}\,dv' \ (Wb/m)}$$

A → magnetic vector potantial

A vektör potansiyeli ile C çevriti tarafından sınırlanmış, verilen bir S alanı içinden geçen Magnetic flux

$$\underset{\text{magnetic flux}}{\Phi} = \int_S B \cdot ds \ (Wb) \Rightarrow \int_S (\nabla \times A) \cdot ds = \oint_C A \cdot dl$$

$\hookrightarrow B = \nabla \times A$

Stoke's theorem

BIOT-SAVART LAW AND APPLICATION

$$\underset{\text{magnetic potantial}}{\vec{A}} = \frac{\mu_0}{4\pi}\int_{V'} \frac{J}{R}\,dv', \quad J\,dv' = J\,S\,dl' = I\,dl'$$

S → cross sectional area

Bir çok devrede akım taşıyan devrenin neden olduğu manyetik alanın belirlenmesi ile ilgileniriz.

~~Kapalı devredeki~~

önemli:

★ Finding vector magnetic potential from current in a closed circuit

$$\boxed{A = \frac{\mu_0 I}{4\pi} \oint_{C'} \left(\frac{dl'}{R}\right) \quad (\mathrm{Wb/m})}$$

manyetik akı yoğunluğu ise

$$B = \nabla \times A = \nabla \times \left[\frac{\mu_0 I}{4\pi} \oint_{C'} \frac{dl'}{R}\right]$$

$\downarrow$

baya işlem var burdan sonra kolay gelsin.

★ Kapalı Bir Devredeki akımdan manyetik akı yoğunluğu bulmak için Biot-Savart yasası

$$\boxed{B = \frac{\mu_0 I}{4\pi} \oint_{C'} \frac{dl' \times \overbrace{a_R}^{\frac{R}{|R|}}}{R^2} \quad (\mathrm{T})}$$

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$$\boxed{\bigstar \; B = \oint_{C'} dB \quad (T)}$$

$$\frac{R}{|R|}$$

$$\boxed{\bigstar \; dB = \frac{\mu_0 I}{4\pi}\left(\frac{dl' \times a_R}{R^2}\right) \quad (T)}$$

"P" noktasında oluşturduğu manyetik alan

$$\left(\frac{dl' \times R}{R^3}\right)$$

dB manyetik alanının büyüklüğü

$$\boxed{dB = \frac{\mu_0 I}{4\pi} \cdot \frac{dl \sin\theta}{r^2}}$$