Nombre:____ Carné:_____________________

Fuerza Eléctrica, Campo eléctrico y Flujo eléctrico

$$F_e = \frac{k_e|q_1||q_2|}{r^2} \qquad \vec{F_e} = \frac{k_e|q_1||q_2|}{r^2}\hat{r} \qquad \hat{r} = \frac{\vec{r}}{|\vec{r}|} = \frac{vector\ r}{magnitud\ del\ vector\ r}$$

$$E = \frac{F}{q_0} = \frac{k_e|q|}{r^2} \qquad \vec{E} = \frac{k_e|q|}{r^2}\hat{r} \qquad \Phi_E = EA\cos\theta = \frac{Q_{interior}}{\epsilon_0} = 4\pi k_e q$$

$$\lambda = \frac{Q}{l} \qquad \sigma = \frac{Q}{s} \qquad \rho = \frac{Q}{V} \qquad E = \frac{Q}{4\pi\epsilon_0 r^2} \qquad E = \frac{\sigma}{2\epsilon_0}$$

Potencial Eléctrico y Capacitancia

$$\Delta EP = -W_{AB} = -qEd = k_e\frac{q_1 q}{r} = q_2V_1 = q(V_B - V_A) \qquad W = \frac{1}{2}mv^2 + |q|Ed$$

$$\Delta V = V_b - V_a = \frac{\Delta EP}{q} = \frac{k_e q}{r} = -E_x\Delta x \qquad C = \frac{Q}{\Delta V} \qquad C = \epsilon_o\frac{A}{d} \qquad C_{eq} = C_1 + C_2 + \cdots$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots \qquad U = \frac{1}{2}Q\Delta V = \frac{1}{2}C(\Delta V)^2 = \frac{Q^2}{2C} \qquad P_{promedio} = \frac{Energía\ Almacenada}{\Delta t}$$

$$W = \frac{1}{2}Q\Delta V \qquad C = \kappa\epsilon_0\frac{A}{d}$$

Corriente y Resistencia

$$I = \frac{\Delta Q}{\Delta t} \qquad I = \lim_{\Delta t\to 0}\frac{\Delta Q}{\Delta t} \qquad Q = Ne \qquad v_d = \frac{I}{nqA}$$

$$\Delta V = IR \qquad R = \rho\frac{l}{A} \qquad \rho = \rho_o[1 + \alpha(T - T_0)] \qquad R = R_0[1 + \alpha(T - T_0)]$$

$$P = I\Delta V = I^2R = \frac{(\Delta V)^2}{R} \qquad P = I\Delta V - I^2R$$

Circuito de Corriente Directa

$$\varepsilon = IR + Ir \qquad R_{Eq} = R_1 + R_2 + \cdots \qquad \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

$$i_{total} = i_1 + i_2 \qquad \sum\Delta V = \varepsilon + i_1R_1 + i_3R_2 + \cdots = 0$$

$$q = Q\left(1 - e^{-t/RC}\right) \qquad \tau = RC \qquad q = Qe^{-t/RC} \qquad i = Ie^{-t/RC}$$

Magnetismo

$F = qvB\sin\theta$ $\vec{F} = q\vec{v}\times\vec{B}$ $F = BIl\sin\theta$ $\vec{F} = I\vec{l}\times\vec{B}$

$\tau = BIAN\sin\theta$ $\mu = IAN$ $qB = \frac{mv}{r}$ $F = qE + q\vec{v}\times\vec{B}$

$\phi = BA\cos\theta$ $v = \frac{E}{B} = \sqrt{\frac{2eV}{m}}$ $\tau = \vec{\mu}\times\vec{B}$ $U = -\vec{\mu}\cdot\vec{B} - \mu B cos\,\phi$

$\omega = 2\pi f$ $v = \omega r$ $T = \frac{1}{f}$ $nq = \frac{J_x B_y}{E_z}$ $J = \frac{I}{A}$

$$\vec{B} = \frac{\mu_0}{4\pi} * \frac{q\vec{v}\times\hat{r}}{r^2}$$

$$|B| = \frac{\mu_0}{4\pi} * \frac{qv\sin\phi}{r^2}$$

$$d\vec{B} = \frac{\mu_0}{4\pi} * \frac{Id\vec{l}\times\hat{r}}{r^2} = \frac{\mu_0}{4\pi} * \frac{Id\vec{l}\sin\phi}{r^2}$$

$$\vec{B} = \frac{\mu_0}{4\pi} * \int \frac{Id\vec{l}\times\hat{r}}{r^2}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B_x = \frac{N\mu_0 I a^2}{2(x^2 + a^2)^{3/2}}$$

$$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi r}$$

$$B_x = \frac{N\mu_0 I}{2a}$$

$$B = N\frac{\mu_o I}{2R}$$

$$B = \frac{\mu_0 I}{2\pi} * \frac{r}{R^2}$$

$$B = \mu_o n I$$

$$B = \frac{N\mu_0 I}{2\pi r}$$

$$n = \frac{N}{l}$$

$$\oint Bdl = \mu_0 I_{encerrada}$$

Inducción electromagnética

$$d\Phi_B = \vec{B}d\vec{A}$$

$$\Phi_B = BA\cos\theta$$

$$\varepsilon_{ce} = \frac{2\varepsilon_{máx}}{\pi}$$

$$\varepsilon = -N\frac{\Delta\Phi_B}{\Delta t} = -N\frac{d\Phi_B}{dt} = Blv$$

$$E = \frac{1}{2\pi r}\left|\frac{d\Phi_B}{dt}\right|$$

$$\varepsilon = NBA\omega\sin\omega t$$

$$\varepsilon_{máx} = NBA\omega$$

$$\oint Ed\vec{l} = -\frac{d\Phi_B}{dt}$$

$$I_D = \epsilon \frac{d\Phi_E}{dt}$$

$$\varepsilon = \oint (\vec{v} \times \vec{B}) d\vec{l}$$

$$\oint \vec{B} d\vec{l} = \mu_0 (i_C + i_D)_{encerrada}$$

$$I = \frac{Blv}{R}$$

$$J_D = \epsilon \frac{dE}{dt}$$

$$\varepsilon = -L \frac{di}{dt}$$

$$L = \frac{-\varepsilon \Delta t}{\Delta I} = \frac{N \Delta \Phi_B}{\Delta I} = \frac{\mu_o N^2 A}{l} = \mu_o n^2 V$$

$$\varepsilon_2 = -M \frac{di_1}{dt} \qquad \varepsilon_1 = -M \frac{di_2}{dt} \qquad M = \frac{N_2 \Phi_{B_2}}{i_1} = \frac{N_1 \Phi_{B_1}}{i_2}$$

$$\frac{di}{dt} = \frac{\varepsilon - ir}{L} \qquad i_0 = \frac{\varepsilon}{R} \qquad \tau = \frac{L}{R}$$

$$i(t) = \frac{\varepsilon}{R}\left(1 - e^{-\tau/t}\right) \qquad \frac{di}{dt} = \frac{\varepsilon}{L} e^{-(R/L)t} \qquad i(t) = i_o e^{-(R/L)t}$$

$$U = L \int_0^I i dt = \frac{1}{2} L I^2 \qquad u = \frac{B^2}{2\mu_o} = \frac{\mu_0 N^2 A I^2}{4\pi r} \qquad u = \frac{B^2}{2\mu}$$

Circuitos L-C y L-R-C

$$x = A\cos(\omega t + \phi) \qquad q = Q\cos(\omega t + \phi) \qquad \omega = \sqrt{\frac{1}{LC}}$$

$$I = -\omega Q \sin(\omega t + \phi) \qquad U_{total} = \frac{1}{2} L I^2 + \frac{q^2}{2C} + \frac{Q_{máx}^2}{2C}$$

$$i = \pm \omega \sqrt{Q^2 - q^2} \qquad q = A e^{-(R/2L)t} \cos\left(\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}} t + \phi\right) \qquad \omega' = \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

Circuitos de corriente alterna

$$V = V_{máx} \cos \omega t \qquad I = I_{máx} \cos \omega t \qquad I_{(vmr)} = \frac{2}{\pi} I \approx 0.637 I$$

$$i_{(rms)} = \frac{I_{máx}}{\sqrt{2}} \qquad V_{(rms)} = \frac{V_{máx}}{\sqrt{2}} \qquad P_{prom} = I_{rms}^2 R \qquad P = V_{rms} I_{rms}$$

$$V_{rms} = I_{rms} R \qquad v_R = V_{máx} \cos \omega t = V_r \cos \omega t = IR \cos \omega t$$

$$q = \frac{I}{\omega} \sin \omega t \qquad v_C = \frac{I}{\omega C} \cos\left(\omega t - \frac{\pi}{2}\right) \qquad X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$$

$$\varepsilon = IL\omega \cos\left(\omega t + \frac{\pi}{2}\right) \qquad X_L = 2\pi f L \qquad V_L = I X_L \qquad V_c = I X_c$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad V = IZ \qquad \tan\phi = \frac{\omega L - \frac{1}{\omega C}}{R} \qquad V_{rms} = I_{rms}Z = \frac{I_{máx}Z}{\sqrt{2}}$$

$$P = \frac{1}{2}VI\cos\phi = V_{rms}I_{rms}\cos\phi \qquad \phi = \frac{R}{Z}$$

Resonancia, Transformadores y Fasores

$$f_o = \frac{1}{2\pi\sqrt{LC}} \qquad \frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_1}{I_2} \qquad P_E = I_1V_1 \qquad P_s = I_2V_2$$

$$X_L = j\omega L \qquad Z = R + jX_L \qquad V = V_{máx}\sin(\omega t + \phi)$$

$$V = (V_{máx}, \phi) \qquad \alpha \times \beta = \alpha + \beta \qquad \frac{\alpha}{\beta} = \alpha - \beta$$

$$r = a + bj \qquad |r| = \sqrt{a^2 + (bj)^2} \qquad \tan\theta = \frac{a}{bj} \qquad r = (|r|, \theta)$$

$$X_C = -j\left(\frac{1}{\omega C}\right) \qquad Z = R - X_C \qquad j = \sqrt{-1}$$

Constantes

Permeabilidad en el espacio libre

$$\mu_o = 4\pi\times10^{-7}T * m/A$$

Relación entre Tesla y Gauss

$$1T = 10^4G$$

Electrón-volt

$$1eV = 1.60\times10^{-19}C \cdot V = 1.60\times10^{-19}J$$

Constante de permitividad

$$\epsilon_0 = 8.85\times10^{-12}\ \frac{C^2}{N * m^2}$$

Constantes

$$k_e = 8.9875\times10^9\frac{Nm^2}{C^2}$$

Kilowatt-hora

$$3.60\times10^6J$$

Tabla 1 Carga y masa de electrón, protón y neutrón

Partícula	Carga (C)	Masa (kg)
Electrón	-1.60×10^{-19}	9.11×10^{-31}
Protón	$+1.60\times10^{-19}$	1.67×10^{-27}
Neutrón	0	1.67×10^{-27}

Constantes dieléctricas y rigideces dieléctricas de varios materiales a temperatura ambiente

Material	Constante dieléctrica κ	Rigidez dieléctrica (V/m)
Aire	1.000 59	3×10^6
Baquelita®	4.9	24×10^6
Cuarzo fundido	3.78	8×10^6
Neopreno	6.7	12×10^6
Nylon	3.4	14×10^6
Papel	3.7	16×10^6
Poliestireno	2.56	24×10^6
Vidrio Pyrex®	5.6	14×10^6
Aceite de silicona	2.5	15×10^6
Titanato de estroncio	233	8×10^6
Teflón®	2.1	60×10^6
Vacío	1.000 00	—
Agua	80	—

Resistividades y coeficientes de temperatura de la resistividad para varios materiales (a 20 °C)

Material	Resistividad $(\Omega \cdot m)$	Coeficiente de temperatura de la resistividad $[(°C)^{-1}]$
Plata	1.59×10^{-8}	3.8×10^{-3}
Cobre	1.7×10^{-8}	3.9×10^{-3}
Oro	2.44×10^{-8}	3.4×10^{-3}
Aluminio	2.82×10^{-8}	3.9×10^{-3}
Tungsteno	5.6×10^{-8}	4.5×10^{-3}
Hierro	10.0×10^{-8}	5.0×10^{-3}
Platino	11×10^{-8}	3.92×10^{-3}
Plomo	22×10^{-8}	3.9×10^{-3}
Nicromo[a]	150×10^{-8}	0.4×10^{-3}
Carbono	3.5×10^{-5}	-0.5×10^{-3}
Germanio	0.46	-48×10^{-3}
Silicio	640	-75×10^{-3}
Vidrio	$10^{10}–10^{14}$	
Caucho duro	$\approx 10^{13}$	
Azufre	10^{15}	
Cuarzo (fundido)	75×10^{16}	

[a] Aleación de níquel-cromo de uso común en elementos calefactores.