MECCANICA

Sistemi di riferimento

$$\vec{R}_{ass} = \vec{R}_{rel} + \vec{R}_{trasc}$$

$$\text{CM} = \sum \frac{m_i \vec{r}_i}{M_{tot}}$$

Traslazioni

$$x(t) = x_0 + v_0 t + \frac{1}{2} a t^2 \ [\, m \,]$$

$$K = \frac{1}{2} m V^2 \ [\, J \,]$$

$$\sum \vec{F} = 0 \text{ equilibrio}$$

$$F = \frac{d\vec{p}}{dt} \ [\, N \,]$$

$$\vec{P} = m\, V \left[Kg \frac{m}{s} \right]$$

$$\vec{I} = \int_{t_i}^{t_f} \vec{F} dt = \Delta \vec{p} \ \left[\text{Kg} \frac{\text{m}}{\text{s}} \right]$$

$$Potenza \ = P = \vec{F}\vec{V} = \frac{d\vec{L}}{dt} \ [\, W \,]$$

$$L = \int \vec{F} ds \ [\, J \,]$$

Piano inclinato

$$\vec{F}_a = \mu\, m\, g cos(\alpha)$$

$$\vec{F}_{//} = \text{m g sen}(\alpha)$$

$$\vec{n} = m\, g\, cos(\alpha)$$

ROTAZIONI

Inerzie belline

$$I = \frac{1}{3} m r^2 \ [Kg\ m^2]$$

$$I = \frac{1}{2} m r^2$$

$$\text{I} = \frac{1}{12} \text{mr}^2$$

$$I = \frac{2}{5} m r^2$$

Teorema degli assi //

$$I = I_{CM} + M d^2$$

Rotazioni

$$I = \sum m_i r^2$$

$$\theta(t) = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2 \ [\, rad \,]$$

$$K_r = \frac{1}{2} I \omega^2 \ [\, J \,]$$

$$\sum \vec{\tau} = 0 \text{ equilibrio}$$

$$\vec{\tau}_F = \vec{r} \times \vec{F} \ [\, N\, m]$$

$$\tau = I\, \alpha \, [\text{N m}]$$

$$L = \vec{r} \times \vec{p} \ = \ I\omega \left[\text{Kg} \frac{\text{m}^2}{\text{s}} \right]$$

$$P \ = \ \tau\, \omega \, [\, \text{W} \,]$$

$$T = \frac{2\, \pi}{\omega} \ [\, s \,]$$

$$freq = \frac{\omega}{2\pi} = \frac{1}{T} \ [\, Hz \,]$$

$$a_c = \omega^2 r = \frac{v^2}{r} \left[\frac{m}{s^2} \right]$$

$$spostamento \ = \ \theta\, r$$

$$velocità \ = \ \omega\, r$$

$$accelerazione \ = \ \alpha\, r$$

moto puro rotolamento

$$\text{K} = \frac{1}{2} I_p \omega^2 = \frac{1}{2} I_{CM} \omega^2 + \frac{1}{2} M_{tot} \text{V}^2$$

Koenig

$$\text{K} = \frac{1}{2} M_{tot} V_{CM}^2 + \frac{1}{2} \sum m_i {v_i'}^2$$

$$L_o = M \vec{r}_{CM} \times \vec{V}_{CM} + I_{CM}\, \omega$$

Schianto elastico tra due corpi

$$v_1 f = \frac{m_1 - m_2}{m_1 + m_2} v_1 i + \frac{2 m_2}{m_1 + m_2} v_2 i$$

$$v_2 f = \frac{2 m_1}{m_1 + m_2} v_1 i + \frac{m_2 - m_1}{m_1 + m_2} v_2 i$$

Molla

$$\Delta x = x - x_{eq}$$

$$\text{F} \ = \ -\text{k}\, \Delta \text{x} \, [\, N \,]$$

$$U = \frac{1}{2} k \Delta x^2 \ [\, J \,]$$

$$x(t) = A\, cos(\omega t + \varphi)$$

$$v(t) = -A\, \omega\, sen(\omega t + \varphi)$$

$$a(t) = -A\, \omega^2\, cos(\omega t + \varphi) = -\omega^2 x(t)$$

$$\omega = \sqrt{\frac{k}{m}} \qquad A = \sqrt{{x_{\text{eq}}}^2 + \left(\frac{v_0}{\omega} \right)^2}$$

Pendolo fisico stupido (ω è cosi solo se c'è solo forza peso)

$$E_{tot} = \frac{1}{2} I \omega^2 + m g h_{CM} \big(1 - cos(\theta)\big) = C$$

$$\omega = \sqrt{\frac{m g h_{cm}}{I}}$$

Attrito

$$\vec{R} = -b V$$

$$V(t) = \frac{m g}{b} \left(1 - e^{-\frac{bt}{m}} \right)$$

Conservazioni

Qt moto = sempre a meno che non ci siano forze esterne o impulsive (es vincoli)

Energia meccanica = urti elastici e quando ci solo forze conservative (es senza attrito o moto puro rotolamento)

Momento angolare = se la somma dei momenti è zero o se il braccio delle forze impulsive è nullo

ELETTROMAGNETISMO

Legge di Gauss

$$\Phi_{\text{E}} = \oint \vec{E}\, d\vec{s} = \frac{q_{int}}{\varepsilon_0} \ [Vm]$$

Campi elettrici $\left[\frac{V}{m} \right]$

$$\frac{\rho\, r}{2\varepsilon_0} \qquad \frac{\rho R^2}{2 r \varepsilon_0} = \frac{2k\lambda}{r}$$

$$\frac{\rho r}{3\varepsilon_0} \qquad \frac{\rho R^3}{3 r^2 \varepsilon_0} = \frac{\text{kq}}{r^2}$$

isolante $\frac{\sigma}{2\varepsilon_0}$ conduttiva $\frac{\sigma}{\varepsilon_0}$

$$E(z) = k \frac{z\, q}{(z^2 + R^2)^{3/2}}$$

$$0 \qquad \frac{\rho}{3\varepsilon_0} \left(r - \frac{{r_1}^3}{r^2} \right) \qquad \frac{kq}{r^2}$$

$$P \ = \ Q\, d$$

$$E = \frac{2k}{z^3} P$$

$$\vec{\tau} = \vec{P} \times \vec{E}$$

Forza, potenziale e energia

Densità Energia $\frac{1}{2} \epsilon_0 E^2$

$$\vec{F} = q \vec{E} \ [N]$$

$$L = q_0 \int E\, ds \ [\, J \,]$$

$$\Delta V = -\int E\, ds \, [V] \qquad V(\infty) \equiv 0$$

$$\Delta U = \Delta V q_0 \ [\, J \,]$$

Potenziale carica puntiforme

$$L = k \frac{q_0 q}{r} \qquad \Delta V = \frac{-kq}{r}$$

Energia cariche puntiformi

$$V_q = k \frac{q}{r} \qquad V_{q_0} = k \frac{q_0}{r}$$

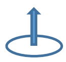
$$U = V_q q_0 = V_{q_0} q = k \frac{q q_0}{r}$$

Potenziali bellini (1 isolante 2 conduttore)

$$\Delta V = k \frac{q}{2R} \left(3 - \frac{r^2}{R^2} \right) \qquad \Delta V = \frac{kq}{r}$$

$$\Delta V = 0 + \frac{kq}{r} \qquad \Delta V = \frac{kq}{r}$$

$$\Delta V \ = \ E\ \ d$$



$$\frac{Qk}{\sqrt{R^2 + z^2}}$$

$$dV = k \frac{dq}{D} = \text{k} \frac{\sigma 2\pi \text{rdr}}{\sqrt{\text{r}^2 + z^2}}$$

$$\rightarrow \ V(h) = \int_{R_1}^{R_2} dV \ \rightarrow$$

$$\Delta V \ = \ \frac{\sigma}{2\varepsilon_0} \left(\sqrt{z^2 + R^2} - z \right)$$

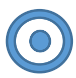
CONDENSATORI

$$C = \frac{Q}{\Delta V} [F] \quad U = \frac{1}{2} C \Delta V^2 \ [\, J \,]$$

$$\text{E} = \frac{\sigma}{\varepsilon_0} \qquad \Delta V = \frac{\sigma\, d}{\varepsilon_0} \qquad C = \frac{\varepsilon_0 A}{d}$$

$$\text{E} = \frac{2\text{k}\lambda}{\text{r}} \qquad \Delta V = 2k\lambda\, ln \left(\frac{b}{a} \right)$$

$$C = \frac{\varepsilon_0 2\pi l}{ln \left(\frac{b}{a} \right)}$$



$$E = \frac{kq}{r^2} \qquad \Delta V = kq \left(\frac{1}{a} - \frac{1}{b} \right)$$

$$C = \varepsilon_0 \frac{4\pi a b}{b - a}$$

CIRCUITI

Intensità di corrente

$$\text{I} = \frac{dq}{dt} = \int \vec{J}\, d\vec{A} \ [A]$$

$$spostamento \ = ds = V_d dt$$

$$dq = ne(V_d dt)$$

Densità di corrente

$$J = n\, e\, V_d = nqV \qquad J = \frac{I}{A} \left[\frac{A}{m^2} \right]$$

Resistenza

$$R = \frac{\Delta V}{I} \quad R = \rho \frac{L}{A} \left[\Omega, \frac{V}{A} \right] \quad \rho = \frac{E}{J} \left[\frac{V\, m}{A} \right]$$

Energia e potenza

$$\Delta U = \Delta V \int_0^t I\, dt = Q \Delta V [J]$$

$$P = \frac{dU}{dt} = \frac{dq \Delta V}{dt} = I \Delta V \ [\, W \,]$$

Kirchoff

Serie

$$R_{tot} = \sum R_i$$

$$\frac{1}{C_{tot}} = \sum \frac{1}{C_i}$$

Parallelo

$$\frac{1}{R_{tot}} = \sum \frac{1}{R_i}$$

$$C_{tot} = \sum C_i$$

CIRCUITO RC

Carica condensatore

$$\xi = \mathrm{IR} + \Delta \mathrm{V} \rightarrow \frac{\mathrm{dq(t)R}}{\mathrm{dt}} + \frac{\mathrm{q(t)}}{\mathrm{c}} = \xi$$

$$\rightarrow q(t) = q_o\left(1 - e^{-\frac{t}{RC}}\right)$$

Scarica condensatore

$$IR + \Delta V = 0 \rightarrow \frac{dq(t)R}{dt} + \frac{q(t)}{c} = 0$$

$$\rightarrow q(t) = q_o\left(e^{-\frac{t}{RC}}\right)$$

MAGNETISMO

Forza di Lorentz

$\vec{F} = q\vec{v} \times \vec{B}\ [N]$

$\vec{F}$ pollice, $\vec{v}$ indice, $\vec{B} medio$

Forza magnetica su filo percorso da corrente

$$\vec{F} = i\vec{L} \times \vec{B}\ [N]$$

$$\vec{B}\ \ indice, i\ pollice, \vec{F}\ medio$$

Momento torcente di una spira

$$\vec{\tau} = i\vec{A} \times \vec{B}$$

Momento di dipolo magnetico

$\vec{\mu} = N\ i\ A\ \hat{n} \qquad \vec{\tau} = \vec{\mu} \times \vec{B}$

Campo magnetico generato da un filo

$$B = \frac{\mu_0 i}{2\pi R}\ [T = 10^4 Gauss]$$

Campo magnetico di un filo piegato ad arco

$B = \frac{\mu_0 i \phi}{4\pi r}$ phi è l'angolo

Legge di Gauss magnetismo

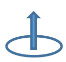
$$\Phi_B = \oint \vec{B}\, d\vec{s} = 0\ [\, Wb\,]$$

Campi magnetici

$$B = \frac{\mu_0 i}{2r}$$

$$B = \mu_0 i n \qquad n = N/L$$

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



$$\vec{B}(z) = \frac{\mu_0 \vec{\mu}}{2\pi(R^2 + z^2)^{\frac{3}{2}}}$$

Legge di Faraday

$$\xi = \oint \vec{E} d\vec{l} = -\frac{\partial \Phi_B}{\partial t}$$

se B è sia perpendicolare che uniforme

$$\Phi_B = B\ A$$

Nelle bobine

$$\xi = -N\frac{\partial \Phi_B}{\partial t}$$

Legge di Ampere Maxwell

$$\oint \vec{B} d\vec{l} = \mu_0 i + \mu_0 \varepsilon_0 \frac{\partial \Phi_E}{\partial t}$$

INDUTTORI E INDUTTANZE

$$L = \frac{N\Phi_B}{i}\ [\, H\,]$$

$$L\frac{\partial i}{\partial t} = N\frac{\partial \Phi_B}{\partial t}\ [\, V\,]$$

Auotoinduzione magnetica

$$\xi_L = -N\frac{\partial \Phi_B}{\partial t} = -L\frac{\partial i}{\partial t}$$

CIRCUITI RL

Carica Induttore

$$\xi = Ri + L\frac{\partial i}{\partial t} \rightarrow i(t) = \frac{\xi_0}{R}\left(1 - e^{-\frac{tR}{L}}\right)$$

Scarica Induttore

$$Ri + L\frac{\partial i}{\partial t} \rightarrow i(t) = \frac{\xi_0}{R}e^{-\frac{tR}{L}}$$

Energia Induttore

$$U = \frac{1}{2}L\, i^2\ [\, J\,]$$

Densità di energia

$$\mu = \frac{1}{2}\mu_0 n^2 i^2 = \frac{B^2}{2\mu_0}$$

CIRCUITI LC

$$\omega = \frac{1}{\sqrt{LC}}\ [\, Hz\,]$$

$$U_{tot} = U_c + U_L = \frac{1}{2}C\Delta V^2 + \frac{1}{2}Li^2 =$$

$$= \frac{1}{2}\frac{q^2}{C} + \frac{1}{2}Li^2\ [\, J\,]$$

$$q(t) = Qcos(\omega t + \phi)\ [\, \mathrm{C}\,]$$

Generatore corrente alternata

$$\Phi_B(t) = BAcos(\omega_g t)$$

Trasformatore

$$\frac{\Delta Vi}{N_{spir\ \ i}} = \frac{\Delta V_f}{N_{spire_f}}$$

GRAVITÀ

$$F = -\frac{GM_1M_2}{r^2}\ [\, N\,]$$

$$U = \frac{GM_1M_2}{r}\ [\, J\,]$$

MULTIPLI UNITÀ DI MISURA

$$Pico[\, p\,] = 10^{-12}$$

$$\mathrm{Nano}[\, n\,] = 10^{-9}$$

$$Micro[\, \mu\,] = 10^{-6}$$

$$Milli[\, m\,] = 10^{-3}$$

$$Centi[\, c\,] = 10^{-2}$$

$$Deci[\, d\,] = 10^{-1}$$

FINAL

$$C_e = 1{,}6 \times 10^{-19}\ [C]$$

$$M_e = 9{,}1 \times 10^{-3}\ [Kg]$$

$$M_p = 1{,}7 \times 10^{-27}[Kg]$$

$$\varepsilon_0 = 8{,}85 \times 10^{-12}\left[\frac{C^2}{Nm^2}\right]$$

$$\mu_0 = 4\pi \times 10^{-7}\left[\frac{Tm}{A}\right]$$

$$k = \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\left[\frac{Nm^2}{C^2}\right]$$

$$\lambda = \frac{Q}{l}\left[\frac{C}{m}\right] \quad \sigma = \frac{Q}{A}\left[\frac{C}{m^2}\right] \quad \rho = \frac{Q}{V}\left[\frac{C}{m^3}\right]$$

$$G = 6{,}67 \times 10^{-11}\left[\frac{Nm^2}{Kg^2}\right]$$

PRODOTTO VETTORE

$$\vec{u} \times \vec{v} = \begin{vmatrix} \mathrm{i} & \mathrm{j} & \mathrm{k} \\ \mathrm{u}_x & \mathrm{u}_y & \mathrm{u}_z \\ \mathrm{v}_x & \mathrm{v}_y & \mathrm{v}_z \end{vmatrix}$$

TRIGONOMETRIA

$$c^2 = a^2 + b^2 - 2\, ab\, cos(\gamma)$$

$$\frac{a}{sen\alpha} = \frac{b}{sen\beta} = \frac{c}{sen\gamma}$$

$$\pi^2 = g$$

Directed and produced by:

Alessandro Versari

With the help of:

Francesco Berti

Aleandro Prudenzano

Feel free to use this space as you wish