FONDAMENTI DI MECCANICA E BIOMECCANICA [IN/0165]

Lezione del 26 ottobre 2017.

Titolo:
Lavoro ed Energia.

Contenuti:
Teorema dell'energia.
Espressione del lavoro di alcuni tipi di forze: lavoro della risultante di un sistema di azioni, lavoro di una forza dipendente dalla posizione (forza lineare elastica), forza peso.
Energia cinetica, potenziale elastica, gravitazionale.

Riferimento:
Ferraresi C., Raparelli T. "Meccanica applicata - Terza edizione", CLUT, 2007.
Cap. 1 – Dinamica – Lavoro ed energia.
Pagg. 59 – 64.
Legnani G., Palmieri G. "Fondamenti di meccanica e biomeccanica del movimento", CittàStudi, 2016.
Cap. 3 – Dinamica.
Pagg. 255 – 303

26.x.17

EQUILIBRIO

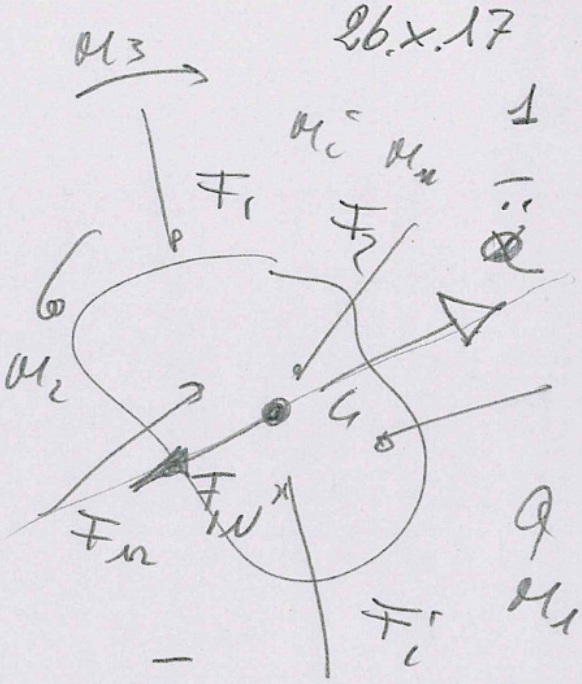
$$\sum_{i=1}^{n} \bar{F}_{e_i} + \bar{F}_{in} = \bar{0}$$

$$\Sigma F_{ex} + F_{inx}$$

$$\Sigma F_{ey} + F_{iny}$$

$$\Sigma F_{ez} + F_{inz}$$

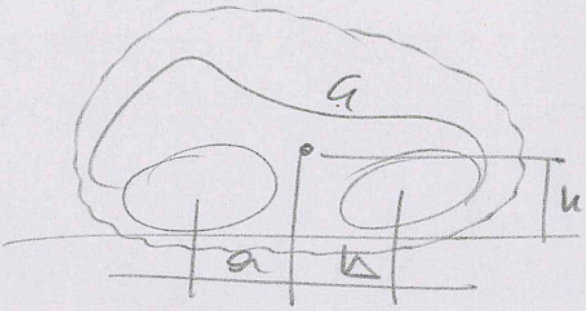
$$\sum_{i=1}^{n} \bar{M}_{e_i} + \bar{M}_{in} = 0$$



$$\bar{F}_{in} = -m\bar{a}$$

$$\bar{M}_{in} = -I_G \dot{\bar{\omega}}$$

Diagr. Corpo Libero

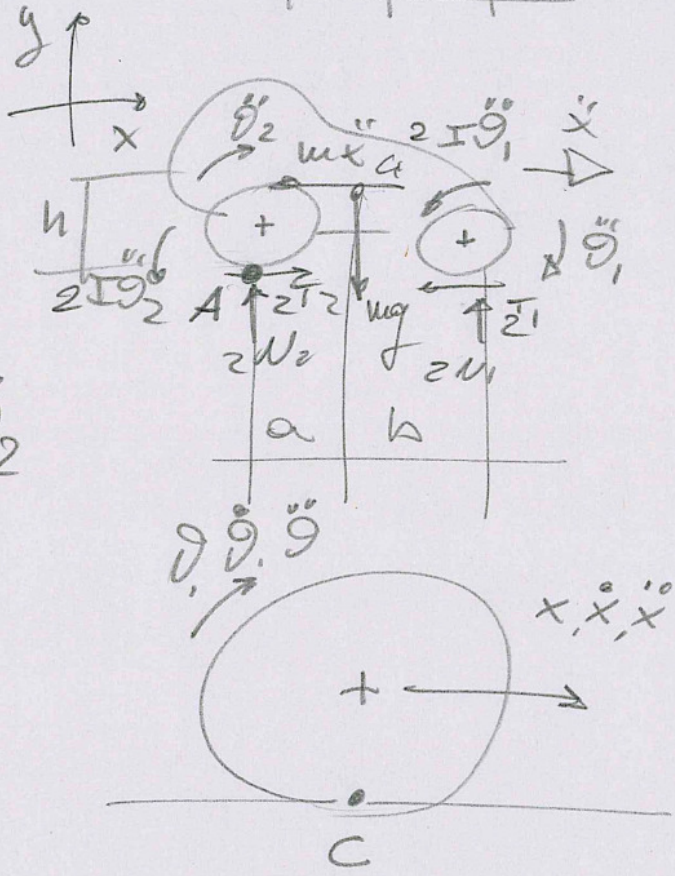


$$x)\ 2T_2 - 2T_1 - m\ddot{x} = 0$$

$$y)\ 2N_1 + 2N_2 - mg = 0$$

$$A)\ 2N_1(a+b) - mg\,a + m\ddot{x}\,h + 2I_1\ddot{\vartheta}_1 + 2I_2\ddot{\vartheta}_2 = 0$$

$$\ddot{x} = \ddot{\vartheta}_2 r$$

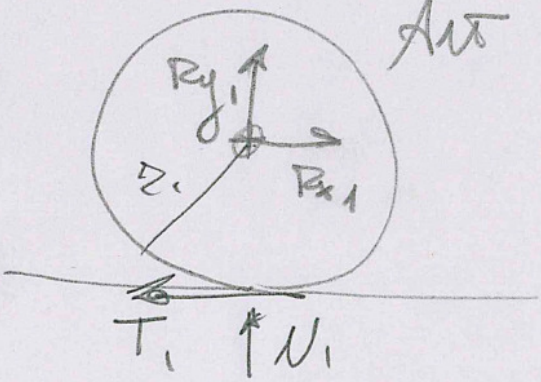


$$T_2 \cdot r_2 - C_2 = 0$$

$$N_2 + R_{y2} = 0$$

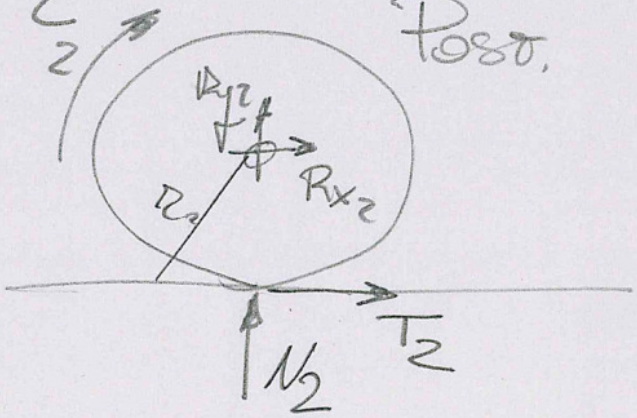
$$T_2 + R_{x2} = 0$$

Ant

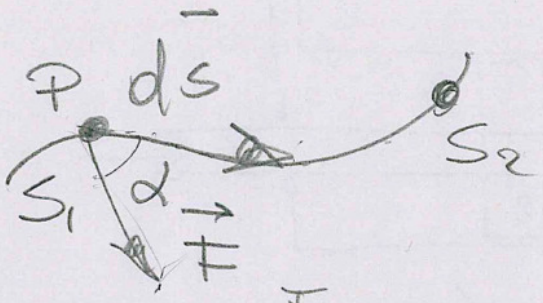


C_2

Post.

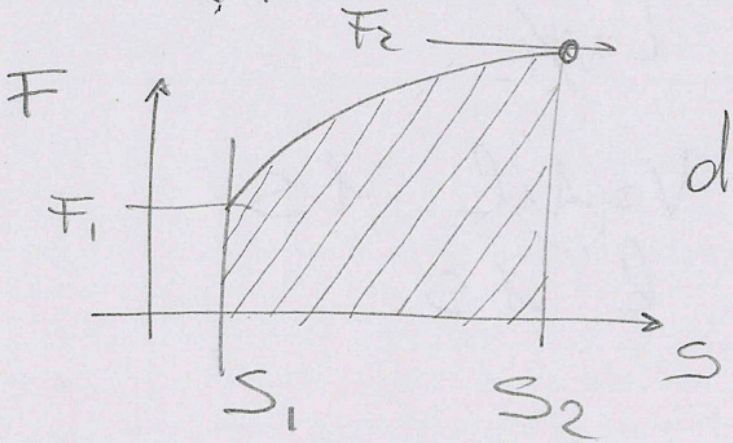


LAVORO

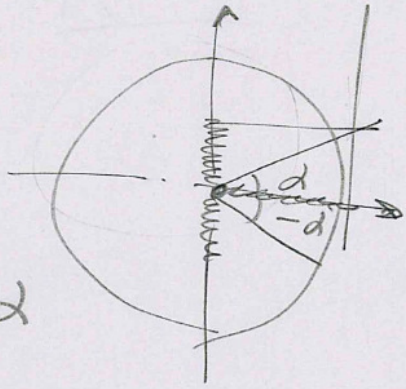


$$dL = \vec{F} \cdot d\vec{s}$$

$$\nu \cdot m = I$$



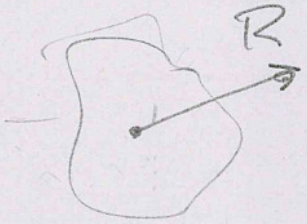
$$dL = \vec{M} \cdot d\vec{\vartheta}$$



$$\vec{F} \cdot d\vec{S} = |F||ds|\cos\alpha$$

LAVORO RISULTANTE SIST. FORZE

$$dL = \vec{F} \cdot d\vec{s} = \vec{R} \cdot d\vec{s}$$



$$\sum \bar{F}_e + \bar{F}_{in} = 0$$

$$\bar{R} + \bar{F}_{in} = \bar{0}$$

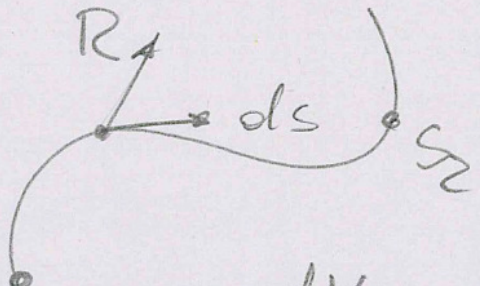
$$\bar{R} = -\bar{F}_{in} \qquad \bar{F}_{in} = m(-\bar{a})$$

$$\bar{R} = m\bar{a} \qquad \bar{F}_{in} = -m\bar{a}$$

$$dL = \vec{F} \cdot d\vec{s} =$$

$$= m\bar{a} \cdot d\vec{s} =$$

$$= m a_t ds$$



$$a_t = \frac{dV}{dt}$$

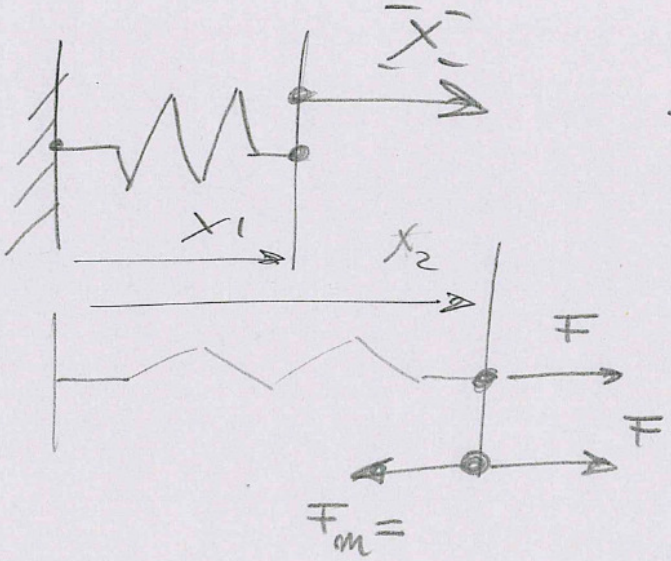
$$= m \frac{dV}{dt} ds = m \frac{dV ds}{dt} = m dV \frac{ds}{dt} =$$

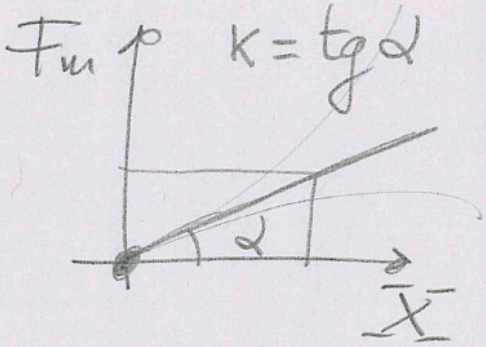
$$= m V dV$$

$$L = \int_1^2 dL = \int_1^2 m V dV = \int_{V_1}^{V_2} m V dV =$$

$$= m \int_{V_1}^{V_2} V dV = m \frac{1}{2} V^2 \Big]_{V_1}^{V_2} = \frac{1}{2} m V_2^2 - \frac{1}{2} m V_1^2$$

FORÇA ELÁSTICA



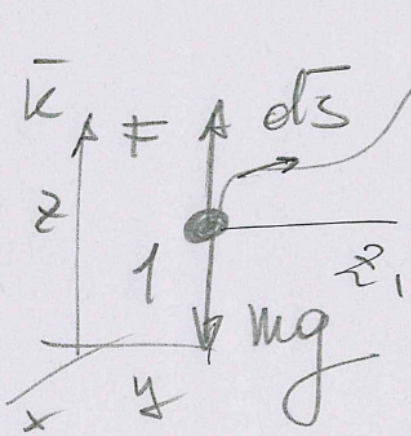


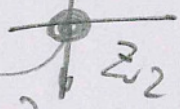
$$F = (k)x$$

$$(k) = N/m$$

$$L = \int_{x_1}^{x_2} \bar{F} \cdot d\bar{s} = \int_{x_1}^{x_2} -kx\,dx = -\frac{1}{2}k\left(x_2^2 - x_1^2\right)$$

FORÇA PESO





$$d\bar{s} = dx\,\vec{i} + dy\,\vec{j} + dz\,\bar{k}$$

$$mg(-\bar{k})$$

$$L = \int_1^2 mg \cdot d\bar{s} =$$

$$= \int_1^2 -mg\,\bar{k} \cdot d\bar{s} = -mg(z_2 - z_1)$$

$$= -mgh$$

- E. CINETICA

$$\Delta E_c = \frac{1}{2} m (v_2^2 - v_1^2)$$

- E. POT. ELASTICA

$$\Delta E_{el} = \frac{1}{2} K (\Delta x)^2$$

- E. POT. GRAV.

$$\Delta E_g = m g \Delta H$$

$$L_e + L_i = \Delta E_c + \Delta E_k + \Delta E_g + \Delta E + \text{——}$$