



VIATA DE LICEU

se traieste o singura data!

Miscarea oscilatorie armonica

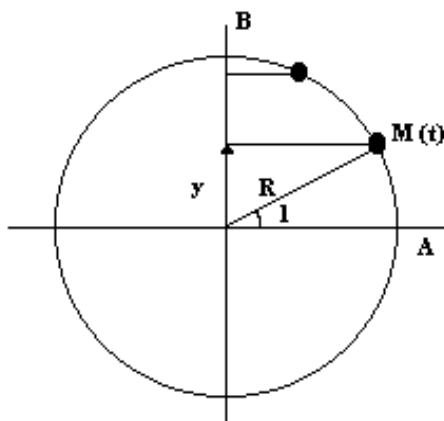
Caracteristica miscarii

Este un caz ideal. Nu exista mediu disipativ, iar energia se conserva. Amplitudinea $A = ct$

Def : Miscarea oscilatorie armonica este miscarea oscilatorie cu amplitudine liniara si constanta in care acceleratia este proportionala cu elongatia si de semn contrar ei.

Ecuatiile miscarii oscilatorie armonice

Consideram ca punctul material porneste din A.



$$\omega = \Delta\alpha / \Delta t \quad \Rightarrow \quad \Delta\alpha = \omega\Delta t$$

$$\alpha = \omega t$$

$$R = A$$

$$\sin \alpha = y / A \quad \Rightarrow \quad y = A \sin \omega t$$

Conditia de maxim :

$$y \rightarrow y_{\max} = A$$

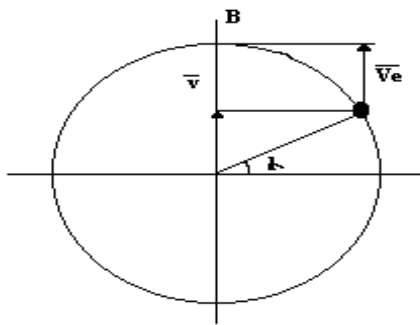
$$\sin (\omega t + \varphi_0) = +1 \quad \omega t + \varphi_0 = \pi/2 \quad \Rightarrow \quad \omega t$$

$$= \pi/2 - \varphi_0$$

$$t = (\pi/2 - \varphi_0) / \omega$$

Generalizare : $t = [(2k+1)\pi/2 - \varphi_0] / \omega$

Ecuatia vitezei



$$v = v_e \cos \alpha$$

Masa circulara

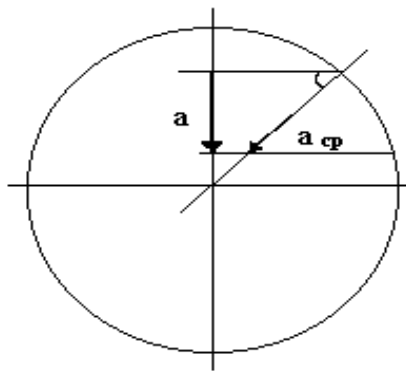
$$\omega = \Delta \alpha / \Delta t \quad (\text{relatie de definitie}) \quad \omega = v / R \quad (\text{modul}) \quad \Rightarrow v = \omega R$$

$$R = A \quad v = \omega A \cos(\omega t + \varphi_0)$$

Conditia de maxim

$$v \rightarrow v_{\max} = \omega t \quad \text{pt. cos} \quad (\omega t + \varphi_0) = 1 \quad \omega t + \varphi_0 = 2k\pi \quad \Rightarrow t = (2k\pi - \varphi_0) / \omega$$

Ecuatia acceleratiei



$$a_{cp} = \omega^2 R \quad \text{sau} \quad a_{cp} = \omega^2 A \quad \Rightarrow a = -\omega^2 A \sin(\omega t + \varphi_0)$$

Conditia maxima :

$$a \rightarrow a_{\max} = -\omega^2 A$$

$$\text{pentru} \quad \sin(\omega t + \varphi) = 1$$

$$A \sin(\omega t + \varphi_0) = y$$

$$a = -\omega^2 y$$



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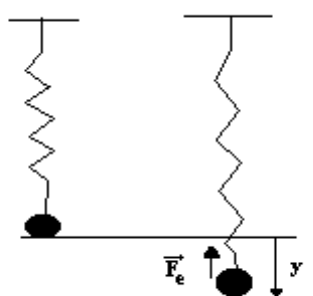
Perioada miscarii oscilatorii armonice

Def : Miscarea oscilatorie armonica este o miscare periodica care se repeta identic la intervale egale de timp. Ea este reprezentata printr-o functie periodica.

$$T = 2\pi / \omega$$

In continuare vom studia :

Perioada pentru resort elastic



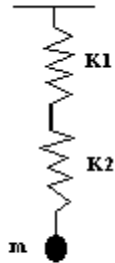
$$\begin{aligned} F_e &= -Ky \quad ; \quad -Ky = ma \quad ; \\ &- Ky = -m \omega^2 A \sin \omega t \\ &- K A \sin \omega t = -m \omega^2 A \sin \omega t \\ &\quad \quad \quad K = \omega^2 m \\ \omega &= \sqrt{K/m} \quad ; \quad 2\pi / T = \sqrt{K/m} \\ &\quad \quad \quad \omega = 2\pi / T \quad ; \\ &\quad \quad \quad T = 2\pi \cdot \sqrt{m/K} \end{aligned}$$

Legi : • perioada depinde direct proportional de $\sqrt{m}$
• perioada depinde invers proportional de $\sqrt{K}$

Observatie : • perioada resortului nu depinde de marimi variabile si nu poate fi influentata.

Grupari resorturi :

a) Serie



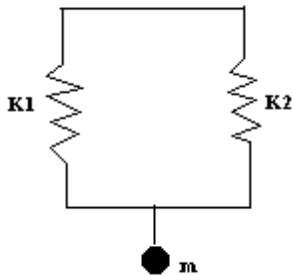
$y = y_1 + y_2 ;$
Constanta echivalenta :

$$1/K_s = 1/K_1 + 1/K_2$$

$$K_s = K_1 K_2 / (K_1 + K_2)$$

$$T_s = 2\pi \sqrt{m/K_s}$$

b) Paralel



$$K_p = K_1 + K_2$$

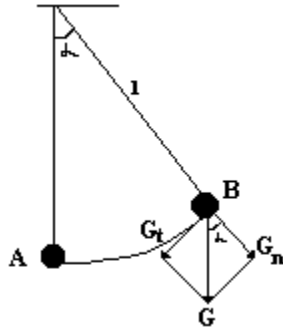
$$T_p = 2\pi \sqrt{m/K_p}$$



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Perioada pentru pendul matematic



Unghiul care corespunde elongatiei :

α = elongatie unghiulara $\alpha \rightarrow y$

α_0 = amplitudine unghiulara $\alpha_0 \rightarrow A$

$G_n = G \cos \alpha$; $G_t = G \sin \alpha$

G_n – la pozitia de extrem este anulata de tensiunea in fir.

$G_t = mg \sin \alpha$; $ma = mg \cdot y / l$

- $m\omega^2 y = - mg \cdot y / l$

$\omega^2 = g / l$; $\omega = \sqrt{g / l}$; $T = 2\pi \sqrt{l / g}$

Energia in miscarea oscilatorie armonica

$$E_t = E_c + E_p$$

Obs : In miscarea oscilatorie armonica energia se conserva.

$$E_t = E_{pmax} \quad (V = 0)$$

$$E_t = E_{cmax} \quad (y = 0)$$

Scop $E_t = ?$

$$E_t = \frac{1}{2} mV^2 + \frac{1}{2} Ky^2 \quad ; \quad y = A \sin \omega t \quad ; \quad v = \omega A \cos \omega t$$

$$E_t = \frac{1}{2} m\omega^2 A \sin^2 \omega t + \frac{1}{2} KA^2 \sin^2 \omega t \quad ;$$

$$E_t = \frac{1}{2} KA^2 (\sin^2 \omega t + \cos^2 \omega t)$$

$$\Rightarrow E_t = \frac{1}{2} KA^2$$

1) Energia in miscarea oscilatorie armonica pentru resort elastic

$$E_c = \frac{1}{2} mv^2 \quad ; \quad E_p = Ky^2 \quad ; \quad E_t = \frac{1}{2} KA^2$$

Obs. Daca nu se cunoaste viteza si se da in ipoteza valoarea lui A respectiv y se aplica conservarea energiei.

$$E_c = E_t - E_p \quad ; \quad E_c = \frac{1}{2} KA^2 - \frac{1}{2} Ky^2 \quad ;$$

$$E_c = \frac{1}{2} K (A^2 - y^2)$$

2) Energia in miscarea oscilatorie armonica pentru pendul matematic

$$E_c = \frac{1}{2} mv^2 \quad ; \quad H = l \cdot 1 \cos \alpha \quad ; \quad H = l (1 - \cos \alpha) \quad ; \quad E_p = mgh \quad ;$$

$$E_p = mgl (1 - \cos \alpha)$$