Miscarea oscilatorie armonica

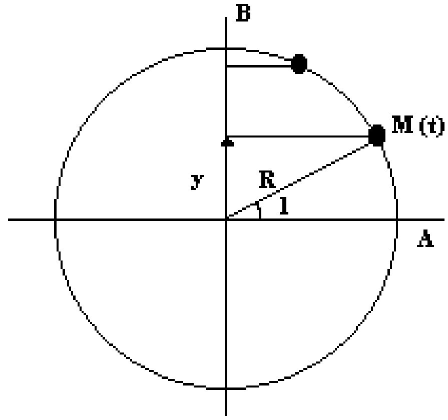
Caracteristica miscarii

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.



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

$\alpha = \omega t$

$R = A$

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

Conditia de maxim :

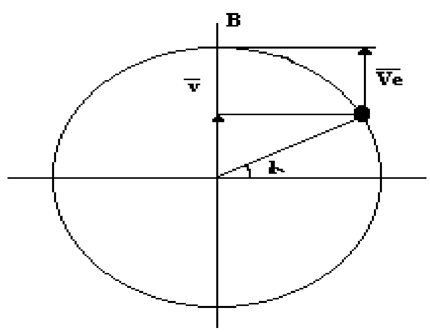
$y \rightarrow y_{max} = A$

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

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

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

Ecuatia vitezei



$v = v_e \cos \alpha$

Masa circulara

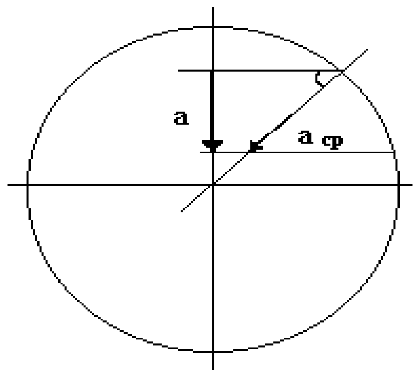
$\omega = \Delta\alpha / \Delta t$ (relatie de definitie) $\omega = v / R$ (modul) $\Rightarrow v = \omega R$

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

Conditia de maxim

$v \dashrightarrow v_{max} = \omega t$ pt.cos $(wt + \varphi_0) = 1$ $\omega t + \varphi_0 = 2k\pi$ $\Rightarrow t = (2k\pi - \varphi_0)\omega$

Ecuatia acceleratiei



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

Conditia maxima :

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

pentru $\sin(\omega t + \varphi) = 1$

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

$a = - \omega^2 y$

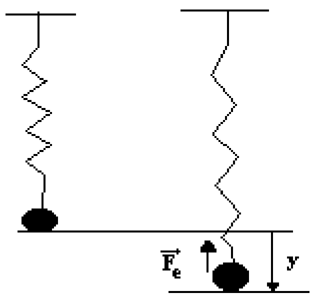
Perioada miscarii oscilatorii armonice

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



$F_e = -Ky$; $-Ky = ma$;

$-\ Ky = -m\omega^2 A \sin \omega t$

$-\ K A \sin \omega t = -m \omega^2 A \sin \omega t$

$K = \omega^2 m$

$\omega = \sqrt{K/m}$; $2\pi / t = \sqrt{K/m}$

$\omega = 2\pi / T$;

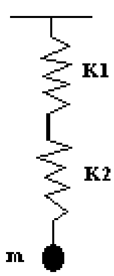
$T = 2\pi \cdot \sqrt{m/K}$

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

<u>Observatie :</u> • perioada resortului nu depinde de marimi variabile si nu poate fi influentata.

<u>Grupari resorturi :</u>

a) Serie



$y = y_1 + y_2$;

<u>Constanta echivalenta :</u>

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

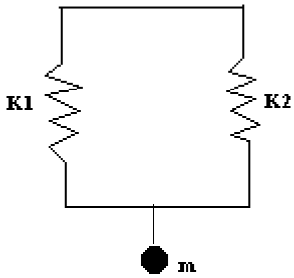
$K_s = K_1 K_2 / (K_1 + K_2)$

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

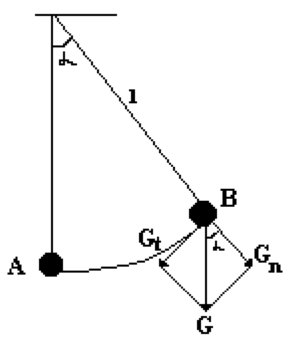
b) Paralel

$K_p = K_1 + K_2$

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



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.

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

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

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

Energia in miscarea oscilatorie armonica

$E_t = E_c + E_p$

Obs : In miscarea oscilatorie armonica energia se conserva.

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

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

Scop $E_t = ?$

$E_t = ½ mV^2 + ½ Ky^2$; $y = A \sin \omega t$; $v = \omega A \cos \omega t$

$E_t = ½ m\omega^2 A \sin^2 \omega t + ½ KA^2 \sin^2 \omega t$;

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

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**

$$E_c = 1/2\, mv^2 \quad ; \quad H = l \cdot l \ \cos \alpha \quad ; H = l \ (1- \cos \alpha) \quad ; \quad E_p = mgh \ ;$$
$$E_p = mgl \ (1- \cos \alpha)$$