Miscarea oscilatorie armonica

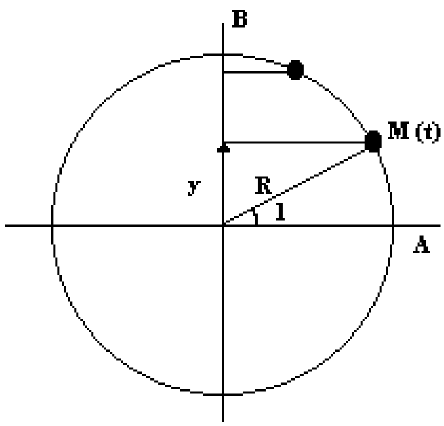
Caracteristica miscarii

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.



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

$\alpha = \omega t$

$R = A$

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

Conditia de maxim :

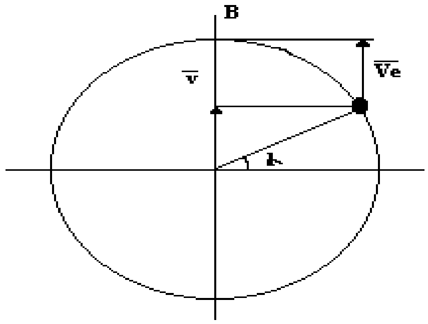
$y \rightarrow y_{max} = A$

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

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

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

<u>Ecuatia vitezei</u>



$v = v_e \cos \alpha$

<u>Masa circulara</u>

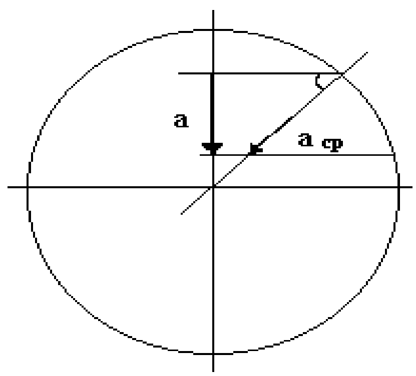
$\omega = \Delta\alpha / \Delta t$ (relatie de definitie) $\omega = v / R$ (modul) => $v = \omega R$

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

<u>Conditia de maxim</u>

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

<u>Ecuatia acceleratiei</u>



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

<u>Conditia maxima :</u>

a → $a_{max} = -\omega^2 A$

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

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

$a = -\omega^2 y$

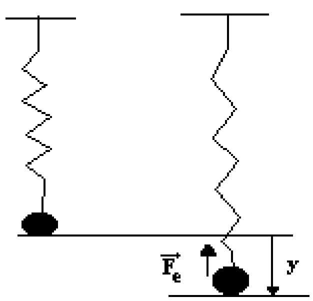
Perioada miscarii oscilatorii armonice

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



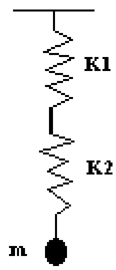
$$F_e = - Ky \quad ; \quad - Ky = ma \; ;$$
$$- \quad Ky = - m\,\omega^2 A \sin \omega t$$
$$- \quad K A \sin \omega t = - m\,\omega^2 A \sin \omega t$$
$$K = \omega^2 m$$
$$\omega = \sqrt{K / m} \; ; \quad 2\pi / t = \sqrt{K / m}$$
$$\omega = 2\pi / T \; ;$$
$$T = 2\pi \bullet \sqrt{m/K}$$

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



$y = y_1 + y_2$;

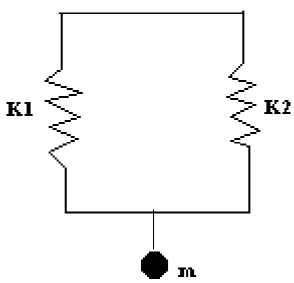
Constanta echivalenta :

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

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

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

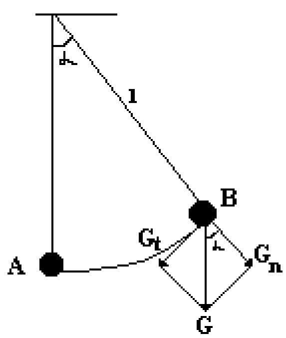
b) Paralel



$K_p = K_1 + K_2$

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

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.

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

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

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

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 $E_t = ?$

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

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

$E_t = ½ KA^2 (\sin^2 \omega t + \cos^2 \omega t)$

=> $E_t = ½ KA^2$

1) Energia in miscarea oscilatorie armonica pentru resort elastic

$E_c = ½ mv^2$; $E_p = Ky^2$; $E_t = ½ KA^2$

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

$E_c = E_t - E_p$; $E_c = ½ KA^2 - ½ Ky^2$;

$E_c = ½ K (A^2 - y^2)$

2) Energia in miscarea oscilatorie armonica pentru pendul matematic

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

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