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Mechanical Vibration
(New) (1290)

P. Pages : 5

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any one** question from each unit.
5. Figure to the right indicate full marks.
6. Non programmable calculator is allowed.
7. Assume suitable data if necessary.

UNIT - I

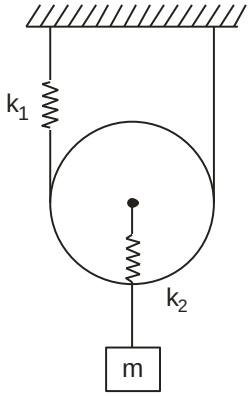
1. a) A body is subjected to two harmonic motions as given below : **10**

$x_1 = 15\sin\left(wt + \frac{\pi}{6}\right)$ and what harmonic motion

$x_2 = 8\cos\left(wt + \frac{\pi}{3}\right)$ What harmonic motion

Should be given to the body to bring it to equilibrium.

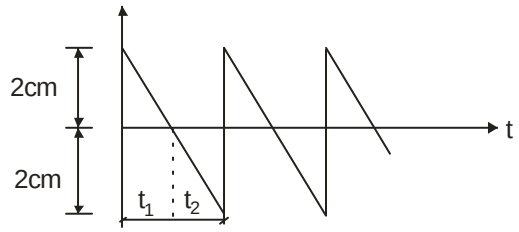
b) Determine the natural frequency of mass as shown in fig. **10**
Assuming that the cords do not stretch and slide over the pulley.
Assume pulley has no mass.



Where m = 22 kg
$K_1 = 4.5 \times 10^3$ N/m
$K_2 = 2 \times 10^3$ N/m.

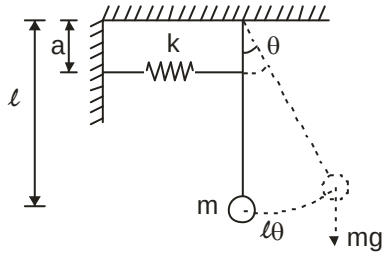
OR

c) Represent the periodic motions given in fig. by harmonic motion series. **10**



$t_1 = t_2 = 0.1$ second.

d) Derive the differential equation of motion for a spring controlled simple pendulum as shown in fig and find the natural frequency. Spring is in its unstarched position when pendulum rod is vertical **10**



m = 3 kg
k = 2 kN/m
a = 0.1 m
ℓ = 0.3 m

UNIT - II

2. a) Show that for coulomb damping amplitude reduces by $\frac{4F}{K}$ in one complete cycle, where F is frictional force and K is stiffnes. **10**

b) A machine having a mass of 100 kg & support on spring of total stiffness 7.84×10^5 N/m has an unbalanced rotating element result in disturbing force of 392 N at a speed of 3000 rpm. Assume damping factor r = 0.20, Determine **10**

a) Amplitude of motion due to unbalance
b) Transmissibility.
c) Transmitted force.

OR

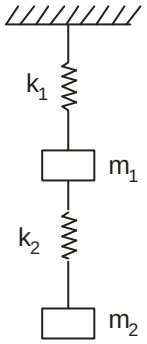
c) For underdamped vibration system, show that logarithmic decrement $\delta=\frac{2\pi r}{\sqrt{1-r^2}}$. Where r is damping ratio. **10**

d) An air compressor of 450 kg operates at a constant speed of 1750 rpm. Rotating parts are well balanced. The reciprocating part is 10 kg and crank radius is 100 mm. The mounting introduces a viscous damping of damping factor 0.15. Specify the spring for the mounting such that only 20% of the unbalanced force is transmitted to the foundation. Find out the amplitude of transmitted force. **10**

UNIT - III

3. a) Explain torsional vibration absorber in detail. **10**

b) Determine the two natural frequency of vibrations and ratio of amplitudes of the motion M_1 & M_2 for the two modes of vibration. **10**



m_1 = 2 kg
m_2 = 1.2 kg
k_1 = 45 N/m
k_2 = 45 N/m

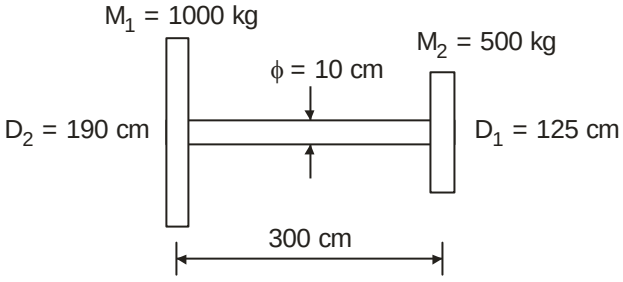
OR

c) For critical speed with damping show that. **10**

$$\frac{x}{e} = \frac{(w/w_n)^2}{\sqrt{\left(1-\{w/w_n\}^2\right)^2+\left(2r\frac{w}{w_n}\right)^2}}$$ where,

x - lateral deflection from shaft center
e - eccentricity of the disc.

d) Determine natural frequency of given system. **10**

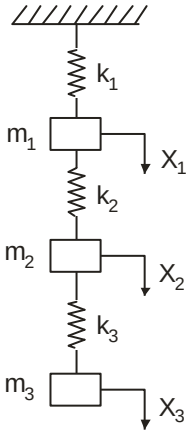


Assume G = 0.83x10'' N/m^2

UNIT - IV

4. a) Explain dynamic coupling and static coupling in detail. **10**

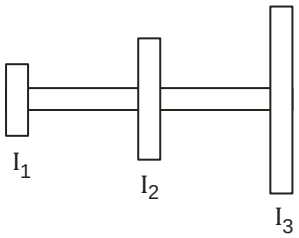
b) Determine natural frequency of given system by using Rayleigh method. **10**



where,
m_1 = 2.5 kg
m_2 = 3.0 kg
m_3 = 1.5 kg
$k_1 = k_2 = k_3$ = 20 N/m

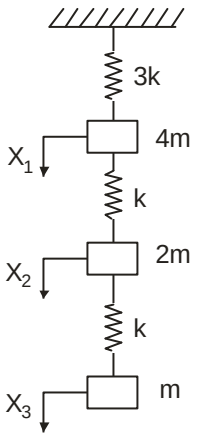
OR

c) A steel shaft of diameter 10cm is carrying three masses 2.5kg, 3.75 kg and 7 kg resp. as shown in fig. **10**



The distance between rotors are 0.7m. Determine f_n of torsional vibrations the radii of gyration of three rotors are 0.2, 0.3 and 0.4m respectively.
Take $G = 9 \times 10^8 \, N/m^2$.

d) Calculate 1st natural frequency and 1st mode by using matrix iteration method for given system. **10**



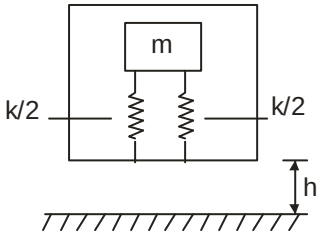
UNIT - V

5. a) Derive the general solution for longitudinal vibration of bar. **10**

b) Explain perturbation method in detail. **10**

OR

c) Mass m is shipped in a container as shown in fig. In process of unloading the container is dropped from a height 'h' to a hard floor, find response of the system. **10**



d) Explain phase plane method. **10**

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