Seat No. | | | | | | |

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Mechanical Vibration
(New) (1290)

P. Pages : 4

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

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet 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. Draw neat figures wherever necessary.
5. Use of non-programmable calculator is allowed.
6. Assume suitable data if necessary.
7. All questions are compulsory. Solve **any two** bit out of a, b, c in each question.

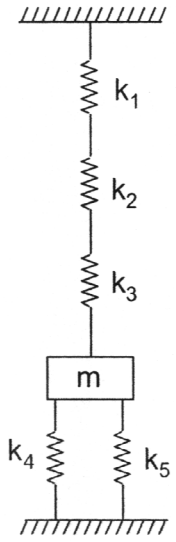
1. a) Explain the importance of study of vibration in Engineering. **10**

b) A body is subjected to two harmonic motions as given below

$x_1 = 15\sin\left(\omega t + \pi/6\right)$ and $x_2 = 8\cos\left(\omega t + \pi/3\right)$.

What harmonic motion should be given to the body to bring it to equilibrium ? **10**

c) For the system shown in figure $k_1 = 2000\,N/m$, $k_2 = 1500\ N/m$, $k_3 = 3000\ N/m$ and $k_4 = k_5 = 500\,N/m$. Find "m" such that the system has a natural frequency of 10 Hz. **10**



2. a) The disc of a torsional pendulum has a moment of inertia of 600 kg-cm^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 10 cm diameter and 40 cm long. When the pendulum is vibrating, the observed amplitudes on the same side of the rest position for successive cycles are 9°, 6° and 4° Determine:

i) Logarithmic Decrement.
ii) Damping torque at unit velocity and
iii) The periodic time of vibration.

Assume for the brass shaft $G = 4.4 \times 10^{10}\ N/m^2$. **10**

b) A machine of 100 kg mass is supported on springs of total stiffness 700 KN/m has an unbalanced rotating element, which results in a disturbing force of 350 N at a speed of 3000 rpm.
Assuming a damping factor of r = 0.20, Determine

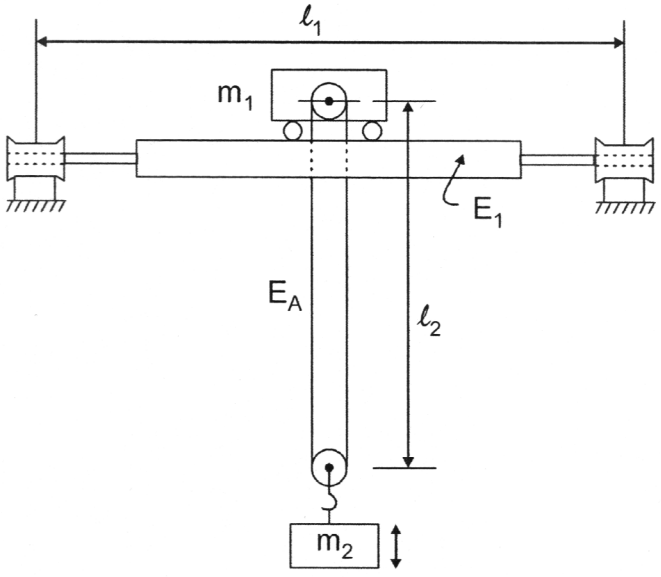
i) Its amplitude of motion due to the unbalance.
ii) The transmissibility and
iii) The transmitted force. **10**

c) i) Interfacial Damping. ii) Viscous Damping. **10**

3. a) i) Houdaille Damper with frequency response curve.
ii) Lanchester Damper. **10**

b) Figure shows an overhead crane schematically. The cabin is at the center of the beam of length ℓ_1. Reduce the system to an equivalent two degree freedom system and determine, the natural frequencies. **10**

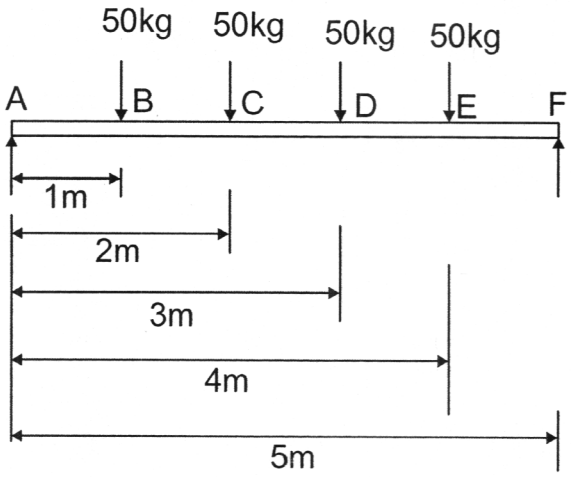
Assume $EI = 21 \times 10^6\ Nm^2$
$m_1 = 3000\ kg$
$\ell_1 = 5m$
$E_A = 82.47 \times 10^6\ N$
$m_2 = 700kg$
$\ell_2 = 6m$



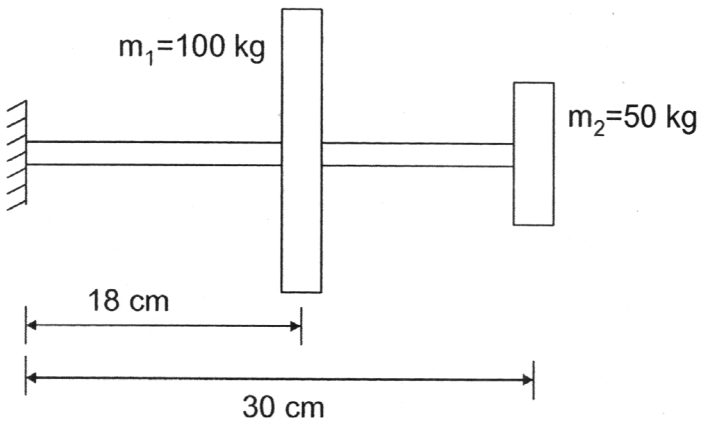
c) Define critical speed. A rotor of mass 12 kg is mounted in the middle of 25mm diameter shaft supported between two bearings placed at 900mm from each other. The rotor is having 0.02 mm eccentricity. If the system rotates at 3000 rpm. Determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take $E = 2\times10^5\ N/mm^2$. **10**

4. a) Explain stiffness influence coefficient and flexible influence coefficient in details. **10**

b) A shaft of negligible weight 6 cm diameter and 5 meter long is simply supported at the ends and carries four weights 50 kg each at equal distance over the length of the shaft. Find the frequency of vibration by Dunkerley's method. Take $E = 2\times10^6\ kg/cm^2$ **10**



c) Find the lowest natural frequency of vibration for the system shown in figure by Rayleigh's method, $E = 1.96\times10^{11}\ N/m^2, I = 4\times10^{-7}\ m^4$. **10**



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5. a) Determine the shock spectrum of rectangular pulse. **10**

b) Explain following in details.

i) Self excited vibration.

ii) Phase plane representation. **10**

c) Determine the normal function in transverse vibration for a simply supported beam of length "ℓ" and uniform cross-section. **10**

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