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AU/ME-7001 (CBGS)

B.E. VII Semester

Examination, November 2019

Choice Based Grading System (CBGS)

Mechanical Vibrations

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.

ii) All questions carry equal marks.

1. a) What is the vibration? Explain the Rayleigh's method. What are its application?

   b) A force $F_0 \sin \omega t$ acts on displacement $X_0 \sin(\omega t - 60°)$, where $F_0 = 100$ N $X_0 = 0.02$ m, $\omega = 2\pi$ rad/s. Find the work done during

   i) First cycle

   ii) First second

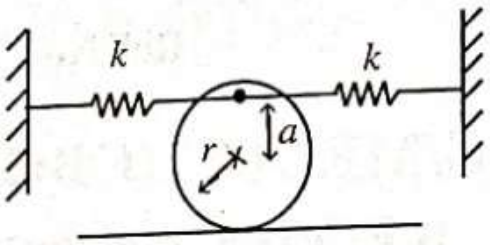
   iii) First 1/40 second

   iv) First quarter second

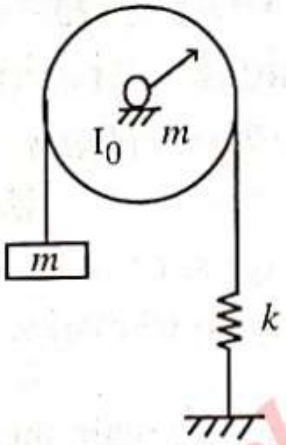
2. a) What is resonance? A body performs two motions simultaneous $x_1 = 1.9 \sin(9.5\, t)$ $x_2 = 2.1 \sin(10.0\, t)$

   Find the maximum and minimum amplitude of combined motion and time period of periodic motion in cm and second.

   b) Determine the natural frequency of system shown in figure by Newton's method. Assume M is the mass of disk and J_0 is polar moment of inertia of disk about centre. System is in static equilibrium.



3. a) Determine the natural frequency of the system shown in figure by energy and Newton's method.

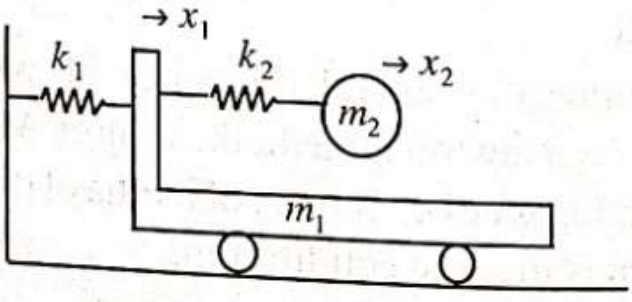


b) The mass of spring mass-dashpot system is given an initial velocity $5W_n$ where W_n is the undamped natural frequency of system. Find the question of motion for the system,

(i) $\xi = 2$ (ii) $\xi = 1$ (iii) $\xi = 0.2$

4. a) A compressor runs at 5000 rpm with forcing frequency near to its natural frequency. Design a suitable vibration absorber for the system shown the frequency should be at least 20% away from forcing frequency assume the mass of machine as 30 kg.

b) Derive the equation of motion of the vibrating system show and determine the natural frequencies if $m_1 = 196\,\text{kg}, m_2 = 49\,\text{kg}, k_1 = 98000\,\text{N/m}, k_2 = 19600\,\text{N/m}$.



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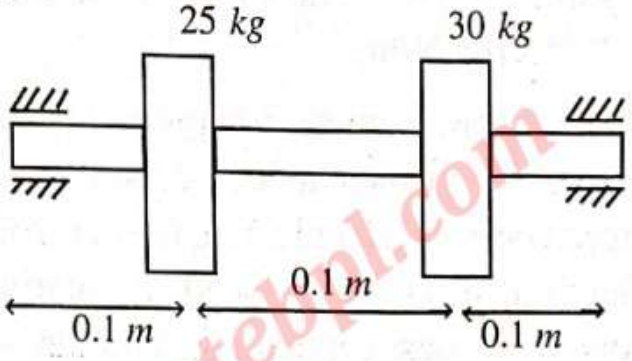
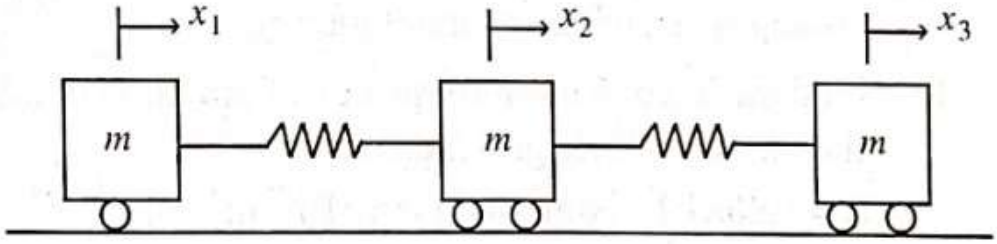
5. a) Design the dynamic vibration absorber of nearest frequency of system at least 20% from the excitation frequency of reciprocating machine weighing 25N running at 6000 rpm.

   b) Determine the influence coefficient of the following system.



$E = 2\times10^{11}$ N/m^2 $I = 4\times10^{-7}$ m^4

6. a) Determine the frequency of vibration of system shown consisting of three rail bogies connected by two springs neglecting friction between wheels and rails.
   Take $k = 40\times10^5$ N/m, m = 20×10^3 kg



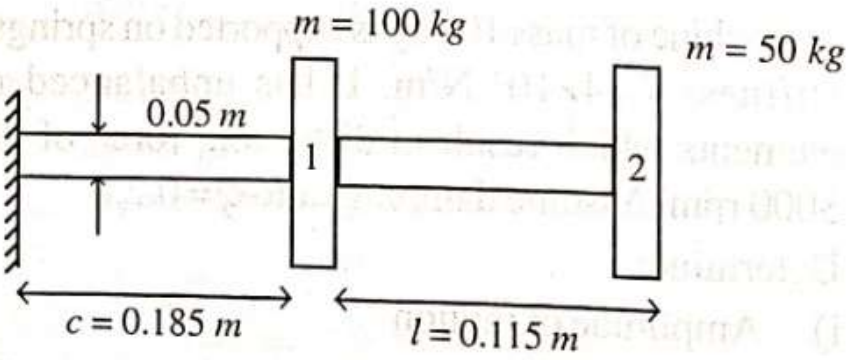
   b) A machine of mass 100 kg is supported on springs of total stiffness 7.84×10^5 N/m. It has unbalanced rotating elements which result in disturbing force of 382 N at 3000 rpm. Assume damping ratio $\xi = 0.2$.
   Determine:
   i) Amplitude of motion
   ii) Transmissibility
   iii) Force transmitted.

7. a) A 1000 kg machine is mounted on four identical springs with total stiffness k and neglecting damping the machine is subjected to a harmonic external force of amplitude F_0 = 490N and frequency of 180 cpm. Determine: Amplitude of motion of machine and maximum force transmitted to the foundation due to unbalance force when k = 1.96×10^6 N/m.

   b) A shaft 12 mm diameter rotates in spherical bearings with a span of 0.9 m and carries a disk of mass 10 kg midway between bearings. Neglecting the mass of shaft determine deflection in terms of speed of rotation in radian per second if the mass centre of disk is 0.25 mm out of centre. E = 206000 N/mm^2. If the stress in the shaft is not exceeds 100 N/mm^2. Find the range of speed within which it is safe to run the shaft.

8. a) Steam turbine have to run through dangerous resonance speed during starting and stopping. Determine equation of amplitude build up with time without damping. The critical speed w^1 has an amplitude r_0.

   b) Find the lower natural frequency of vibration of system shown using Rayleigh's methods.
   E = 1.96×10^{11} N/m^2 and I = 4×10^{-7} m^4



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