

- N.B.: (1) Question No. 1 is compulsory.
 (2) Attempt any **four** questions from remaining **six** questions.
 (3) Assume **suitable** data wherever required with justification.
 (4) **Figures** to the **right** indicate **full marks**.

1. (a) Find the natural frequency of the pulley system shown in Fig. 1 by neglecting the friction and masses of the pulley. 10

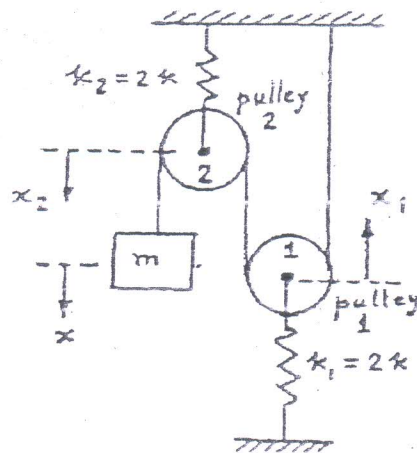


Fig. 1

- (b) Using Newton's second law of motion find the natural frequency of vibration of a spring-mass-system arranged on an inclined plane as shown in Fig. 2. 10

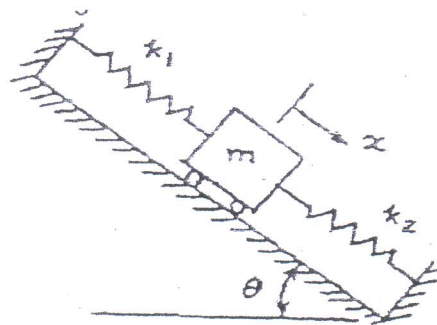


Fig. 2

2. (a) What is logarithmic decrement and what is its importance? 5
 (b) In what ways is the response of system with coulomb damping different from that of system with viscous damping. 5

- (c) Derive the equation of motion and find the natural frequency of vibration for the system shown in Fig. 3. 10

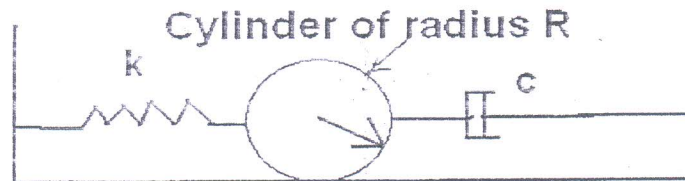


Fig. 3

3. (a) 25 N at 30cm, 30N at 60cm and 10N at 100cm from the fixed end are the loads on a cantilever beam. The deflection under 30N load due to all load is 2.5mm. What would be the natural frequency of transverse vibration if 20N is added at 80cm from the fixed end? 10

The deflection at section "i" due to unit load at section "j" is given by :

$$\alpha_{ij} = \frac{s_i^2(3s_j - s_i)}{\text{Cantilever constant "c"}} = \alpha_{ji} \text{ for } s_i > s_j$$

Where 's' is the distance from the fixed end.

- (b) Explain why mechanical vibration is an important area of study for engineers. Mechanical vibrations are known to have harmful effects as well as useful ones. Briefly describe five practical examples of good vibrations and also five practical examples of bad vibrations. 8
4. (a) A machine 90 kg mass has a 20 kg rotor with 0.5 mm eccentricity. The mounting springs have stiffness 85000N/m and damping ratio 0.02. The operating speed of machine is 600rpm and the unit is constrained to move vertically. Find 10
- (i) The dynamic amplitude of machine.
- (ii) The force transmitted to the supports.
- (b) The springs of an automobile trailer are compressed 0.1 m under its own weight. Find the critical speed when the trailer is passing over a road with a profile of sine wave whose amplitude is 100mm and the wavelength is 20mm. Find the amplitude of vibration at a speed of 60km/hr. 10
5. (a) With a neat diagram explain working principle of a vibrometer. 10
- (b) An accelerometer is constructed by suspending a mass of 0.1 kg from a spring of stiffness 10,000 N/m with negligible damping. When mounted on the foundation of an engine, the peak-to-peak travel of the mass of the accelerometer has been to be 10mm at an engine speed of 1000rpm. Determine the maximum displacement, maximum velocity and maximum acceleration. 10

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6. (a) A shaft carries four masses A, B, C and D placed in parallel planes, perpendicular to the shaft axis and in the same order along the shaft. The masses of B and C are 36kg and 25kg and both are assumed to be concentrated at a radius of 150mm, while the masses A and D are both at a radius of 200mm. The angle between the radius of B and C is 100° and that between B and A is 190° , both angles being measured in the same sense. The planes containing A and B are 250 mm apart and those containing B and C are 500 mm apart. If the shaft is to be in complete dynamic balance. Find :
- (i) The masses of A and D.
 - (ii) The distance between planes C and D
 - (iii) The angular position of mass D.
- (b) Explain static and dynamic balancing. 5
7. (a) A six cylinder four stroke vertical inline engine has a firing order 1-4-5-2-3-6. Firing takes place with equal angular interval. The mass of reciprocating parts per cylinder is 2.5 kg, stroke 100mm and connecting rod length 200mm. The cylinder center lines are spaced at 300mm apart. The crank shaft speed is 300rpm. Examine the engine for the balance of primary and secondary forces and couples. If the engine is not completely balanced, suggest a suitable firing order to make it complete balance. 15
- (b) Explain the follower Jump Phenomenon in cam. 5
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