Kafrelsheikh University
Faculty of Engineering
Mechanical Engineering Department
Year: 3rd Subject: Vibration Theory
Name:

Date: 29 May 2016
Time allowed: 3 Hours
Full Marks: 100 Marks
Final Exam: 2 pages
Academic Number

Note: Illustrate all answers with sketches whenever possible.

Question 1: (15 Marks)

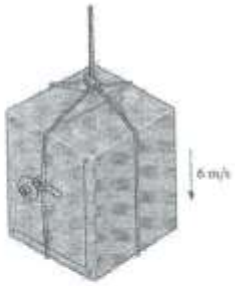
a) Explain why mechanical vibration is an important area of study for engineers?

b) 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?

c) What are the elementary parts comprised in any vibratory systems? Illustrate your answer with sketch?

Question 2: (20 Marks)

A cable is used to suspend the 800 kg safe (as shown in the figure). If the safe is being lowered at 6 m/s when the motor controlling the cable suddenly jams (stops), determine the frequency of vibration of the safe and the maximum tension in the cable. Neglect the mass of the cable and assume it is elastic such that it stretches 20 mm when subjected to a tension of 4 kN.

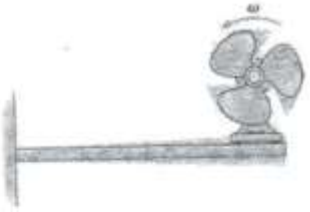


Question 3: (15 Marks)

The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can combined to give an equivalent spring of stiffness 5.4 N/mm. if the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find: critical damping coefficient, damping factor, logarithmic decrement, ratio of two constitutive amplitudes.

Question 4: (15 Marks)

The fan shown in Fig. has a mass of 25 kg and is fixed to the end of a horizontal beam that has a negligible mass. The fan blade is mounted eccentrically on the shaft such that it is equivalent to an unbalanced 3.5 kg mass located 100 mm from the axis of rotation. If the static deflection of the beam is 50 mm as a result of the weight of the fan, determine:



- The angular velocity of the fan blade at which resonance will occur
- The amplitude of steady-state vibration of the fan if the angular velocity of the fan blade is 10 rad/s
- What will be the amplitude of steady-state vibration of the fan if the angular velocity of the fan blade is 18 rad/s?

Question 5: (10 Marks)

A shaft 1.5 m long, supported in flexible bearings at the ends and carries two wheels each of 50 kg mass. One wheel is suited at the center of the shaft and the other at a distance of 375 mm from the center toward the left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GPa. Find the lowest whirling speed of the shaft.

Question 6: (15 Marks)

A centrifugal pump is driven through a pair of spur wheels from an oil engine. The pump runs at 4 times the speed of the engine. The shaft from the engine flywheel to the gear is 75 mm in diameter and 1.2 m long, while that from the pinion to the pump is 50 mm diameter and 400 mm long. The moments of inertia are as follows: flywheel 1000 kg.m^2, gear 25 kg.m^2, pinion 10 kg.m^2, and pump impeller 40 kg.m^2. Find the natural frequencies of torsional oscillations of the system. Assume modulus of rigidity of the shaft material is 84 GN/m^2.

Question 7: (15 Marks)

The rigid beam, shown in its position of static equilibrium in the figure, has a mass m and a mass moment of inertia $2ma^2$ about an axis perpendicular to the plane of the diagram, and through its centre of mass G. Assuming no horizontal motion of G, find the frequencies of small oscillations in the plane of the diagram.