MenoufiaUniversity
Faculty of Engineering-ShebinElkom
Prod. Eng. & Mech. Design Department
First Semester Examination-2013/2014
Date of Exam: 12/1/2014

Subject: Mechanical Vibrations
Code : PRE 218
Year : 2nd year Mech.Power Dept
Time Allowed : 3 hours
Total Marks : 60 marks

Answer The Following Questions

Question 1: **(12 marks)**

A mechanical shaker of mass 100 kg with two shafts rotating with constant speed Ω opposite direction . If the shaker is supported by two isolators each of which spring constant K and dashpot C as shown in Fig. 1. If each shaft is equivalent to eccentric mass m_0 : =2kg at an eccentricity e= 0.5 cma) Derive general equation of motion of the shaker and dynamic amplitude. By varying the speed Ω, it is observed that the maximum amplitude[is 1cm at Ω=50 rad/s Find the coefficients K and C for each isolator and find the maximum force transmitted to the foundation.

Question 2: **(12 marks)**

A Francis water turbine is shown in Fig.2 in which water flows from A into the blades B and down into the tail race C. The rotor has a mass of 250 kg and an unbalance me = 5 kg.mm. The radial clearance between the rotor and stator is 5mm .The turbine operates in the speed range 500 to 5000 r.p.m and the steel shaft carrying the rotor can be assumed to be cantilever support. Knowing shaft length =2m and E= $2.07 \times 10^{11} N/m^2$. Determine the diameter of the shaft and transmissibility.Assume damping to be negligible.

Question3: **(12 marks)**

A mathematical model of machine tool is shown in Fig.3 Having a mass of m=1000 kg and a mass moment of inertia of $J_{0\ =300kg}.m^2$ is supported on elastic supports as k_1= 3000 N/mm and k_2=2000N/mm. The supports are located at L1= 0.5 m and L2= 0.8 m.

a- Derive the equation of motion of the model .

b-Determine the natural frequencies and mode shapes of the machine tool.

b- Check the correctness of the results

Question 4: **(12 marks)**

A cantilever of longitudinal rigidity EA, mass density ρ and length L performs a longitudinal vibration .If the free end of the beam is fastened. To a motor of mass m as shown in Fig .(4) Derive the frequency equation of the present continuous system

(b)- If (ρ =0) the beam becomes one degree of freedom system the motor having of 500 kg and an unbalance of 5 kg.cm. The beam is observed to vibrate with large amplitudes at the operating speed of 1500 r.p.m of the motor .It is proposed to add a vibration absorber to reduce the vibration of the beam. Determine the mass and stiffness of

The absorber needed in order to have the lower frequency of the resulting system equal to 75% of the operating speed of the motor.

Question 5: **(12 marks)**

A rotating shaft with four unbalanced masses should be completely balanced by the two masses situated on the radius r_o in the two respective planes P_L and P_R as shown in Fig.5. Find the magnitudes of these masses m_L and m_R and these angular locations φ_L and φ_R.

Given: m_1= 0.5kg,m_2=1.5kg,m_3=0.75kg,m_4= 1.25kg, a=20cm, r_1=15 cm, r_2=r_3=25 cm, r_4= 15cm,r_o= 25 cm, φ_1= 60°, φ_2= 150°, φ_3= 240°, φ_4= 345°

With our best wishes

This exam measures the following ILOs															
Question Number	1-(a-c)	1-d				4-a	4-b	5-a	5-b	2, 5	3-i'	3-ii			
	a-1	a-19				b17-1	b17-2	b17-1	b17-2	b17-2	c1	c1			
Skills	Knowledge &Understanding Skills					Intellectual Skills					Professional Skills				

$K_e = \frac{3EI}{e^3}$

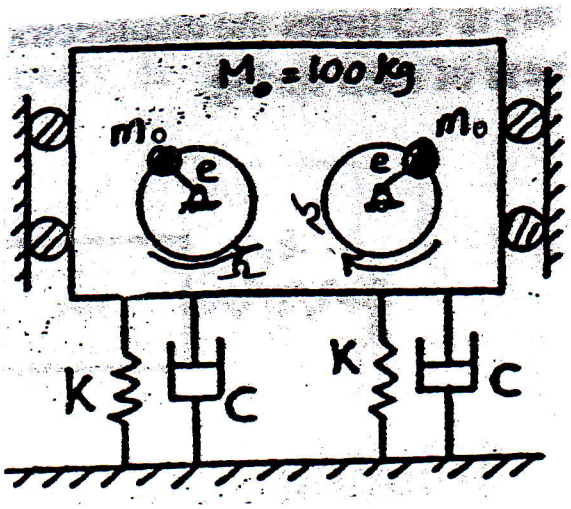

Fig. 1

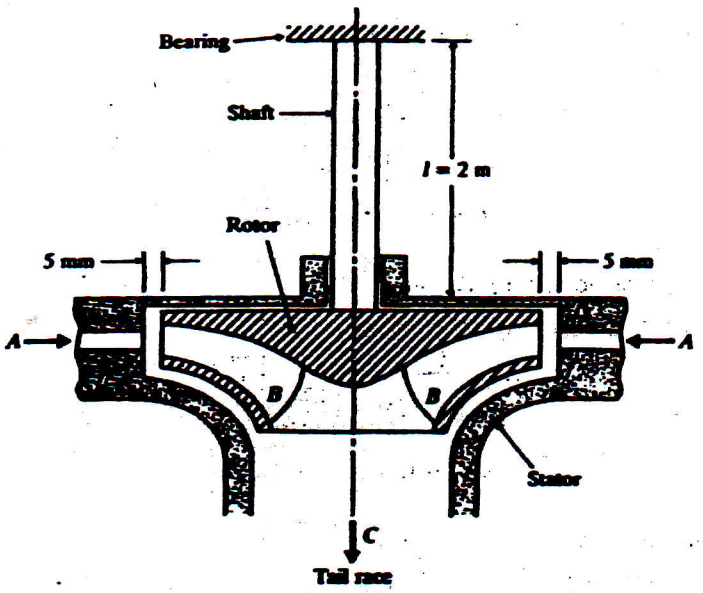

Fig. 2

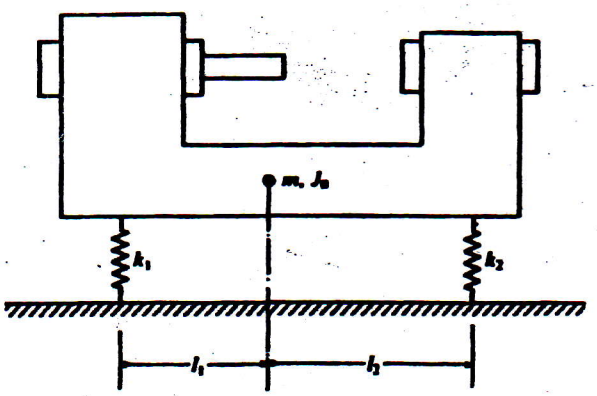

Fig. 3

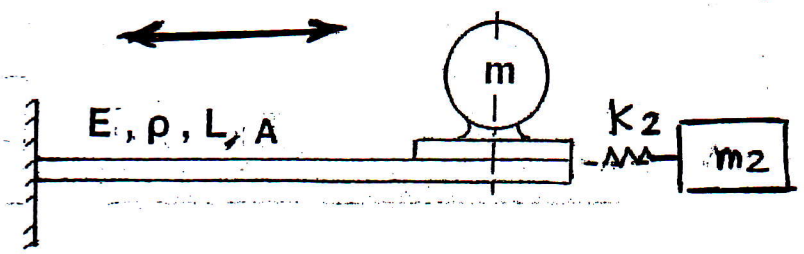

Fig. 4