Menoufia University
Faculty of Engineering-Shebin Elkom
Prod. Eng. & Mech. Design Department
First Semester Examination-2013/2014
Date of Exam: 4/1/2014

Subject: Mechanical Vibrations
Code : PRE 312
Year : 3 rd year
Time Allowed : 3 hours
Total Marks : 120 marks

Answer Only Five Questions

Question 1 : (24 marks)

For the forced damped vibrating system shown in Fig. 1, neglecting the rotating of the rigid link 2 :

a) Express the potential energy of the system at an arbitrary instant
b) Express the kinetic energy of the system at an arbitrary instant.
c) Express the dissipative energy of the system at an arbitrary instant.
d) Write the system equation of motion by using Lagrange's equation.

Question 2: (24 marks)

A spring mass system of mass 20 kg, and spring stiffness 4000 N/m, vibrates in a viscous medium of coefficient 50 N.sec/m. If the initial amplitude is 20 mm, Find :

a) The amplitude after 5 cycles,
b) The damped natural frequency,
c) The periodic time of damped oscillation.

Question 3: (24 marks)

A machine of mass M= 600 kg is supported on springs with a static deflection of 60 mm and attached with a damper of c= 3000 N.sec/m. If the machine has a rotating unbalance (me) of 0.9 kg m, determine:

i) The steady state amplitude at a speed 1200 rpm and the force transmitted to the foundation at this speed, and
ii) If the machine mounted on a large block of mass 400 kg and the static deflection of the springs is still 60 mm, what be the steady state amplitude.

Question 4: (24 marks)

A mathematical model of vibration pile driver is shown in Fig.2. The mass of gear box pile, m_1=4000 kg and mass of yoke, m_2=1000kg. The stiffness of the connecting links k_2= 3000 kN/m and helical spring k_3= 300 kN/m. The soil into the pile driven having stiffness, K_1=600 kN/m.

a- If an exciting force of gear box F= 5000 cos 100t N, derive the equation of motion, natural frequencies and mode shapes of the system.
b- Compute the impedance matrix and hence estimate the amplitudes and displacement of the pile set and yoke.

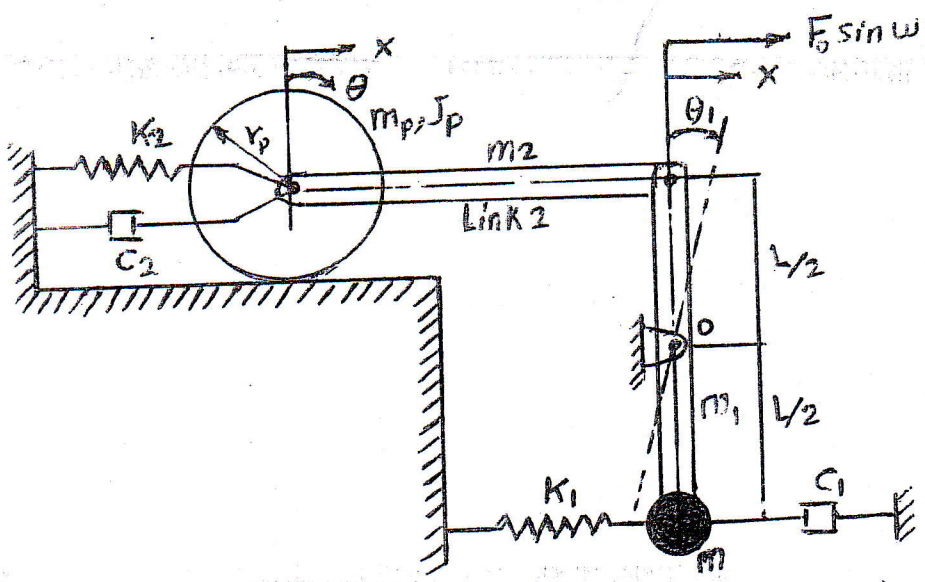

Fig. 1

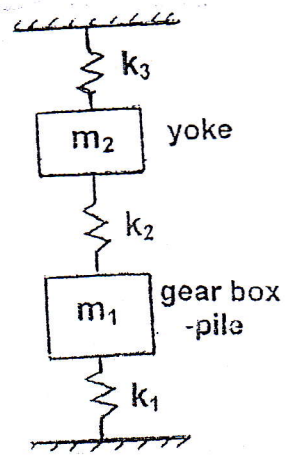

Fig. 2

Please see page no. (2)

Question 5 (24 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. (3)

(a) 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 400 kg and an unbalance of 3 kg.cm. The beam is observed to vibrate with large amplitudes at the operating speed of 1200 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 60% of the operating speed of the motor.

Question 6 (24 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. 4.

Find the magnitudes of these masses m_L and m_R and these angular locations φ_L and φ_R.

Given: m_1=10 gm, m_2=15 gm, m_3= 20 gm, m_4= 25 gm, a=10 cm, r_1=25 cm, r_2= 30 cm r_3=10 cm, r_4= 20 cm, r_o= 20 cm, φ_1= 30°, φ_2= 135°, φ_3= 210°, φ_4= 300°.

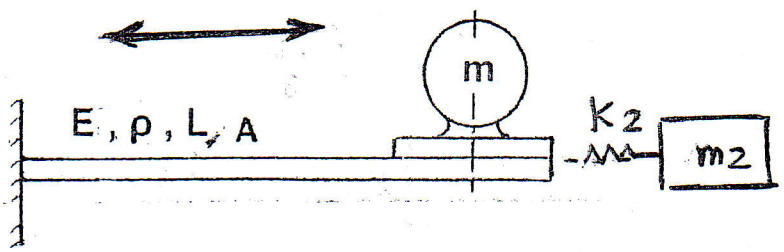

Fig. 3

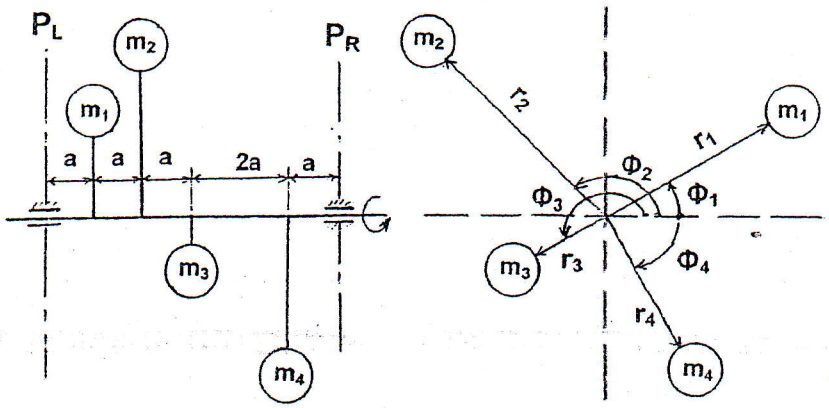

Fig. 4

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	2,6	3-i	3-ii			
Skills	a-1	a-19				b17-1	b17-2	b17-1	b17-2	b17-2	c1	c1			
	Knowledge &Understanding Skills					Intellectual Skills					Professional Skills				