Menoufiya University
Faculty of Engineering
Shebin El-Kom
Final First Semester Exam.
Academic Year: 2015-2016
Date: 28/1/2016

Year: 3rd year
Department: Prod. Engineering
Subject: Theory of Machines (2)
Code : PRE 312
Time Allowed: 3 hours
Total Marks : 120 Marks

Examiner: Prof . Dr. Sobhy Mohamed Ghoneam
. Prof .Dr. Ahmed A bd–El Hamid Hamada

Answer all the following Questions :

Question (1): [25 Marks]

A precision grinding machine Fig.(1) is supported on an isolator that has a stiffness of 1 MN/m and a viscous damping constant of 1 KN-s /m . The floor on which the machine is mounted is subjected to a harmonic disturbance due to the operation of an unbalanced engine in the vicinity of the grinding machine . Find the maximum acceptable displacement amplitude of the floor if the resulting amplitude of vibration of the grinding wheel is to be restricted to 10^{-6} m .Assume that grinding machine and the wheel are one rigid body of weight 5000 N.

Question (2): (25 Marks)

A cantilever of longitudinal rigidity EA, mass density ρ and length L performs a longitudinal vibration.

(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 a mass of 300 kg and an unbalance of 2 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.

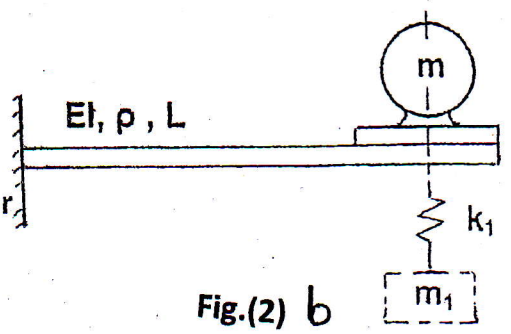
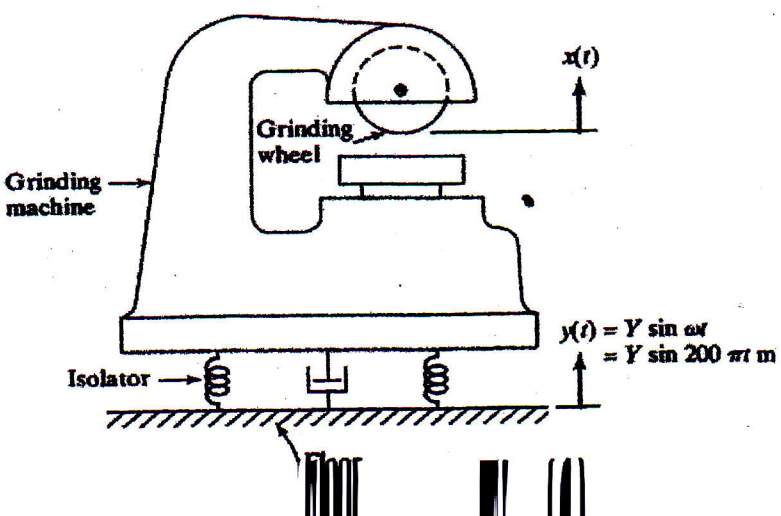


Fig.(2) b

This exam measure the following ILO s					
Question number	Q 1	Q 2	Q 3	Q 4	Q 5
skills	A 1	A 1	A 3	A 1	A 4
	Knowledge & Understand				

Q1	Q 2	Q 3	Q 4	Q 5	Q 1	Q 2	Q 3	Q 4	Q5
B 2	B 2	B 5	B 5	B 2	C 1	C 3	C 1	C 3	C 3
Intellectual					Professional				



Question (3): [25 Marks]

A mathematical model of the vibration pile driver which is utilized to derive a pile into the ground is shown in Fig.(3). The mass of the combined gear box-pile set (m_1) and the yoke (m_2) are given by 4000 kg and 1000 kg respectively. The stiffness of the connecting links (k_2) and the helical spring (k_3) are given by 3000 KN/m and 300 KN/m respectively. The soil into which the pile is driven can be regarded as having a linear stiffness k_1 = 600 KN/m.

(a)- If an exiting force generating from the gear box is given by: $F = 10^5 \sin 100t$ N, derive the equation of motion and the natural frequencies and mode shapes of the pile driver,

(b)- Compute the impedance matrix and hence estimate the amplitudes of displacements of the pile set and the yoke, and

(c)- If the soil can be regarded as having further viscous c = 400 N.s/m, calculate the amplitude of the force in the soil.

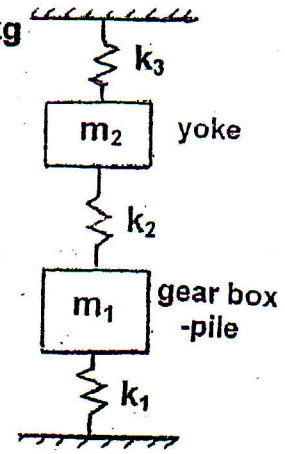


Fig.(3)

Question (4): (20 Marks)

a) **Explain the phenomenon of whirling of rotating shafts and the causes of th.. phenomenon, and how to avoid it?**

b) **The rotor of the turbine weighting 15 kg and is mounted at the mid-point of a steel shaft 25mm diameter, supported in self – aligning bearing over a span of 75 cm . (The ends are simply supported, and E_{steel}=2.1 x10 ^{6} kg/m^2). If the rotor has an unbalance equal 0.25 kg. cm. Determine:-**

- **The critical speed of the shaft,**
- **The amplitude of vibration of the rotor at a speed 3000 r.p.m.,**
- **The dynamic force transmitted to each bearing at this speed,**
- **The change in the force if the diameter is increased to 35 mm, Is this change desirable for the life of the bearing?**

Question (5): [25 Marks]

A rotating shaft with four unbalanced masses should be completely balanced by the two masses situated on the radius r_0 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 their 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_0 = 20 cm, $\Phi_1 = 30^0$, $\Phi_2 = 135^0$, $\Phi_3 = 210^0$ and $\Phi_4 = -60^0$.

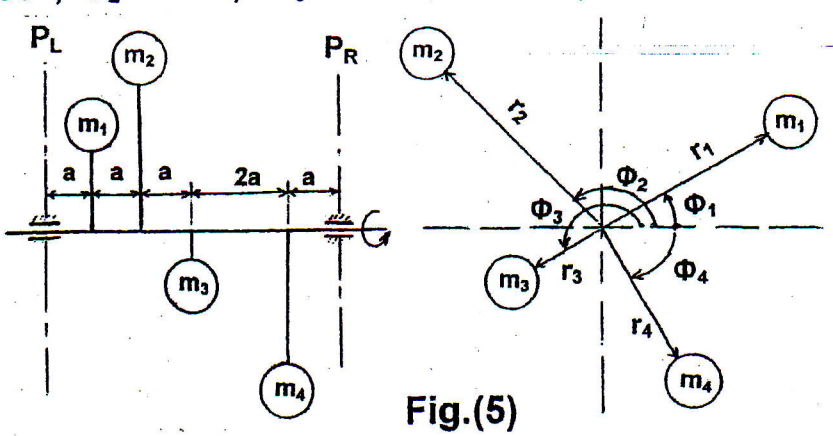


Fig.(5)