Menofia University
Faculty of Engineering Shebien El-kom
Basic Engineering Science Dept.
First semester Examination, 2016-2017
Date of Exam: 02 / 06 / 2018

Subject: Mechanical Vibrations.
Code: BES 621
Year: Master (Grade 600)
Time Allowed: 3 hrs.
Total Marks: 100 Marks

Answer the following questions

Question 1 (30 marks)

(A) Define:

i) Vibration

ii) Degree of freedom

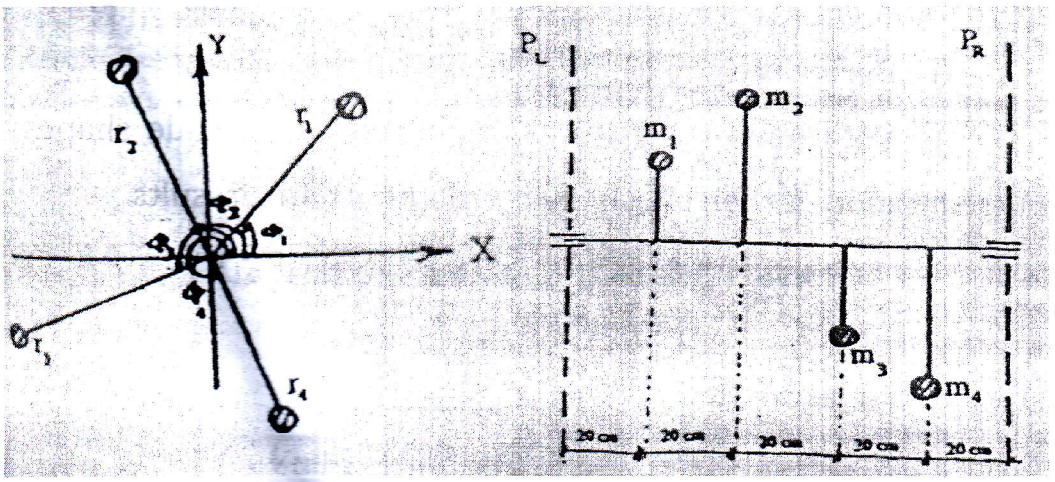
iii) Magnification factor

iv) Critical damping

v) Phase angle

(B) A shaft with four unbalanced masses should be completely balanced by two masses situated on the radius r_0 in two respective planes δ_L and δ_R as shown, find these masses m_L and m_R as well as their angular locations $\emptyset_L$ and $\emptyset_R$.

Given: $m_1 = m_2 = 15$ gm , $m_3 = m_4 = 10$ gm , $r_1 = 30$ cm , $r_2 = 35$ cm , $r_3 = 50$ cm , $r_4 = 40$ cm , $\emptyset_1 = 45^o$, $\emptyset_2 = 120^o$, $\emptyset_3 = 210^o$, $\emptyset_4 = 300^o$, $r_0 = 40$ cm.



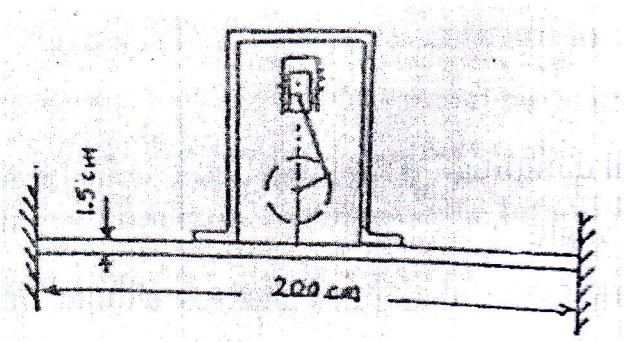
Question 2 (40 marks)

(A) A reciprocating engine, weighting 75 kg, is mounted at middle of a steel plate of thickness 1.5 cm, width 40 cm and length 200 cm, clamped along two edges as shown in figure. If $E = 2.114 \times 10^6\ kg/cm^2$ during the operation of the engine, the plate is subjected to a harmonic unbalanced vertical force:

$$F(t) = 1000 \sin 80\, t \ N$$

i) Determine the steady-state amplitude and if the damping is introduced with damping factor 0.3 to the system, determine the steady state amplitude,

ii) In the absence of the damping, design the proper undamped dynamic absorber to be fitted to the system in order to obtain zero amplitude (r_1) of machine, and also the corresponding amplitude (r_2) in this case, taken into the account the mass ratio is 1/3.

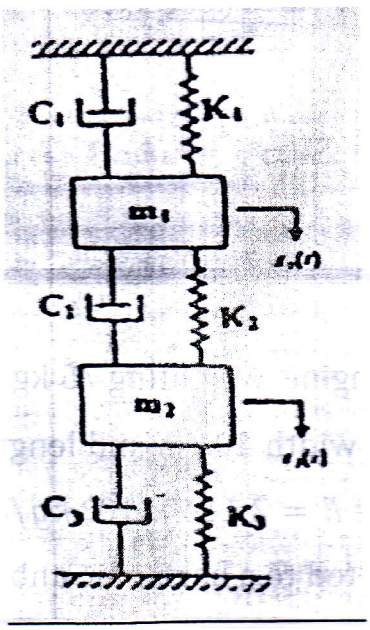


(B) The shown system in figure performs small vibration about its stable equilibrium position.

Given $K_1 = K_2 = 0.5\, K_3 = 10.000\ N/m$, and $C_1 = C_2 = C_3 = 2000\ N - s/m$, $2\, m_1 = m_2 = 2\ kg$, Determine:

i) Derive the equations of motion of the system,

ii) Determine the natural frequencies and mode shapes, and sketch these modes, then check the correctness of the results.



Question 3 (30 marks)

(A) Write short notes about:

i) Sources of vibration in machines

ii) Methods to control vibration of machines

iii) Critical speed and its effect on bearings

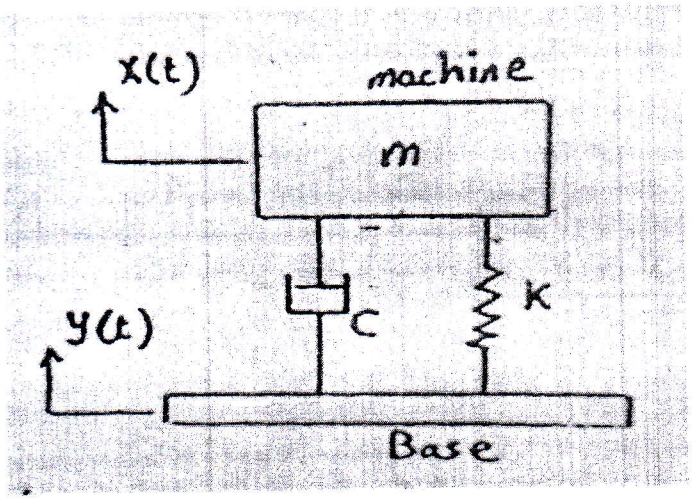
iv) Sources of unbalance

v) Purpose of balancing

(B) A 40 kg machine is attached to a base through a spring of stiffness 2×10^4 N/m in parallel with a dashpot of damping coefficient 150 N.s/m the base is given a time dependent displacement 0.15sin30t m.:

i) Derive the differential equation governing the absolute vertical displacement of the machine and find the amplitude of the machine.

ii) Recast the differential equation to govern the relative motion between the machine and its base and find the amplitude displacement of the machine relative to the base.



This exam measures the following ILOs											
Question Number	Q1-1	Q1-2	Q1-3	Q1-4	Q3-1,2,3	Q4-1,2,3			Q2-a	Q2-b	
Skills	Q1-5										
	Knowledge &understanding skills				Intellectual Skills				Professional Skills		

Good Luck

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