

بسم الله الرحمن الرحيم

King Abdulaziz University
Engineering College
Department of Production and Mechanical System Design



MENG 470 Mechanical Vibrations

First Exam
Closed-book Exam
Monday: 8/2/1425 H
Time Allowed: 60 mins

Name:	Sec. No.:	ID No.:
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Question 1		5
Question 2		5
Question 3		5
TOTAL		15

Instructions

1. There are totally 3 problems in this exam.
2. This is a closed book and closed notes Opportunity to Shine
3. Show all work for partial credit.
4. Assemble your work for each problem in logical order.
5. Justify your conclusion. I cannot read minds.

1. The single degree-of-freedom harmonic oscillator shown below in Figure 1 has a logarithmic decrement and static deflection equal to 1.435 and $0.765m$, respectively. The spring stiffness is $k = 525 N/m$.
 - (a) Show the characteristic roots of the system in the complex plane.
 - (b) Indicate the free response type (i.e., undamped, underdamped, critically damped, or overdamped).
 - (c) If the oscillator is subjected to a (vertical) harmonic force with magnitude f_o and frequency $0.477 Hz$, determine the range of f_o such that the steady-state amplitude of vibration is less than $0.798 cm$.

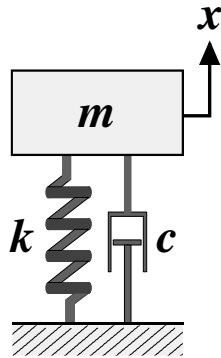


Figure 1

2. Consider the system shown below, which consists of a uniform rigid bar OA that is welded to a uniform disk. The composite system is pinned to ground at point O . Using the parameters indicated in the Figure 2, determine a) the equation of motion for the system in terms of the angular coordinate $\theta(t)$ and b) the critical damping constant.

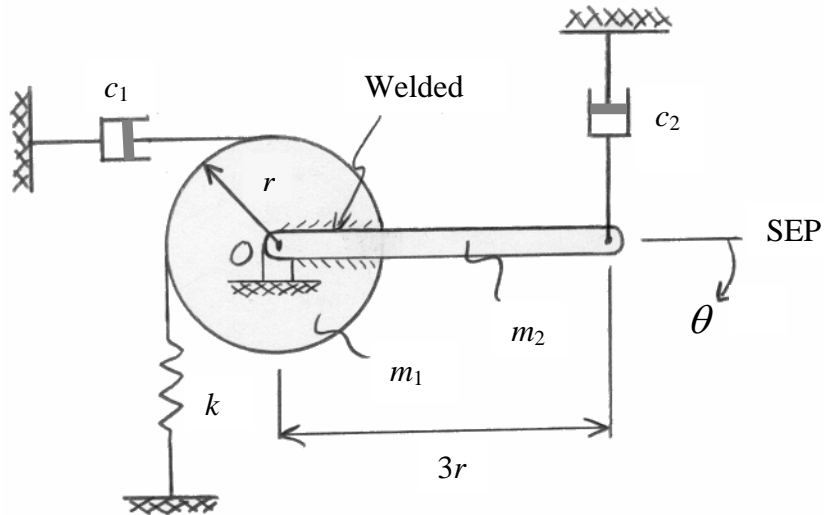


Figure 2

3. Also late for a dinner party, Ahmed is driving his MAZDA on *old Makkah road*. Since Ahmed is a poor composer, he cannot afford to replace the bad shocks on his vehicle. They have lost most of their damping properties and behave essentially like springs.

Amanat Jeddah has halted old Makkah road maintenance for some reason. As a result, the road becomes very bumpy now. If the road surface can be approximately described by $y(t) = y_0 \sin(\omega t)$,

- (a) What is the most unfavorable speed for which Ahmed can travel?
- (b) If Ahmed replaces the shocks on his MAZDA, is the most unfavorable speed less than, equal to, or greater than the most unfavorable speed found in part (a). Why?

مع دعواتي لكم بالتوفيق

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