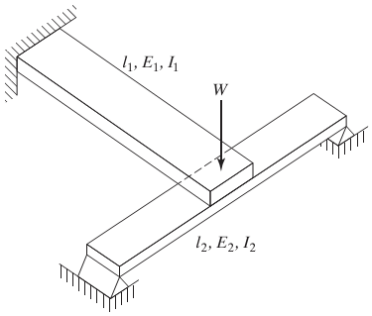
Benha University
Faculty of Engineering at Shoubra
Mechanical Engineering Department
Third Year (Production)

Midterm Exam
Date: Tuesday 8/6/2015
Subject: System Dynamics and Mechanical Vibration
Duration: 3 hours

- **Answer all the following questions.**
- **Please Note that this is the exam consists of 2 papers**
- **No. of questions : 2**
- **Total Mark: 35 Marks**

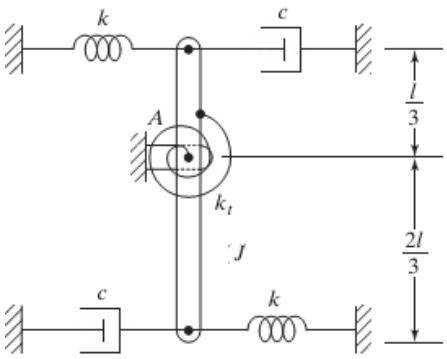
Part 2

Question (1) (20 marks)



a) Drive the expression for the natural frequency of the system shown. Note that the load W is applied at the tip of beam 1 and at midpoint of beam 2. (5 marks)

b) A uniform slender rod of mass m and length l is hinged at point A. This rod is attached to two springs, two dampers and one torsional spring as shown in the figure. The rod has a mass moment of inertia J at the center point of the rod length.
Find with respect to the inclination angle θ:



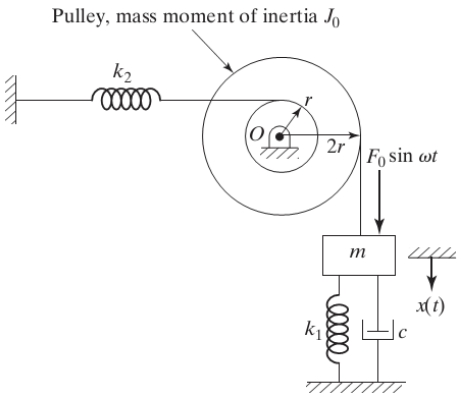
a. The equation of motion. (2 marks)
b. The equivalent spring. (2 marks)
c. The equivalent damper. (2 marks)
d. The equivalent mass moment of inertia. (2 marks)
e. The natural Frequency. (2 marks)
f. Damping ratio. (2 marks)
g. If k=2000 n/m, k_t=1000 N-m/rad, C= 150 N.S/m, m=10 kg, J=120 kg.m2 and l=5m, find the Natural frequency and the Damping ratio. (3 marks)

Question (2)(15 marks)

a) Drive the relationship between the relative motion Z for the accelerometer sensor with respect to the motion of the platform Y. (7 marks)

b) For the given system shown in the figure, *K_1 = 5000 N/m, K_2 = 500 N/m, l=1 m, C= 500 N.s/m, F_o=50 N, m=10 kg, r=5 cm, J_o=1 kg.m^2 and ω= 1000 rpm.* (8 marks)

1. ***Drive the equation of motion***
2. ***find the steady-state solution***
3. ***If this system starts from rest, find the velocity equation***
4. ***Determine the displacements and the velocity for the system after 5 seconds of vibration.***



Best Wishes