Name _____ Section _____

EM406
Examination I
September 19, 2000

Problem	Score
1	/20
2	/20
3	/30
4	/30
Total	/100

This is an closed book/closed note exam with the following conditions.

1. You are allowed a maximum of 2 hours to take the exam
2. The exam must by completed at one sitting
3. You may only use your crib sheet or the inside cover of the book.
4. You are not to discuss the exam with ANYONE!

Show all work for credit
AND
Turn in your signed help sheet

Honor Statement: I pledge my honor that I neither gave nor received help on this exam, and I only worked on the test during the time allotted.

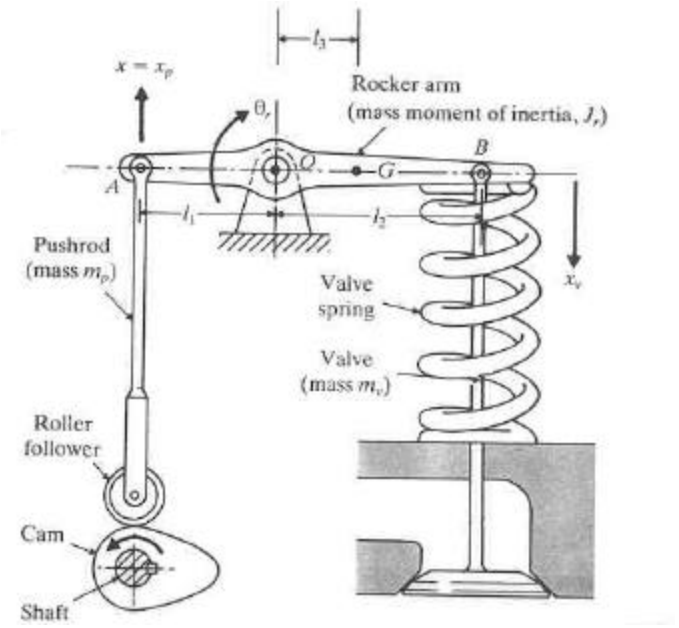
Signed _____

Start time _____ End _____

Name _____ 20 pts

EM406 Examination I **Problem 1** September 19, 2000

A cam-follower mechanism is used to convert the rotary motion of a shaft into the oscillating or reciprocating motion of a valve. The follower system consists of a pushrod of mass m_p, a rocker arm of mass m_r, and mass moment of inertia J_r about its C.G., a valve of mass m_v, and a valve spring of mass m_s. Find the equivalent mass of this cam-follower by assuming the location of m_{eq} is point A.



Name _____ 20 pts

EM406 Examination I **Problem 2** September 19, 2000

Given a physical system how could you determine the kind of damping that is present? How could you determine the magnitude of the damping? **Please be very specific.**

Name _____ 30 pts

EM406 Examination I **Problem 3** September 19, 2000

When a large turbine generator having a mass of 2500 kg is installed on its suspension system it is observed to deflect the suspension system by 5 mm. When the system is brought to its operating speed of 3600 rpm (376.99 rad/s) the housing is observed to have a peak-to-peak oscillation amplitude of 8 mm. In an effort to determine the magnitude of the unbalance (the unbalance is defined to be the unbalanced mass, *m*, times the eccentricity, *e*, that is *me*), the system is later run at resonance, and the resulting peak to peak oscillation amplitude is 10 mm. Assume that the suspension system is composed of linear springs and viscous dampers. Determine

a) the magnitude of the unbalance, *me*, in kg-m
b) the damping ratio for this system

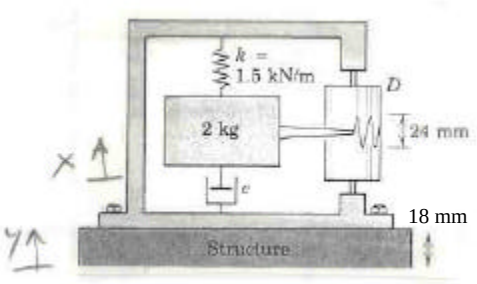
Note: If you use Maple, staple a printout to the exam.

Name _____ 30 pts

EM406 Examination I **Problem 4** September 19, 2000

The seismic instrument shown is mounted on a structure which has a vertical vibration with a frequency of 5 Hz and a peak to peak amplitude of 18 mm. The sensing element has a mass of m = 2 kg, and the spring stiffness is k = 1.5 kN/m. The motion of the mass relative to the base is recorded on a revolving drum and is found to have a peak-to-peak amplitude of 24 mm during the steady state condition.

a) Find the equation of motion for the mass in terms of the output x and the input y. Put the EOM in standard form.
b) Find the equation of motion for the relative motion of the mass (that is, the motion of the mass with respect to the structure.)
c) Find the viscous damping constant c.



Hint: Define the displacement of the mass to be x(t), the displacement of the base to by y(t), and the relative displacement to be z(t) = x(t)-y(t).