Name _____

EM406
Examination II
October 11, 2005

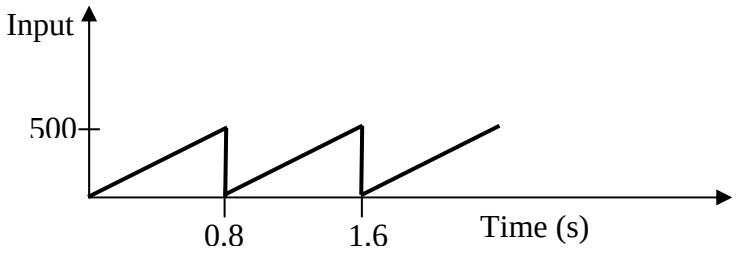
Problem	Score
1	/10
2	/20
3	/30
4	/40
Total	/100

Show all work for credit
AND
Turn in your signed help sheet
AND
Stay in your seat until the end of class

Name _____ 10 pts

EM406 Examination II **Problem 1** October 11, 2005

A system with a transfer function $\frac{3s+10}{s^2+s+10000}$ is forced with the function shown below.



Determine

a) the fundamental frequency of the input?

b) the Fourier series for the input force. Fill in the blanks below.

$f(t) =$ _____ + _____ $\cos(\omega_0 t)$ + _____ $\sin(\omega_0 t)$

c) the steady state response of the system. Fill in the blanks below

$x_{ss}(t) =$ _____ + _____ $\cos(\omega_0 t + \phi_1)$ + _____ $\sin(\omega_0 t + \phi_2)$

d) About how many terms do you need in your steady state solution to have a good approximation?

Name _____ 20 pts

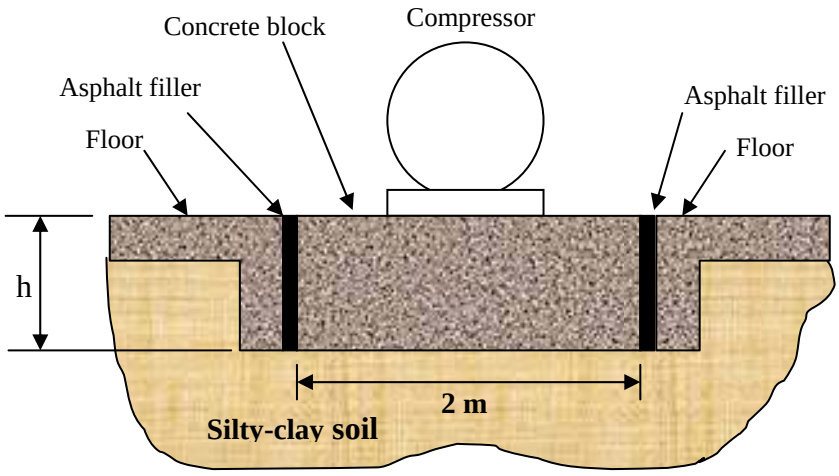
EM406 Examination II **Problem 2** October 11, 2005

You have a vibration measurement application that requires a frequency range of 1 to 20 kHz. The only accelerometer you have available has a specified frequency range of 0.5 to 10 kHz, a natural frequency of 35 kHz and a damping ratio of 0.65. Estimate the maximum error you could expect in your measurement.

Name _____ 30 pts

EM406 Examination II **Problem 2** October 11, 2005

The compressor shown has a mass of 300 kg and operates at 1800 rpm (188.5 rad/s). At this operating condition undesirable vibration occurs when the compressor is attached directly to the ground. To reduce the vibration of the concrete floor that is resting on silty-clay soil, it is proposed to isolate the compressor by mounting it on a square concrete block separated from the rest of the floor as shown. The density of concrete is 2400 kg/m^3 and the spring constant for the soil is found to be 81x10^6 N/m. The geometry of the compressor leads to choosing a block that is 2 m by 2 m. Determine the depth, h, that will reduce the force transmitted by 75%.



Name _____ 40 pts

EM406 Examination II **Problem 3** October 11, 2005

Two identical slender bars are connected by a torsional spring as shown. The mass moment of inertia of the rod about the shaft is I_0. Determine:

a) the natural frequencies
b) the natural modes
c) What is the physical interpretation of a natural mode of a structure.

Note: Express your answers for a) and b) in terms of a, m, k, I_0 and the gravitational constant, g.