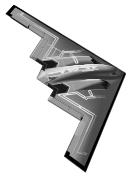
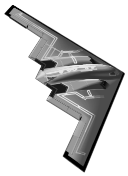
O K L A H O M A  S T A T E  U N I V E R S I T Y

S C H O O L  O F  E L E C T R I C A L  A N D  C O M P U T E R  E N G I N E E R I N G



# ECEN 3723 Systems I
# Spring 2003



## Final Exam

**Choose any four out of five problems.**
***Please specify which four listed below to be graded:***
**1)_____; 2)_____; 3)_____; 4)_____;**

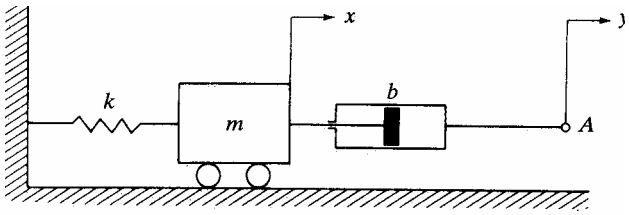
**Name : _____**

**Student ID: _____**

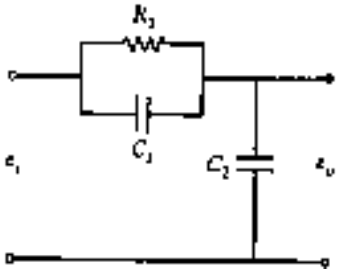
**E-Mail Address:_____**

**Problem 1**: (*Time Response*)

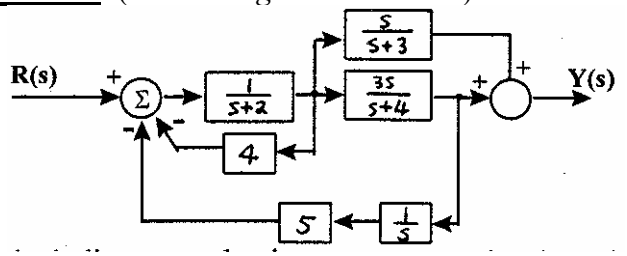
The mechanical system shown below is at rest initially. At $t = 0$, a unit-step displacement input is applied to point $A$ (i.e., $y(t) = u(t)$). Assuming that the system remains linear throughout the response period and is *overdamped*, determine the response $x(t)$ as well as the values of $x(0+)$, $\dot{x}(0+)$ and steady state $x(\infty)$.



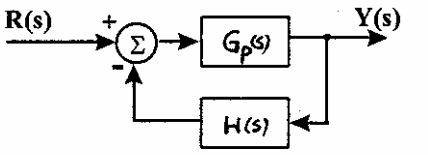
**Problem 2**: (*Frequency Response*)
Consider the stable electrical circuits shown beloew. Assume that the input is sinusoidal, $e_i(t) = E_i \sin\omega_1 t \cos\omega_2 t$, determine the steady state output voltage $e_o(t)$.



**Problem 3**: (*Block Diagram Reduction*)




Use block diagram reduction to rearrange the above block diagram into the form shown below and find its transfer function, $\frac{Y(s)}{R(s)}$.



**Problem 4**: (*Routh Stability Criteria*)
Find the region of $K$ in $G_p(s)$ for which the unity feedback (i.e., $H(s)=1$) control system is stable

$$G_p(s)=\frac{K(s^2+15s+55)}{s(s^2+s+10)}.$$

**Problem 5:** (*Analogous System*)
Using the force-current analogy, derive an analogous electrical circuit from the mechanical system shown below, where $p(t)$ is the force input to the system.