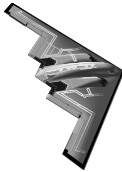
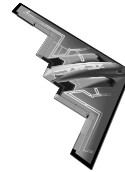


O K L A H O M A S T A T E U N I V E R S I T Y

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING



ECEN/MAE 3723 Systems I
Fall 2006
Midterm Exam #2
November 21, 2006



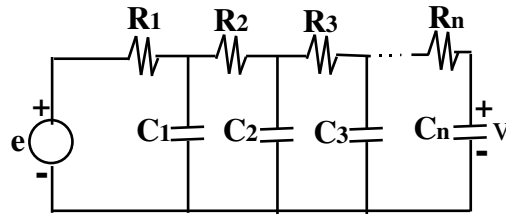
Choose any four out of five problems.
Please specify which four listed below to be graded:
1)____; 2)____; 3)____; 4)____;

Name : _____

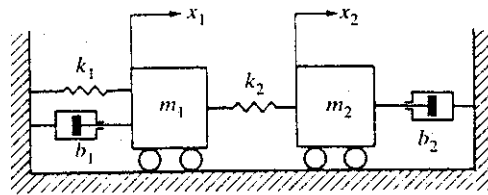
Student ID: _____

E-Mail Address:_____

Problem 1: Derive the transfer function $V(s)/E(s)$ for the given RC ladder circuit given below where e is the input source and V is the output response (note $R_1 \neq R_2 \neq \dots \neq R_n$ and $C_1 \neq C_2 \neq \dots \neq C_n$).



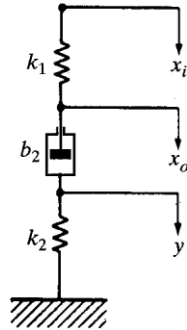
Problem 2: Obtain an *analogous* electrical circuits (using force-current analogy) for the mechanical system shown below.



Problem 3: Derive the transfer function $\frac{X_o(s)}{X_i(s)}$ of the mechanical system shown below. Then

obtain the response $x_o(t)$ when the input $x_i(t)$ is a pulse signal given by

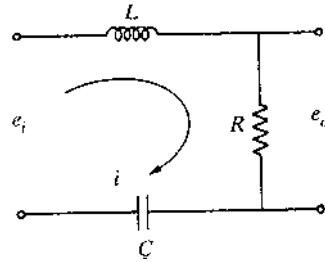
$$x_i(t) = \begin{cases} X_i, & 0 < t < t_1 \\ 0, & \text{elsewhere} \end{cases}. \text{ Assume that } x_o(0^-) = 0.$$



Problem 4: Consider the electrical circuits shown below. Assume that the input is sinusoidal,

$$e_i(t) = E_i \cos \omega t,$$

what is the steady state current $i(t)$? Please derive the formula for steady state response when the system is subject to an input of $E_i \cos \omega t$.



Problem 5: Consider the mechanical vibratory system shown below. Assume that displacement x is measured from the equilibrium position in the absence of the sinusoidal excitation force. The initial conditions are $x(0) = 0$ and $\dot{x}(0) = 0$, and the input force

$p(t) = P \sin \omega t$ is given at $t = 0$. The numerical values are given as $m = 2$ kg, $b = 24$ N-s/m, $k = 200$ N/m, $P = 5$ N and $\omega = 6$ rad/s. Obtain the complete solution $x(t)$.

