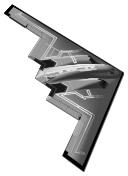
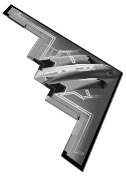
O K L A H O M A S T A T E U N I V E R S I T Y

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING



ECEN 3723 Systems I
Fall 2010
Final Exam
December 14, 2010

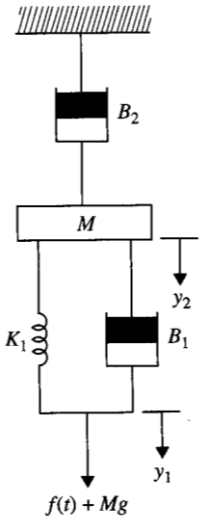


Choose any four out of five problems.
Please specify which four listed below to be graded:
1)_____; 2)_____; 3)_____; 4)_____;

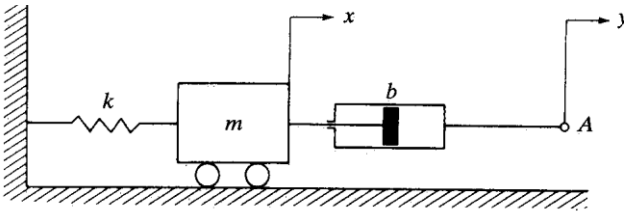
Name : _____

E-Mail Address:_____

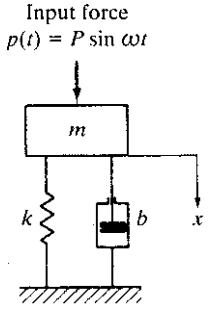
Problem 1: Derive the equations of motion for the mechanical systems shown below.



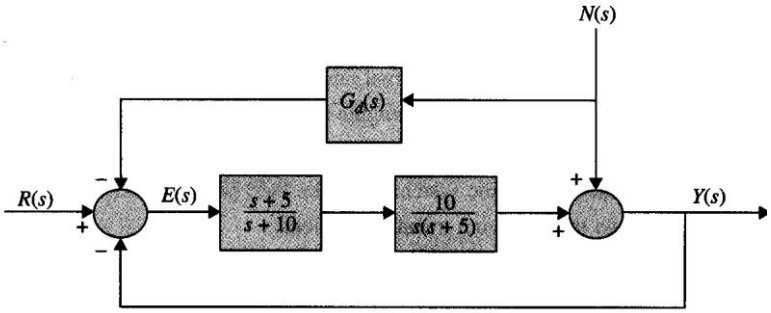
Problem 2: The mechanical system shown below is at rest initially. At $t = 0$, a unit-step displacement input is applied to point *A* (i.e., $y(t) = u(t)$). Assuming that the system remains linear throughout the response period and is *critically damped*, determine the response $x(t)$ as well as the values of $x(0+)$ and $\dot{x}(0+)$.



Problem 3: 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 $x(t)$.



Problem 4: Figure below shows the block diagram of the antenna control system of the solar-collector field. The signal $N(s)$ denotes the wind dust disturbance acted upon the antenna. The feedforward transfer function $G_d(s)$ is used to eliminate the effect of $N(s)$ on the output $Y(s)$. Find the transfer function $Y(s)/N(s)\big|_{R=0}$. Determine the expression of $G_d(s)$ so that the effect of $N(s)$ is entirely eliminated (i.e., equivalently find $G_d(s)$ so that $Y(s)/N(s)\big|_{R=0} = 0$).



Problem 5: Apply the gain formula to the SFG shown below to find the transfer functions of $\frac{Y_7}{Y_1}$ and $\frac{Y_7}{Y_4}$.