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 4413/MAE 4053
Automatic Control Systems
Spring 2006
Final Exam

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

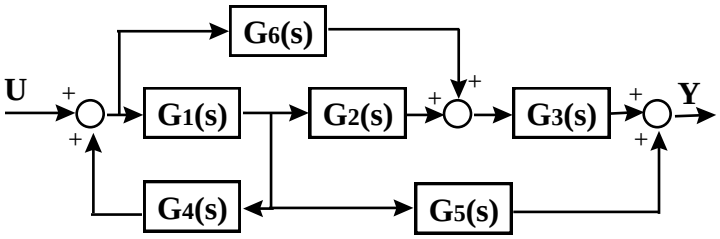
Name : _____

Student ID: _____

E-Mail Address:_____

Problem 1:

Using the block diagram reduction technique, find the plant transfer function $G_p(s)$ in the G-configuration.



Problem 2:

The following differential equation represents linear time-invariant system, where $u(t)$ denotes the input and $y(t)$ the output,

$$\frac{d^2y(t)}{dt^2} + \frac{dy(t)}{dt} + 5y(t) = \dot{u}(t) + 2u(t)$$

Find the transfer function $Y(s)/U(s)$ of the system. In addition, express the system in the state space form of $\dot{x} = Ax + Bu,\ y = Cx + Du$. Clearly indicate how the state variables are chosen.

Problem 3:

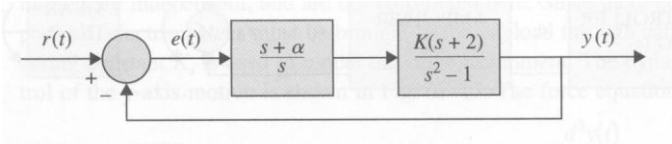
Given a nonlinear system described by

$$\ddot{y} - \dot{y} - e^{a+1} y = \ddot{u} + \dot{u} + 2u ,$$

linearize the system about the equilibrium point and show the linearized state space representation in $\dot{x} = Ax + Bu,\ y = Cx + Du$.

Problem 4:

The block diagram of a control system is shown below. Find the region in the K vs. α plane for the system to be stable. (Use K as the vertical and α as the horizontal axis.)



Problem 5:

Considering the state feedback control system shown below, determine the feedback coefficients (k_1 and k_2) so that the poles of the closed-loop control system are located at -5 and -7.