KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
ELECTRICAL ENGINEERING DEPARTMENT

EE380-03 CONTROL ENGINEERING 031

October 15, 2001 Time: 12:30-2:00 PM

[**MAJOR EXAM # 1**]

Instructor: Dr. Mahmoud Kassas

Name:	
ID #:	
Section	

PROBLEM #	SCORE	MAXIMUM
1		35
2		25
3		25
4		15
TOTAL		**100**

Problem 1:

A single-input, single-output system has the matrix equations:

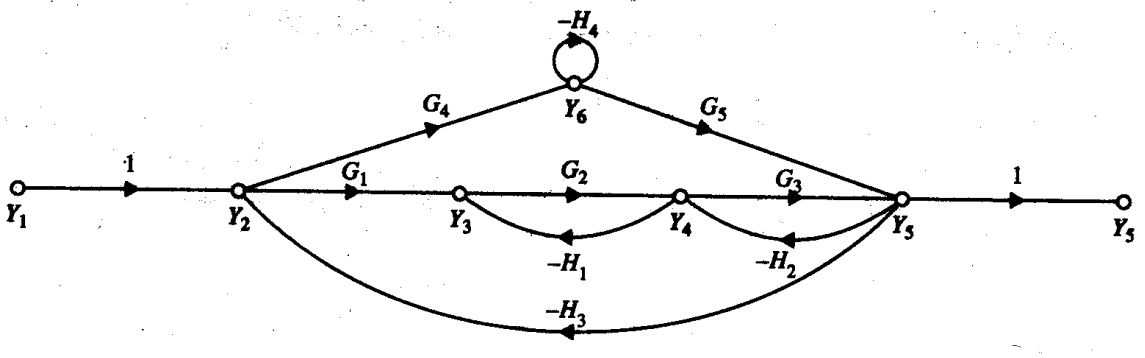
$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \quad y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} x(t)$$

(a) Derive the system transfer function G(s)=Y(s)/U(s).
(b) Draw the state diagram for arbitrary initial conditions.
(c) Find the state transition matrix Φ(t).
(d) Find y(t) for $x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and u(t) = 1 (unit step input).

Problem 2:

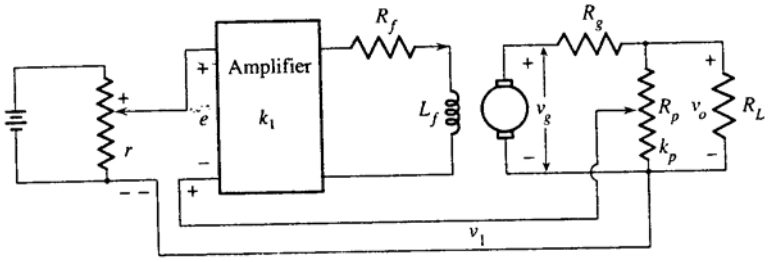
Consider the signal flow graph shown in Figure 1.

(a) Identify all the forward paths and their loop gains.
(b) Identify all the loops.
(c) Find the transfer function from Y_1 to Y_5 using Mason's rule.



Problem 3:

An electromechanical closed-loop system is shown below. The output voltage $v_1=k_p v_o(t)$ is subtracted from r(t) to generate an error voltage below. Draw the block diagram and derive the transfer function $T(s)=V_o(s)/R(s)$.



Problem 4:

A system is described by its transfer function:

$$\frac{Y(s)}{R(s)} = T(s) = \frac{5(s+6)}{s^3 + 10s^2 + 31s + 30}$$

1. Determine the input feedforward representation.