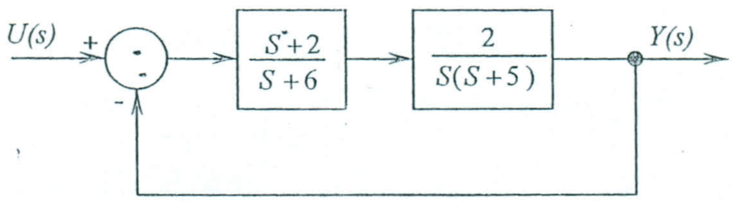
Mansoura University
Faculty of Engineering
Computers & Systems Dept.

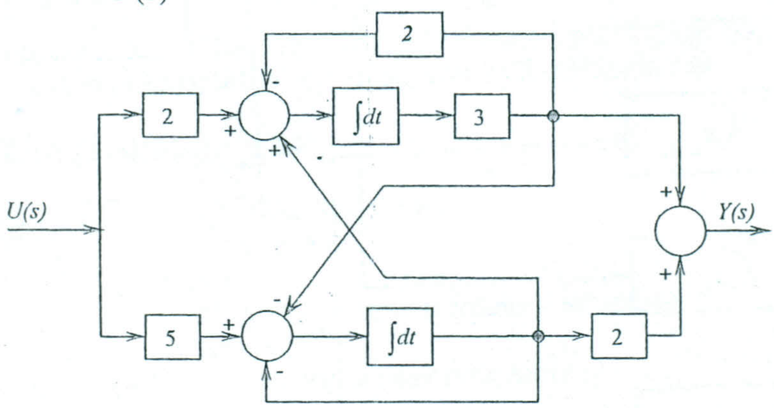
Final Exam 2012
Automatic Control
Time allowed: 3 H

1- For the following control system,



Obtain the state space representation of the system and then sketch its corresponding block diagram.
(15 Marks)

2- Obtain the transfer function $\frac{Y(s)}{U(s)}$ for the following system.



(15 Marks)

3- Consider a control system described by,

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ -3 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Determine the states $x_1(t)$ and $x_2(t)$ and the output $y(t)$, when the control signal $u(t)$ is a unit step input, and the initial condition $x(0) = [0 \quad 1]^T$. (20 Marks)

4- Define controllability, and then discuss the controllability and observability of the following system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \\ \dot{x}_5 \end{bmatrix} = \begin{bmatrix} 2 & 0 & 0 & 0 & 0 \\ 0 & -3 & 1 & 0 & 0 \\ 0 & 0 & -3 & 1 & 0 \\ 0 & 0 & 0 & -3 & 0 \\ 0 & 0 & 0 & 0 & 5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 2 & 1 \\ 0 & 0 \\ 3 & 2 \\ 5 & 9 \end{bmatrix} \begin{bmatrix} u_2 \\ u_2 \end{bmatrix}, \quad y = \begin{bmatrix} 0 & 1 & 3 & 2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix}$$

(15 Marks)

Q5) A control system as shown in (Fig. 1) ,obtain a transfer matrix of a series Compensator such that the closed loop

$$G(s) = \begin{pmatrix} \dfrac{1}{S+1} & 0 \\ 1 & \dfrac{1}{5s+1} \end{pmatrix}$$

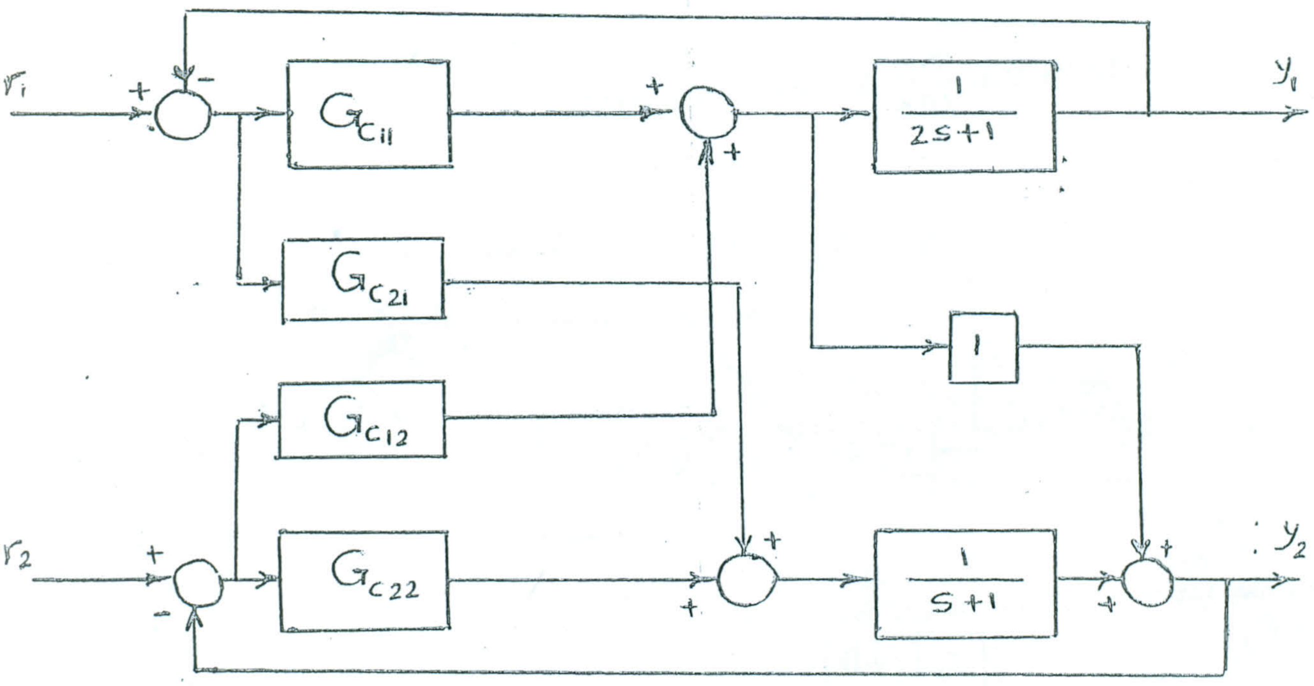


Fig. 1

(25 Marks)

All the best

M. N. SERAG