COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electrical & Control Engineering
Lecturer : Dr. Mostafa Abdel-Geliel
Course : Control Systems II
Course Code : EE412 **Marks: 40**
Date : 10/1/2015 **Time : 2 hours**

Final Exam

Answer the following questions:-

Q1- (16 marks) [A5, A15, B1]

(a) Deduce the state space representation of the system shown in Fig. 1.
(b) Check system controllability and observability
(c) Find the system transfer function
(d) Deduce the state space representation of the system using controllable canonical form.
(e) Explain how to obtain transformation matrix between the representation in (a) and (d)

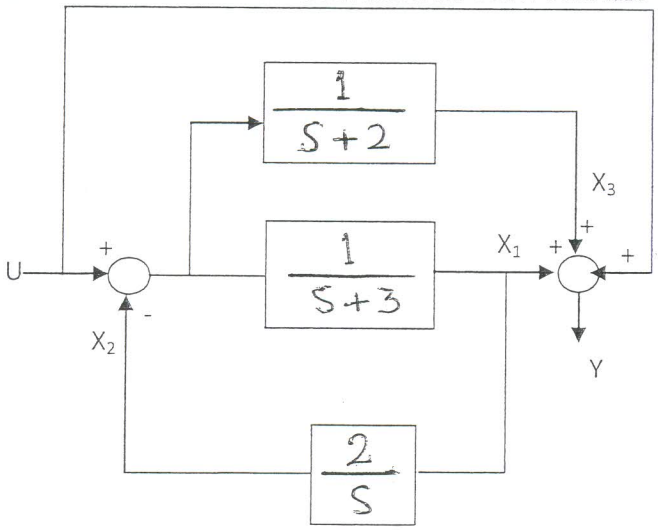

Fig. 1

Q2- (14 marks) [A4, A5, B2,C1]

Consider a system has a state space model

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

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

Members of course Examination Committee:	Signature:	Date:
Lecturer: Dr. Mostafa Abdel-Geliel		29 /12/2014
Course Coordinator : Dr. Ahmed Elshenawy		5/1/2015
Head of Department: Prof. Hamdy Ashour	Hamdy	5/1/2015

It is required to:

a) Find **x**(t) and y(t) when $\mathbf{x}(0)=\begin{bmatrix}0\\1\end{bmatrix}$ and $u(t)=\begin{bmatrix}0 & t<0\\ e^{-t} & t\geq 0\end{bmatrix}$

b) Transform the system into diagonal form

c) Design a state feedback gain "**K**" so that the closed loop system has *an overshoot* "$Mp\leq 20\%$" and a peak time " $t_p \leq 0.7$s"

d) Discuss how to reduce the steady state error of the system to be zero.

Q3- **(10 marks) [B1, B2]**

a- For the nonlinear system shown in Fig. 2

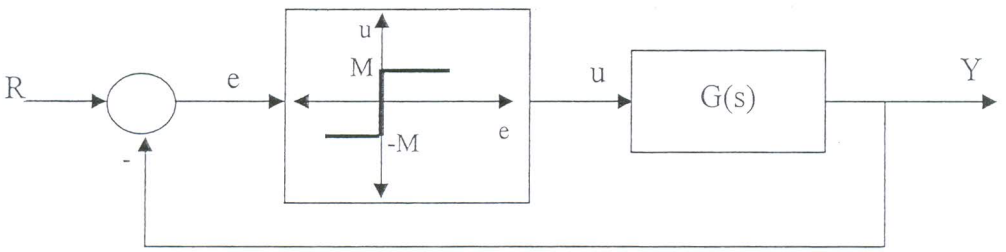

Fig. 2

i) Draw the phase plane if $G(s)=\frac{4}{s(1+4s)}$

ii) Deduce the describing function.

iii) Discuss the system stability

Good Luck

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