



COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electrical & Control Engineering
Lecturer : Dr. Mostafa Abdel-Geliel
Course : Control Systems II
Course Code : EE412
Date : 9/1/2016

Marks: 40
Time : 2 hours

Final Exam

Answer the following questions:-

Q1- (15 marks) [A15, B1]

- (a) Deduce the state space representations and draw the equivalent block diagram of the system in

$$\frac{(s + 6)}{(s + 1)(s^2 + 5s + 6)}$$

- Controllable canonical form
 - Observable canonical form
 - Diagonal form
- (b) Check system controllability and observability
(c) Explain how to obtain transformation matrix between controllable and observable canonical forms

Q2- (15 marks) [A4, A5, B2,C1]

Consider a system has a state space model

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & -0.4 \\ 1 & -1.3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0.8 \\ 1 \end{bmatrix} u$$

It is required to:

- Find $\mathbf{x}(t)$ and $y(t)$ when $\mathbf{x}(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and $u(t) = \begin{cases} 0 & t < 0 \\ 1 & t \geq 0 \end{cases}$.
- Transform the system into diagonal form
- Design a state feedback gain "K" using two different techniques so that the closed loop system poles are located at $s = -2$ and $s = -4$.
- Explain how to reduce the steady state error to be less than 1%.

Members of course Examination Committee:	Signature:	Date:
Lecturer: Dr. Mostafa Abdel-Geliel	<i>Mostafa</i>	3/1/2016
Course Coordinator : Dr. Ahmed Elshenawy	<i>Ahmed</i>	3/1/2016
Head of Department: Prof. Hamdy Ashour	<i>Hamdy</i>	3/1/2016

Q3- (10 marks) [B1, B2]

a- For the nonlinear system shown in Fig. 1

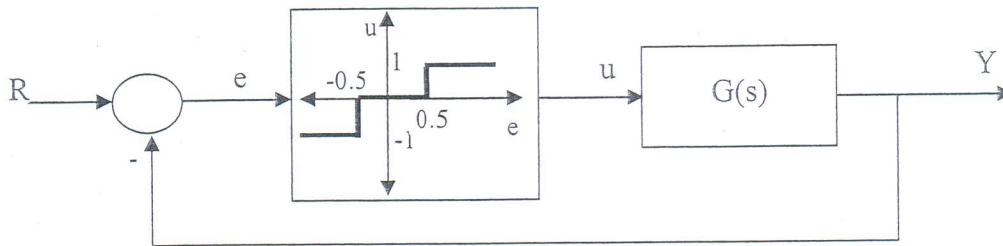


Fig. 1

- i) Draw the phase plane if $G(s) = \frac{4}{(s+1)(1+4s)}$ and $r(t) = 2\sin(\omega t)$
- ii) Deduce the describing function.
- iii) Discuss the system stability

Good Luck

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