SLOT B

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch: ELECTRICAL AND ELECTRONICS ENGINEERING

Stream(s):

1. ***Control Systems***
2. ***Guidance and Navigational Control***
3. ***Electrical Machines***
4. ***Power System and Control***
5. ***Power Control and Drives***

Course Code & Name: 01EE6101 Dynamics of Linear System

Answer *any two full* questions from *each* part

Limit answers to the required points.

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Max. Marks: 60 Duration: 3 hours

PART A

1.		Design a suitable compensator for the unity feedback system with forward transfer function $G(s) = \frac{10}{s(1+s)(1+0.1s)}$ without changing the gain crossover frequency to achieve a phase margin of 60° and steady state error of 0.01 for unit ramp input.	9
2.	a.	Consider the unity feedback system $G(s) = \frac{k}{(s+3)(s+5)(s+7)}$. Design a compensator that will yield Kp=20 without appreciably changing the dominant pole location that yield a 10% overshoot for the uncompensated system.	5
	b.	Design a P, PI and PID controller for the unity feedback system $G(s) = \frac{10}{s(s+1)(s+3)}$ by applying Zeigler_Nichols tuning method.	4
3.		Design a P or PD or PID controller for the unity feedback system with forward transfer function $G(s) = \frac{250}{s(s+1)(s+25)}$ to reduce the settling time by a factor of 4 while continuing to operate the system with overshoot 25% for unit step input and reducing the steady state error to unit ramp input to zero.	9

PART B

4.	a.	Design a state feedback controller for the system to place the poles of the system at -1±j0.5 for the system $\dot{x} = \begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u, y = \begin{bmatrix} 0 & 1 \end{bmatrix} x$.	2

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b. Design an output feedback controller for the unity feedback system with transfer function $(s) = \frac{10}{(s-2)(s-5)}$, if exist, to stabilize the system. 3

c. Define reachability and constructability. 4

5. a. Compute the unit step response of the system $\dot{x} = \begin{bmatrix} t & -t \\ t & -t \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u, y = \begin{bmatrix} 0 & 1 \end{bmatrix} x$ starting from $x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$. 6

b. Explain the effect of state feedback control on the zeroes of the system. 3

6. a. Determine the controllability and stabilisability of the system $\dot{x} = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u, y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$ 6

b. Identify the controllable sub realization for the system $\dot{x} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u, y = \begin{bmatrix} 0 & 1 \end{bmatrix} x$ 3

PART C

7. a. What are the advantages of closed loop observer over open loop observer. 4

b. Design a reduced order observer for the system $\dot{x} = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u, y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$ to place the observer poles at -4±j2. 8

8. a. State and explain separation principle. 6

b. Design a reduced order combined observer-controller for the system $G(s) = \frac{10}{(s+3)(s+5)(s+7)}$ to place the closed loop system pole at -5±j2 and -10 and that of the observer at -20±j8, by transfer function approach. 6

9. a. Design a reduced order combined observer-controller for the system $G(s) = \frac{s+1}{s^2+s+1}$ to place the closed loop poles at -2±j1 and that of the observer at -5, by applying Diophantine equation approach. 5

b. Transform the system $\dot{x} = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix} u, y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$ to controllable canonical form. Also identify how many controllable canonical form exist for this system. 7