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No. of Pages: 2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M.TECH DEGREE EXAMINATION, July 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

01EE6101: DYNAMICS OF LINEAR SYSTEMS

Duration: 3 hrs | Max. Marks: 60

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Answer any two full questions from each PART
Limit answers to the required points.

PART A

1. (a) Derive the overall transfer function of a lag lead compensator network in pole-zero form. (3)

   (b) The open loop transfer function of a unity feedback system is $G(s) = \frac{K}{(s(1+0.4s)(1+0.2s))}$. It is desired that for a unit step input, the steady state error has to be less than $0.1deg/sec$, $PM \geq 45^0$, $GM \geq 20dB$. Design a suitable compensator. (6)

2. (a) Realize a lag compensator using operational amplifiers. (3)

   (b) Design a suitable compensator for the system whose open loop transfer function $G(s) = \frac{K}{(s(s+3)(s+6))}$ to have a $K_v = 80$ and $PM \geq 35^0$ (6)

3. (a) Explain the Ziegler-Nichols methods for tuning the PID controllers. (3)

   (b) Consider a system with an open loop transfer function $G(s) = \frac{4}{s(s+0.5)}$. Design a cascade compensator to meet the following specifications, the damping ratio of the dominant closed loop pole is 0.5, the undamped natural frequency is $5rad/sec$ and $K_v = 80sec^{-1}$. (6)

PART B

4. Obtain the controller canonical realization, controllability canonical realization, observer canonical realization and observability canonical realization for the system whose transfer function is given by $\frac{4s^3+25s^2+45s+34}{s^3+6s^2+10s+8}$. (9)

5. (a) Derive the Bass-Gura formula for determining the state feedback gain matrix. (3)

   (b) With the help of a suitable example analyze the stability of a system by pole zero cancellation. (6)

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6. Solve $\dot{x}(t) = A(t)x(t) + B(t)u(t)$ where (9)

$$A(t) = \begin{pmatrix} 1 & e^{-t} \\ 0 & -1 \end{pmatrix}, \quad B(t) = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

for a unit step input. Given, $x_0 = \begin{pmatrix} x_{10} \\ x_{20} \end{pmatrix}$

PART C

7. (a) Explain the terms controllability index and observability index in MIMO systems. (4)

   (b) Design a reduced order observer for the system whose transfer function is given by $\frac{10}{s^2+\sqrt{10}s+10}$ so as to place the observer pole at $s = -8$. (8)

8. (a) Write short note on observability in MIMO systems. (4)

   (b) Given the system (8)

$$\dot{x} = Ax + Bu$$

   where

$$A = \begin{pmatrix} 5 & 4 & 0 \\ 0 & 1 & 0 \\ -4 & 4 & 1 \end{pmatrix} \; and \; B = \begin{pmatrix} -2 & 0 \\ -1 & 1 \\ -4 & 0 \end{pmatrix}$$

   Obtain the controllable form realization.

9. (a) Explain in detail the separation principle in the design of control systems. (4)

   (b) Explain the direct transfer function design procedure of observer-controller. (8)

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