Code No: 07A71301 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,NOVEMBER 2010
COMPUTER AIDED DESIGN OF CONTROL SYSTEMS
Instrumentation And Control Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the effect of phase lag compensator to a system. [16]

2. Discuss briefly about the different types compensation. [16]

3. (a) Write a procedure to analyze the frequency response and stability analysis.
   (b) Write a MATLAB programme and comment on the results. [8+8]

4. Explain the following:
   (a) Diagonal dominance
   (b) Sensitivity. [8+8]

5. Calculate the i.d.zeros and o.d.zeros of a polynomial system with system matrix. [16]

$$P(s) = \begin{bmatrix} I_2 & 0 & 0 & 0 \\ 0 & s(s+1) & s(s+3) & -s \\ 0 & 0 & (s+2) & 1 \\ 0 & 0 & -1 & 0 \end{bmatrix}$$

6. What are the control statements in MATLAB and explain each with one simple example? [16]

7. State and prove the stability theorem using inverse Nyquist diagram for a polynomial closed SISO loop system. [16]

8. Consider the pulse transfer function system defined by $\frac{y(z)}{u(z)} = \frac{(b_0z^n+b_1z^n+--------+b_n)}{(z^n+a_1z^{n-1}+------+a_n)}$. The system involves a multiple pole of order 'm' at z =p ; and all other poles are distinct. Show that above system may be represented by the following state and output equations:-

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \\ ----- \\ x_m(k+1) \\ ---- \\ x_{n-1}(k+1) \\ x_n(k+1) \end{bmatrix} = \begin{bmatrix} p_1 & 1 & -- & -- & -- & 0 \\ 0 & p_1 & -- & -- & -- & 0 \\ -- & -- & -- & -- & -- & -- \\ 0 & 0 & 0 & -- & -- & p_1 \\ -- & -- & -- & -- & -- & -- \\ 0 & 0 & 0 & -- & p_{n-1} & 0 \\ 0 & 0 & -- & -- & -- & p_n \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \\ -- \\ x_m(k) \\ -- \\ x_{n-1}(k) \\ x_n(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ -- \\ -- \\ -- \\ 0 \\ 0 \end{bmatrix} u(k)$$ [16]

$$y(k) = [c_1 \; c_2 ----c_n] \begin{bmatrix} x_1(k) \\ x_2(k) \\ -- \\ -- \\ x_n(k) \end{bmatrix} + b_0 u(k)$$

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Code No: 07A71301 **R07** **Set No. 4**

IV B.Tech I Semester Examinations,NOVEMBER 2010
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Instrumentation And Control Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Explain any 8 matrix operations in the MATLAB with suitable examples. [16]

2. Determine the state controllability and observability of the following system
$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u;$
$y = \begin{bmatrix} 1 & -2 \end{bmatrix} x$ [16]

3. Explain the selection criteria for the design of inverse nyquist diagram. [16]

4. Show that state space model is not unique. [16]

5. Briefly explain design of compensator for a closed loop SISO system using inverse Nyquist diagram. [16]

6. Enumarate the procedural steps involved in determining the gresgorin bands. [16]

7. Consider the system defined by X=AX+BU and Y=CX
where A = $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -5 & -6 & 0 \end{bmatrix}$ B = $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ C=$\begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$
design a state feed back gain matrix such that the closed loop poles are located at S=-10, S=-10, S=-15. [16]

8. Sketch the Nyquist plot for the system $G(s) = \frac{(s+1)}{s^2(s-2)}$ [16]

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Answer any FIVE Questions
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1. Explain the rules to construct the root locus. [16]
2. Explain any 4 Time response commands in control system toolbox with suitable examples. [16]
3. Write a MATLAB programme to find sum of 10 numbers in an array. [16]
4. Explain how increasing gain only at S = 0 will help a system to reduce offset. Also explain how this is achieved by a compensator. [16]
5. If the system matrix P(s) $= \begin{bmatrix} 1 & 0 & 0 \\ (s+1) & (s+2)(s+3) & 6 \\ 0 & -1 & 0 \end{bmatrix}$. Check whether the above system is of least order. [16]
6. Consider the discrete - time system defined by $\frac{y(z)}{u(z)} = \frac{(b_0 z^n + b_1 z^n + -------- + b_n)}{(z^n + a_1 z^{n-1} + ------ + a_n)}$. Show that a state - space representation of this system may be given by

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \\ ---- \\ ---- \\ x_{n-1}(k+1) \\ x_n \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & -- & -- & 0 \\ 0 & 0 & 1 & -- & -- & 0 \\ -- & -- & -- & -- & -- & -- \\ -- & -- & -- & -- & -- & -- \\ 0 & 0 & 0 & -- & -- & 1 \\ -a_n & -a_{n-1} & -a_{n-2} & -- & -- & -a_1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \\ -- \\ -- \\ x_{n-1}(k) \\ x_n(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ -- \\ -- \\ 0 \\ 1 \end{bmatrix} u(k)$$

$$y(k) = [b_n - a_n b_0 : b_{n-1} - a_{n-1} b_0 : ---- : b_1 - a_1 b_0]\, x \begin{bmatrix} x_1(k) \\ x_2(k) \\ -- \\ -- \\ x_n(k) \end{bmatrix} + b_0 u(k)$$

[16]

7. Sketch the greshgorin column band for $Q(s) = \begin{bmatrix} \frac{(s+4)}{(s+1)(s+5)} & \frac{1}{(s+5)} \\ \frac{(s+3)}{(s+1)(2s+5)} & \frac{2}{(2s+5)} \end{bmatrix}$ and investigate the closed loop stability. [16]
8. State and prove the stability theorem using Nyquist diagram for a polynomial closed loop SISO system. [16]

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Code No: 07A71301 **R07** **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. Explain briefly about the circle criteria. [16]

2. Briefly explain following system specifications to be satisfied by a control system:-
   (a) Transient frequency
   (b) Speed of response
   (c) Conditional stability. [16]

3. Explain any 4 two dimensional plotting functions in the MATLAB with a suitable examples. [16]

4. Determine state controllability and observability of the following system: -
$$\begin{bmatrix} x_1((k+1)T) \\ x_2((k+1)T) \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix}\begin{bmatrix} x_1(kT) \\ x_2(kT) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(kT)$$
[16]
$$y(kT) = \begin{bmatrix} 1 & 5 \end{bmatrix}\begin{bmatrix} x_1(kT) \\ x_2(kT) \end{bmatrix}$$

5. (a) Define polynomial system matrix? Write the general form of the above matrix.
   (b) If a system matrix P(s) $= \begin{bmatrix} 1 & (s+3) & (s+2) \\ (s+1) & (s+1) & 6 \\ -1 & 0 & 0 \end{bmatrix}$, Check whether T(s) and V(s) for the above system are relatively (right) prime. [8+8]

6. (a) Draw a typical inverse Nyquist plot and derive the expression for the offset as a proportion of desired value.
   (b) Explain how to reduce offset for a given system with a suitable compensator. [8+8]

7. Sketch the greshgorin column bands for Q(s) When $Q(s) = \begin{bmatrix} \frac{(s+5)}{(s+1)(s+4)} & \frac{1}{(s+4)} \\ \frac{(s+6)}{(s+1)(s+4)} & \frac{2}{(s+4)} \end{bmatrix}$ and Investigate the closed loop stability. [16]

8. Write the MATLAB programmes for the given transfer function to obtain G(s) $= \frac{10}{s(s+2)(s+6)}$
   (a) Rootlocus
   (b) Nyquist plot

(c) State space model

(d) Bode plot. [16]

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