M.E. First Semester (Electrical Engg. (Electrical Power System))

13568 : Advanced Control System : EP 2101

P. Pages : 3 | AW - 3860

Time : Three Hours | Max. Marks : 80

* 0 3 9 8 *

Notes :
1. Due credit will be given to neatness and adequate dimensions.
2. Assume suitable data wherever necessary.
3. Illustrate your answer necessary with the help of neat sketches.
4. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) Explain the configuration of the basic digital control scheme. Also explain the operation of A/D converter and D/A concerted in details. **7**

b) Find the Z-transform of following functions useful for control system. **6**
   i) Sample exponential signal.
   ii) Sample sinusoidal sequence.

OR

2. a) For a discrete time system **7**

$$y(k+2)+\frac{1}{4}y(k+1)-\frac{1}{8}y(k)=3r(k+1)-r(k)$$

with input $r(k)=(-1)^k u(k)$ and

initial conditions $y(-1)=5;\ y(-2)=-6$

Find the output y (k) ; $x \geq 0$.

b) The characteristics polynomial **6**

$$F(z)=4z^4+6z^3+12z^2+5z+1.$$

find stability using Jury's stability test.

3. a) Explain in details the digital temperature control system? **7**

b) Explain in details digital position control system. **6**

OR

4. a) For a sample data control system shown in fig (3) find the output y(k) for r (t) = unit step. **7**

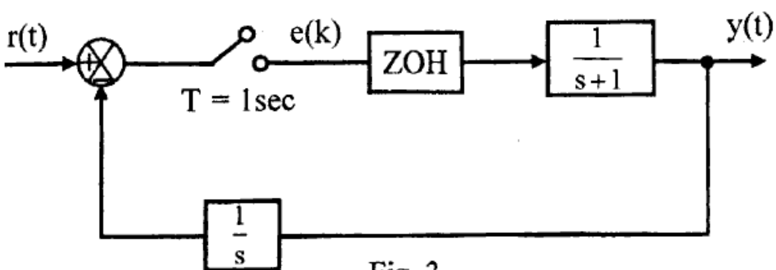

Fig. 3

b) A unity feedback system has OLTF $G(s)=\frac{5}{s(s+1)(s+2)}$ using the Routh stability criteria. Show that closed loop system is stable. **6**

5. Feedback control system shown in fig (5). The plant is described by $G(s)=\frac{k}{s(s+2)}$ **14**

Design a digital control scheme for the system to meet the specifications.

i) $k_u = 6$ ii) M_p to step input $\le 15\%$

iii) t_s for 2% tolerance band ≤ 5 sec

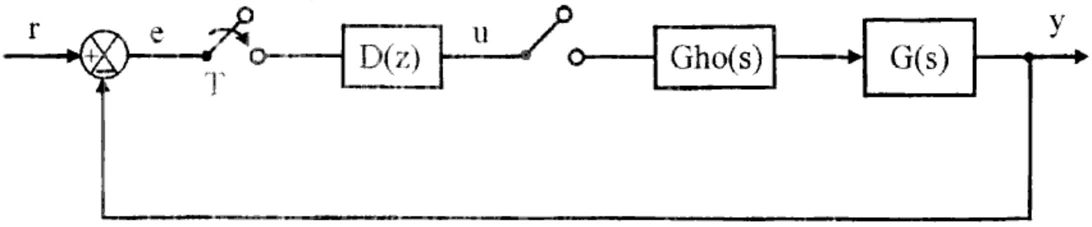

Fig. 6

OR

6. a) For a unity feedback discrete time system determine steady state error & error constant for various input signal such as **7**

i) Unit step ii) Ramp input

iii) Parabolic input

b) Explain the types of compensators as referred to frequency response & also mention need for compensation. **7**

7. a) Determine the controllability and observability properties of the following systems. **7**

i) $A=\begin{bmatrix}-2 & 1\\ 1 & -2\end{bmatrix}; b=\begin{bmatrix}1\\0\end{bmatrix}; c=\begin{bmatrix}1 & -1\end{bmatrix}.$

ii) $A=\begin{bmatrix}-1 & 0 & 0\\ 0 & -2 & 0\\ 0 & 0 & -3\end{bmatrix}; B=\begin{bmatrix}1 & 0\\ 1 & 2\\ 2 & 1\end{bmatrix}; C=\begin{bmatrix}1 & 1 & 2\\ 3 & 1 & 5\end{bmatrix}.$

b) Find the eigenvalue & eigenvectors for the following matrices. **7**

i) $\begin{bmatrix}-3 & 2\\ -1 & 0\end{bmatrix}.$ ii) $\begin{bmatrix}0 & 1 & 0\\ 3 & 0 & 2\\ -12 & -7 & -6\end{bmatrix}.$

OR

8. Construct the state model for the following differential equations obtain a different canonical form for each system. **14**

i) $\dddot{y}+6\ddot{y}+11\dot{y}+6y=u.$

ii) $\dddot{y}+6\ddot{y}+11\dot{y}+6y=\dddot{u}+8\ddot{u}+17\dot{u}+8u.$

9. a) Determine controllability & observability of following system. 6

i) $X(k+1)=\begin{bmatrix}1 & -2\\ 1 & -1\end{bmatrix}X(k)+\begin{bmatrix}1 & -1\\ 0 & 0\end{bmatrix}u(k)$

$y(k)=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}x(k)$

ii) $X(k+1)=\begin{bmatrix}-1 & 1\\ 0 & -1\end{bmatrix}X(k)+\begin{bmatrix}0\\ 1\end{bmatrix}u(k)$

$y(k)=\begin{bmatrix}1 & 1\end{bmatrix}x(k)$

b) Consider the matrix $F=\begin{bmatrix}0 & 1\\ -0.16 & -1\end{bmatrix}$ compute the $F^k=\phi(k)$ using inverse Z-transform. 7

OR

10. a) A discrete time system has state equation 6

$X(k+1)=\begin{bmatrix}0 & 1\\ -10 & -7\end{bmatrix}x(k).$

use Cayley Hamilton approach to find its state transition matrix.

b) $\underset{n\times n}{\wedge}=\begin{bmatrix}\lambda_1 & 1 & 0 & \cdots\cdots & 0\\ 0 & \lambda_1 & 1 & \cdots\cdots & 0\\ \vdots & \vdots & \vdots & & \\ 0 & 0 & 0 & \cdots\cdots & 1\\ 0 & 0 & 0 & \cdots\cdots & \lambda_1\end{bmatrix}$ Compute $\wedge^k$ using Cayley Hamilton technique. 7

11. $X(k+1)=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -0.5 & -0.2 & 1.1\end{bmatrix}X(k)+\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u(k).$ 13

Determine state feedback gain matrix 'k' such that $u(k)=-k\,x(k);X\,(0)$ is the initial state. Give state variable model of closed loop system.

OR

12. Consider a system $\dot{x}=Ax+Bu$ 13

$y=cx+du$

$A=\begin{bmatrix}-2 & -1\\ 1 & 0\end{bmatrix};B=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix};C=\begin{bmatrix}0 & 1\end{bmatrix}$

$d=\begin{bmatrix}2 & 0\end{bmatrix}.$

Design a full order state observer so that the estimation error will decay in less than 4 second.

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