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

13568 : Advanced Control System : EP 2101

P. Pages : 3 **AW - 3589**

Time : Three Hours Max. Marks : 80

Notes : 1. Assume suitable data wherever necessary.
2. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION – A

1. a) Explain the process of reconstruction of analog signal from digital signal. **6**

b) The characteristics polynomial. **7**
$F(z) = 4z^4 + 6z^3 + 12z^2 + 5z + 1$
Find stability using Jury's stability test

OR

2. a) For discreate time system $y(k+2) + \frac{1}{4}y(k+1) - \frac{1}{8}y(k) = 3r(k+1) - r(k)$ with input $r(k) = (-1)^k\, u(k)$ & initial conditions $y(-1) = 5, y(-2) = -6$ Find the output $y(k)\,;\; k \geq 0$. **6**

b) Explain the block diagram of digital control system. **7**

3. a) Explain digital control system. **6**

b) A unity feedback system has open loop transfer function $G(s) = \frac{5}{s(s+1)(s+2)}$ using the Routh stability criteria, show that closed loop system is stable **7**

OR

4. a) Explain in details the digital temperature control system? **6**

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

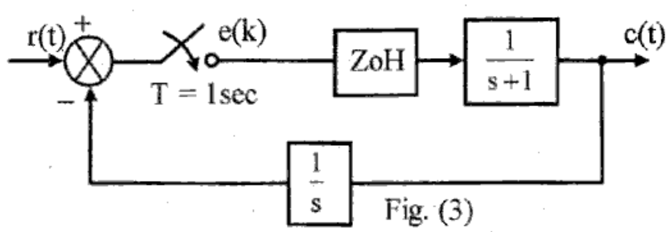

Fig. (3)

5. a) For a unity feedback discreate time system determine steady state error & error constant for various input signal such as **7**
i) Unit step ii) ramp input iii) Parabolic i/p

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

OR

6. Feedback control system is shown in fig (6). The plant is described by $G(s)=\frac{k}{s(s+2)}$, **14**

Design a digital control scheme for the system to meet the specification

i) $k_v = 6$ ii) Mp to step i/p $\leq 15\%$

iii) t_s for 2% tolerance band ≤ 5 sec

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

OR

8. A feedback system closed loop transfer function **14**

$$\frac{Y(s)}{R(s)}=\frac{10(s+4)}{s(s+1)(s+3)}$$

construct three different state models for this system

a) One where the system matrix A is a diagonal matrix.

b) One where A is in first companion form

c) One where A is in second companion form.

9. a) Consider the matrix $F=\begin{bmatrix}0 & 1\\ -0.16 & -1\end{bmatrix}$ **6**

Compute the $F^k=\phi(k)$ using inverse z transform

b) **7**

$$\underset{n\times n}{A}=\begin{bmatrix}\lambda_1 & 1 & 0 & \dots\dots & 0\\ 0 & \lambda_1 & 1 & \dots\dots & 0\\ \vdots & \vdots & \vdots & & \\ 0 & 0 & 0 & \dots\dots & 1\\ 0 & 0 & 0 & \dots\dots & \lambda_1\end{bmatrix}$$

Compute $\wedge^k$ using Cayley Hamilton technique.

OR

10. a) Determine the controllability & observability of the system. **6**

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

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

b) Consider the matrix $F=\begin{bmatrix}0 & 1\\ -2 & 3\end{bmatrix}$ Determine F^k. **7**

11.

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

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 the system

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

$$y = cx + du$$

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

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

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

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