G 393

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Reg. No..............................

Name.................................

B.TECH. DEGREE EXAMINATION, MAY 2014

Sixth Semester

Branch : Applied Electronics and Instrumentation / Electronics and Instrumentation Engineering

AI 010 605/EI 010 605—CONTROL ENGINEERING—II (AI, EI)

(New Scheme—2010 Admission onwards)

[Regular/Improvement/Supplementary]

Time : Three Hours

Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 3 marks.

1. Define Eigen values and Eigen vector of a matrix.
2. State the properties of state Transition matrix.
3. Define the terms controllability and observability.
4. Determine the Z-transform of the discrete sequence $f(k) = \left(\frac{1}{2}\right)^k u(k)$.
5. How are singular points classified ?

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*
Each question carries 5 marks.

6. Obtain a state model for the system described by $y(k+3) + 3y(k+2) + 2y(k+1) + y(k) = 5u(k)$.

7. Find the state Transition matrix for the system given by $\dot{X} = \begin{bmatrix} 0 & 2 \\ -1 & -2 \end{bmatrix} X$.

8. Evaluate the observability of the system :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}^u \text{ and } y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

Turn over

9. Determine the inverse Z-transform of $F(z) = \frac{(z-4)}{(z-1)(z-2)^2}$.

10. Determine the location and type of singular points for the non-linear system described by $\ddot{x} + 2\dot{x}^2 + x = 0$.

(5 × 5 = 25 marks)

Part C

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. (a) Obtain a state model in canonical form for the system described by $G(s) = \frac{(s+2)}{(s+5)^2 (s+7)^2}$.

(6 marks)

(b) Represent the following system in phase variable form :

$$G(s) = \frac{s^3 + 2s^2 + 7s + 1}{s^4 + 3s^3 + 5s^2 + 6s + 4}.$$

(6 marks)

Or

12. State and explain Lagrange's equation with an appropriate illustration. (12 marks)

13. (a) Find the Laplace Transform of :

$$f(t) = \begin{cases} 0 & t < 1 \\ t+1 & 1 \le t \le 3 \\ 4 & 3 \le t \le 4 \\ 0 & 4 < t \end{cases}$$

(6 marks)

(b) Obtain the state transition matrix and state model of the system :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

(6 marks)

Or

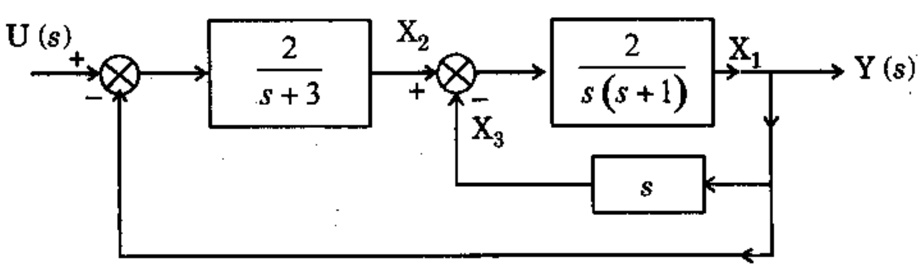
14. (a) Define the state transition matrix and derive an expression to obtain the state transition matrix from the state matrix.

(7 marks)

(b) What is the significance of state variable approach and how state variables are selected ?

(5 marks)

15. Write the state equations of the system shown below and determine its state controllability and observability



(12 marks)

Or

16. Given the system $\dot{x} = Ax + Bu$, $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$. Design a linear state variable feedback such that the closed loop poles are located at $-1, -2, -3$.

(12 marks)

17. Check for the stability of the sampled data control system represented by the following characteristic equation by Jury's stability test :

(a) $5z^2 - 2z + 2 = 0$.

(b) $z^3 - 0.2z^2 - 0.25z + 0.05 = 0$.

(c) $z^4 - 1.7z^3 + 1.04z^2 - 0.268z + 0.024 = 0$.

(12 marks)

Or

18. (a) Find the Z-transform of $x(n) = 7\left(\frac{1}{3}\right)^n u(n) - 6\left(\frac{1}{2}\right)^n u(n)$. (6 marks)

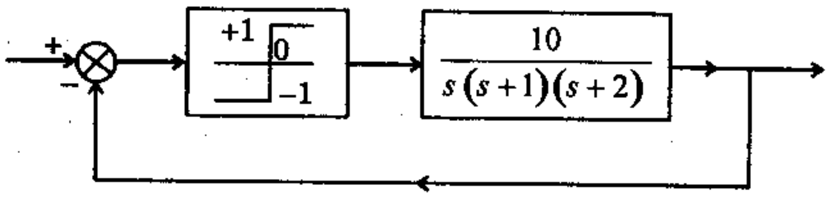
(b) Solve the following difference equation for the given initial condition and input

$$y(n) - \frac{1}{9}y(n-2) = x(n-1)$$

with $y(-1) = 0, y(-2) = 1$ and $x(n) = 3u(n)$.

(6 marks)

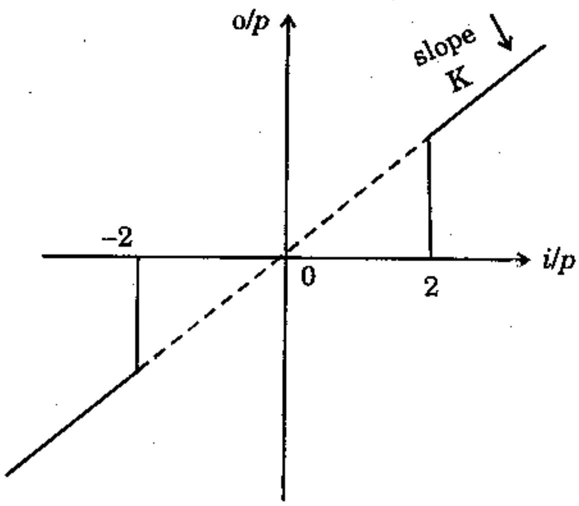
19. For the system shown below, determine the frequency and amplitude of limit cycle.



(12 marks)

Or

20. Obtain the describing function of the non-linearity shown below :



(12 marks)

[5 × 12 = 60 marks]