

61N0602**61N0602****B.Tech. VI Sem Main/Back (New Scheme) Examination 2025-26****Electrical Engineering****(6EE4-02) – Modern Control Systems****Time : 3 Hours****Maximum Marks: 70****Min. Passing Marks:**Instructions to Candidates:

Part-A: Short answer questions (up to 25 words) 10x2 marks = 20 marks. All ten questions are compulsory.

Part- B: Analytical/Problem Solving questions 5x4 marks = 20 marks. Candidates have to answer 5 questions out of 7.

Part – C: Descriptive/Analytical/Problem Solving questions 3x10 marks = 30 marks. Candidates have to answer 3 questions out of 5.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1. _____

2. _____

PART-A

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|-------|--|-----|
| Q.1. | Differentiate between Modern and conventional control system. | [2] |
| Q.2. | Define state space. | [2] |
| Q.3. | What is state diagram? | [2] |
| Q.4. | Mention stability criteria in Z-plane. | [2] |
| Q.5. | What is the necessary and sufficient condition for arbitrary pole placement? | [2] |
| Q.6. | What are sampler and hold circuits? | [2] |
| Q.7. | Mention the condition for complete controllability and complete observability. | [2] |
| Q.8. | What is meant by sampled data controlled system. | [2] |
| Q.9. | Find the Z-transform of $f(k)=k+\sin(2k)$; $k \geq 0$. | [2] |
| Q.10. | Define eigen values and eigen vectors. | [2] |

PART-B

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|-----|--|-----|
| Q.1 | Explain the advantages and disadvantages of physical Variables, phase variables and Canonical variables for state-space formulation of control system. | [4] |
| Q.2 | Find the eigen values and eigen vectors for the system matrix A | [4] |

$$A = \begin{bmatrix} -4 & 1 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & -2 \end{bmatrix}$$

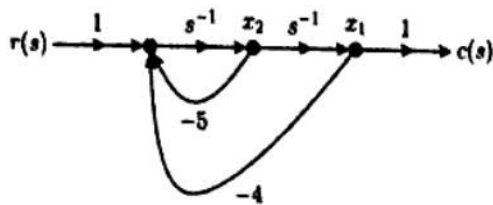
Q.3. Construct the state model for a system characterized by following differential equation. [4]

$$\frac{d^3 y}{dt^3} + 5 \frac{d^2 y}{dt^2} + \frac{dy}{dt} + 2y = u$$

Q.4. Construct the state model in Jordan's canonical form for the system transfer function [4]

$$\frac{Y(s)}{X(s)} = \frac{10}{(s+1)^2(s+2)}$$

Q.5. Consider the following state diagram [4]



Prove that the transfer function of state diagram is given as

$$G(s) = \frac{c(s)}{r(s)} = \frac{1}{s^2 + 5s + 4}$$

Q.6. Explain the method of pole placement by state feedback with suitable example. [4]

Q.7. Test the stability of characteristics equation using Jury's stability Test. [4]

$$F(z) = 2z^4 + 7z^3 + 10z^2 + 4z + 1$$

PART-C

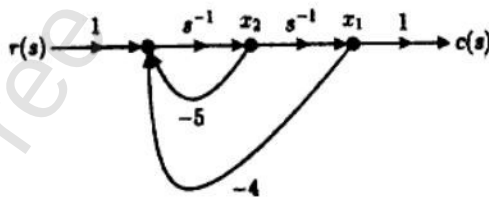
Q.1. (a) Explain the mapping between S-Plane and Z-Plane [5+5]
(b) Derive transfer functions for Zero order hold circuit

Q.2. Discuss the stability analysis of discrete control system using (a) Routh stability criteria (b) Bilinear transformation. <https://www.rtuonline.com> [5+5]

Q.3. For SISO system given below determine the feedback gain to place the closed-loop poles at $\frac{1}{2}$ and $\frac{1}{4}$ using full state feedback [10]

$$\dot{X} = \begin{bmatrix} 0 & -1 \\ -3 & 1 \end{bmatrix} X + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u$$

Q.4. (a) Explain the concept of controllability and observability [5+5]
(b) Check the controllability and observability of following



Q.5. Write short note on any two [5+5]
(a) Digital PID controllers
(b) Introduction to Robust Control and Adaptive control
(c) Sliding mode control

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