

CBCS SCHEME

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18MT823

Eighth Semester B.E. Degree Examination, June/July 2024 Digital Control System

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the steps involved in diagonalization of $n \times n$ matrix in state-space representation with example. (10 Marks)
- b. With a neat block diagram, explain the functional units of digital control system and mention its characteristics. (10 Marks)

OR

- 2 a. Derive an expression or standard state space equations for discrete time system in observable canonical form. (10 Marks)
- b. Represent the given function into Jordan or diagonal canonical form $\frac{y(s)}{u(s)} = \frac{s+3}{s^2+3s+2}$. (10 Marks)

Module-2

- 3 a. Explain the concept of principle of duality under observability of continuous time system with equations. (10 Marks)
- b. Derive an expression for the following under complete state controllability:
(i) Output controllability (ii) Stabilizability (10 Marks)

OR

- 4 a. Show that the following system is not completely observable:
$$x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, C = [4 \ 5 \ 1]$$
 (10 Marks)
- b. Derive an expression for state controllability of continuous time system $\dot{x} = Ax + Bu$ and show controllability matrix. (10 Marks)

Module-3

- 5 a. With a neat block diagram, explain the characteristics of adaptive control system. (10 Marks)
- b. Outline the working of gain scheduling adaptive scheme with a neat functional diagram. (10 Marks)

OR

- 6 a. Derive an expression for quadratic optimal control problem based on performance index. (10 Marks)
- b. Explain the operation of Model Reference Adaptive Controller (MARAC) with a neat sketch and mention its advantages. (10 Marks)

Module-4

- 7 a. Summarize the backlash nonlinearity with a neat graph and expression. (10 Marks)
b. List and explain the various types of non-linear describing functions with example. (10 Marks)

OR

- 8 a. Illustrate the relays non-linearity with a neat graph and derive an expression to represent the same. (10 Marks)
b. Explain the characteristics of non-linear control system and mention its advantages over linear control system. (10 Marks)

Module-5

- 9 a. With a neat block diagram, explain the working of series and parallel compensation. (10 Marks)
b. Explain the design steps involved in a lag compensator technique with a neat electronic circuit. (10 Marks)

OR

- 10 a. Derive an expression for transfer function of a lead-lag compensator network with a neat diagram. (10 Marks)
b. Compare the characteristics of Lead, Lag and Lead-Lag compensation technique. (10 Marks)
