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**Eighth Semester B.E. Degree Examination, Dec.2024/Jan.2025**  
**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. Derive an expression or standard state – space equation for discrete time system in Jordan or diagonal canonical form. (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. Represent the given function into observable canonical form :  

$$\frac{y(s)}{u(s)} = \frac{s+3}{s^2+3s+2}$$
 (10 Marks)
- b. Explain the following with equations :  
 i) State vector  
 ii) State space  
 iii) State space equations  
 iv) State variable. (10 Marks)

**Module-2**

- 3 a. Derive an expression and show alternate form of the condition for complete observability. (10 Marks)
- b. Define controllable and observable system and list the features of observable and controllable system. (10 Marks)

**OR**

- 4 a. Illustrate the conditions for observability of continuous – time system and show the observability matrix. (10 Marks)
- b. Show that the following system is not completely observable :  

$$x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \quad A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad C = [4 \ 5 \ 1]$$
 (10 Marks)

**Module-3**

- 5 a. Explain the operation of self – Turing regulator adaptive scheme with a neat sketch and mention its limitation. (10 Marks)
- b. Describe the major functions involved in closed loop adaptive control system. (10 Marks)

**OR**

- 6 a. With a neat block diagram, explain the characteristics of adaptive control system. (10 Marks)
- b. Discuss various parameters considered to form an optimization problem and dependences to solve the same. (10 Marks)

**Module-4**

- 7 a. Explain the saturation non-linearity with neat graph and expression. (10 Marks)  
b. Describe various types of friction non-linearity with a neat graph and expression. (10 Marks)

**OR**

- 8 a. Explain the characteristics of non linear control system and mention its advantages over linear control system. (10 Marks)  
b. Explain the various classifications of non-linear describing function with an example. (10 Marks)

**Module-5**

- 9 a. List the fundamental characteristics of lead, lag and lead – lag compensation technique. (10 Marks)  
b. Derive one expression for transfer function of a lead-lag compensator networks with a neat diagram. (10 Marks)

**OR**

- 10 a. Explain the steps involved in design of lead compensation technique and mention its limitations. (10 Marks)  
b. With a neat block diagram, explain the working of series and parallel compensation networks. (10 Marks)

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