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SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)

B.Tech III Year II Semester Supplementary Examinations February-2022

MODERN CONTROL THEORY
(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 60

PART-A

(Answer all the Questions 5 x 2 = 10 Marks)

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|---|---|--|----|
| 1 | a | What is state diagram? | 2M |
| | b | What is observability? | 2M |
| | c | Define full order & reduced order observer. | 2M |
| | d | How limit cycles are determined from phase portrait. | 2M |
| | e | State Lyapunov stability theorem. | 2M |

PART-B

(Answer all Five Units 5 x 10 = 50 Marks)

UNIT-I

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|---|---|---|----|
| 2 | a | State and prove the various properties of state transition matrix. | 5M |
| | b | Obtain state space representation for following systems $\frac{Y(S)}{U(S)} = \frac{10(S+4)}{S(S+1)(S+3)}$ | 5M |

OR

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| 3 | | $X = \begin{bmatrix} -1 & -4 & -1 \\ -1 & -6 & -2 \\ -1 & -2 & -3 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} U; Y = [1 \ 1 \ 1]X$. Find the transfer function of the system. | 10M |
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UNIT-II

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|---|---|---|----|
| 4 | a | Define Controllability. What are the tests to find the controllability of a system? | 5M |
| | b | Test observability for $\dot{x}_1 = -2x_1 + x_2 + U$, $\dot{x}_2 = -x_2 + U$ and $y = x_1 + x_2$. | 5M |

OR

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| 5 | a | State and prove the principle of duality between controllability and observability. | 5M |
| | b | Write the effect of state feedback on controllability and observability | 5M |

UNIT-III

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| 6 | | Consider the system defined by | 10M |
|---|--|--------------------------------|-----|

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -5 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t) \quad y(t) = [1 \ 0 \ 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Design a full order state observer assuming the desired poles for the observer are located at -10,-10,-15.

OR

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| 7 | | Explain the full order and reduced order observer. | 10M |
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UNIT-IV

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| 8 | | With the help of graphical representations, explain about various common physical nonlinearities. | 10M |
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OR

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| 9 | | What is singular point? Explain various types of singular points. | 10M |
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UNIT-V

- 10 a State and prove Lyapunov instability theorem. 5M
b Define quadratic form and Hermitian form. 5M

OR

- 11 Using Lyapunov analysis, determine the stability of the equilibrium state of the system 10M

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

END