

(3 hours)

[Marks:80]

- NOTE: 1) Question No. 1 is compulsory.  
 2) Out of remaining questions, attempt any 3 questions.  
 3) In all 4 questions to be attempted.  
 4) All questions carry equal marks.  
 5) Figures in brackets on the right hand side indicate full marks.  
 6) Assume Suitable data if necessary

Q1 Answer any 5

- i) How do you compare open loop and closed loop system? 4
- ii) What are position, velocity and acceleration error coefficients? 4
- iii) What is importance of state space representation? 4
- iv) Write expression for rise time, peak time, maximum peak overshoot and settling time of second order under damped system. 4
- v) How to find breakaway point in root locus 4
- vi) How do you define stable system? 4
- vii) What are properties of state transition matrix? 4

Q2a) Check whether the following systems are stable using Routh's stability criterion 10

- i)  $3s^4 + 10s^3 + 5s^2 + 2$
- ii)  $s^4 + 4s^3 + 6s^2 + 4s - 5$

2b) Find root locus for the transfer function  $G(s) = \frac{2}{s(s+2)(s+5)}$  10

3a) Find the state equation and output equation for the transfer function 10

$$G(s) = \frac{2s+1}{s^2+7s+9}$$

3b) Check the controllability and observability of the following system 10

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = [0 \quad 0 \quad 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

