*Total No. of Questions :8]* *[Total No. of Printed Pages :3*

**Roll No** .....

# MEPE-103

## M.E./M.Tech., I Semester

Examination, December 2016

## Advanced Control System

***Time : Three Hours***

***Maximum Marks : 70***

***Note*:** i) Attempt any five questions.
ii) All questions carry equal marks.

1. a) What are the difficulties arising in the Routh-Hurwitz stability criterion? How these difficulties are overcome? 7

   b) Explain any one example of variable structure control in detail. Comment of stability of the control system. 7

2. a) Select Lyapunov function and determine the stability for: 8

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

   b) What are necessary conditions for stability of a control system? 6

3. The closed-loop poles (eigen values) are to be located at S = –3 and S = –7. Design a state variable feedback. Given that : 14

$$A = \begin{bmatrix} 0 & 1 \\ -20 & -9 \end{bmatrix} \text{ and } B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

4. Check the controllability and observability of the system given below : 14

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

$$\begin{bmatrix}y_1\\ y_2\end{bmatrix}=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

5. The state space representation of a system is given below : 14

$\dot{x} = Ax + Bu$

$y = Cx$

given that $A=\begin{bmatrix}0 & 15\\ 1 & 0\end{bmatrix}$, $B=\begin{bmatrix}0\\ 1\end{bmatrix}$ and $C=[0 \quad 2]$

Determine the observer gain matrix L such that $\lambda_1 = -2 + j3$ and $\lambda_2 = -2-j3$ are the eigen values of the observer gain matrix.

6. a) Discuss the design strategy of a variable structure control for an armature control d.c. servomotor. 7

   b) Derive the equation which shown the transversal condition. 7

7. a) Discuss the use of control action of overcome the effect of load disturbance. 5









   b) A unity feedback system has open loop transfer function.

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

   Sketch Nyquist plot for the system and therefore obtain the gain margin and phase margin. 9

8. Write a short note (any two) 7 each

   a) Euler-Lagrange equations

   b) Pole placement problem

   c) Phase plane technique

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