OR

Write short note on

a) Euler-Lagrange equations

b) Pontyazin's maximum principle

******

Roll No ....

MEIC - 205

M.E./M.Tech., II Semester

Examination, June 2016

Advanced Controlled Systems

Time : Three Hours

Maximum Marks : 70

Note : i) Attempt all the five questions.

ii) All questions carry equal marks.

1. Explain Jury stability test. Consider the system described by

$$y(k)-0.5y(k-1)-0.8y(k-2)+0.7y(k-3)-0.12y(k-4)=x(k)$$

Where $x(k)$ is the input and $y(k)$ is the output of the system. Determine the stability of the system.

OR

Explain controllability and observability. Determine the controllability and observability of the system described by the state equation. Find out the transfer function and draw the block diagram

$$\dot{x}(t)=\begin{bmatrix}-1 & 0 & 0\\ 0 & -2 & 0\\ 0 & 0 & -3\end{bmatrix}x(t)+\begin{bmatrix}1\\1\\0\end{bmatrix}u(t)$$

$$y(t)=\begin{bmatrix}1 & 0 & 2\end{bmatrix}x(t)$$

2. Write advantages of state space method. A pendulum with frequency ω_o and a state space description given by

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

Find the control law that places the closed loop poles of the system so that they are both at $-2\omega_o$.

OR

Define and draw schematic diagram of state observer. Consider the system defined by

$x(k+1) = G \times (k) + Hu(k)$

$y(k) = C \times (k)$

$u(k) = k_o r(k) - kx(k)$

Where $G=\begin{bmatrix}0 & 1\\ -0.15 & -1\end{bmatrix}, H=\begin{bmatrix}0\\ 1\end{bmatrix}, C=\begin{bmatrix}1 & 0\end{bmatrix}$

Design a control system such that the desired closed-loop poles of the characteristic equation are at

$z_1 = 0.5 + j0.5,\ z_2 = 0.5 - j0.5$

3. Explain concept and design of variable structure control. Consider the system in R^2:

$$\dot{x}_1 = -x_2 - x_1\left(x_1^2 + x_2^2 - u\right);$$

$$\dot{x}_2 = x_1 - x_2\left(x_1^2 + x_2^2 - u\right)$$

For $u = r^2$ = constant the system exhibits an asymptotically stable limit cycle, represented by a circle of radius r centred at the origin of co-ordinates. Show that a VSC makes this limit cycle reachable in a finite time.

OR

Explain properties of a VSC system with respect to the reaching mode, sliding mode and the steady state mode.

4. Draw graphical representation of stability, asymptotic stability and instability. Determine the stability, range for the gain K using Lyapunov stability analysis of the system shown in figure 1.

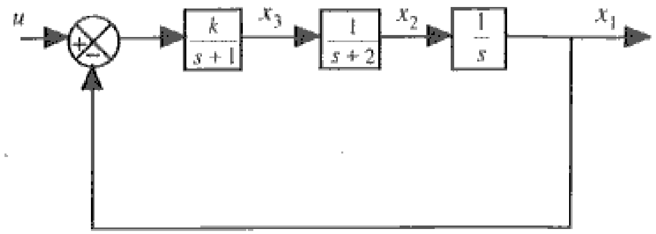

Figure 1

OR

Explain phase plane technique. Derive and draw phase plane trajectory of the second order system shown in figure 2.

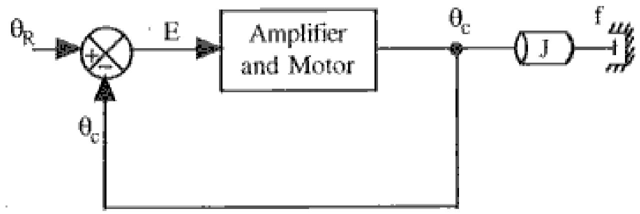

Figure 2

5. Consider the discrete time control system defined by

$x(k+1) = 0.3579x(k) + 0.6421u(k)$,

$x(0) = 1$

Determine the optimal control law to minimize the following performance index:

$$J=\frac{1}{2}\left[x(10)\right]^2+\frac{1}{2}\sum_{k=0}^{9}\left[x^2(k)+u^2(k)\right]$$