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EIC801

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 132801

Roll No.

B. Tech.

(SEM. VIII) THEORY EXAMINATION, 2014-15

OPTIMAL CONTROL SYSTEMS

Time : **3** Hours] [Total Marks : **100**

Note : ALL questions are compulsory.

1 Attempt any two parts of the following : 10×2=20

(a) Write and explain formulation process of the optimal control problem with example.

(b) Find the trajectory in (t, x) plane that will optimize:

$$J(X)=\int_0^2\left(\dot{X}^2+2X\dot{X}+4X^2\right)dt;\ x(0)=1 \text{ and } x(2)$$

is free.

(c) For given plant equation $\dot{x}=-x+u$

With boundary condition x(0)=0, x(1)=1 and the performance index

$$J=\left\{\frac{1}{2}\int_0^1\left(3x^2+u^2\right)dt\right\}$$ Find the optimal control law.

2 Attempt any two parts of the following : 10×2=20

(a) Consider the problem of state reconstruction for the system described by the equation.

$x(t) = -x(t) + w(t)$

$y(t) = x(t) + v(t)$

$Q=4,\ R=0.5,\ P_0 = 0,\ t_0 = 0$

It is desired to find an optimal control law that minimize the performance index

$$J = E\left\{\frac{1}{2}x^2(2) + \frac{1}{2}\int_0^2 2x^2(t) + u^2(t)\,dt\right\}.$$

(b) Give formulation of continuous linear regulator problems using state variable approach.

(c) Explain Pontryagin's minimum principle and state inequality constraints.

3 Attempt any two parts of the following: 10×2=20

(a) Find the control law which minimizes the performance index

$J = E\left\{\int x_1^2 + x_2^2(t) + u^2(t)\,dt\right\}$ for a given system.

$$\overset{\circ}{X_1} = X_2$$

$$\overset{\circ}{X_2} = -X_2 + U\,.$$

(b) Drive the Riccati equation of continuous time linear state Regulator.

(c) What is sub optimal control? Define the methods of sub optimal control for discrete time system.

4 Attempt any two parts of the following : 10×2=20

(a) Explain model of single board DC motor position control system with block diagram.

(b) Explain the utilization of microprocessor in control system. Write one application and explain with help of block diagram and mathematical expressions.

(c) Write the merits of Digital Signal Processor based control system over microprocessor based control system. Draw and explain the architecture of DSP microcontroller.

5 Attempt any two parts of the following : 10×2=20

(a) Explain the effects of finite word length and quantization on controllability and closed loop pole placement.

(b) What is data acquisition system? Draw and explain the transfer characteristics of quantizer.

(c) Write short notes on :

(i) Power-14 DSP Microcontroller

(ii) ALU and Memory.