



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

PAPER ID : 132801

Roll No.

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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:

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

is free.

- (c) For given plant equation $\dot{x} = -x + u$
With boundary condition $x(0)=0, x(1)=1$ and the performance index

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

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.

$$\dot{x}(t) = -x(t) + w(t)$$

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

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

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

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

$$\dot{X}_1 = X_2$$

$$\dot{X}_2 = -X_2 + U.$$

- (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 : $10 \times 2 = 20$
- (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 : $10 \times 2 = 20$
- (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.
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