Q.P. Code: **16EE7510** **R16**

Reg. No: | | | | | | | | | | |

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
M.Tech I Year II Semester (R16) Regular Examinations May/June 2017
OPTIMAL CONTROL THEORY
(Control Systems)
(For Students admitted in 2016 only)

Time: **3 hours** Max. Marks: **60**

(Answer all Five Units **5 X 12 =60** Marks)

UNIT-I

1 a. What is meant by quadratic problem? Explain 6M

b. What are the necessary conditions for quadratic programming problem? Explain. 6M

OR

2 Check the convexity of a problem: Minimize $f(x_1, x_2)=2x_1+3x_2-x_1^3-2x_2^2$ subject to $x_1+3x_2\le 6$, $5x_1+2x_2\le 10$, $x_1,x_2\ge 0$. 12M

UNIT-II

3 a. Explain the concept of duality in a linear programming problem. 6M

b. Consider the program: Maximize $3x_1+2x_2+x_3$ Subject to $x_1\ge 0$, $x_2\ge 0$, $x_3\ge 0$ and $x_1-x_2+x_3\le 4$, $2x_1+x_2+3x_3\le 6$; $-x_1+2x_3\le 3$ and $x_1+x_2+x_3\le 8$ state the dual problem 6M

OR

4 Derive Euler Lagrange Equation 12M

UNIT-III

5 $J(x)=\int_0^{\frac{\pi}{4}}\left[x_1^2(t)+\dot{x}_1(t)+\dot{x}_2(t)+\dot{x}_2^2(t)\right]dt$ The functionsx$_1$ and x$_2$ are independent and boundary conditions are: $x_1(0)=1$; $x_1(\pi/4)=2$;; $x_2(0)=3/2$; $x_2(\pi/4)$=free. 12M

OR

6 For the first-order system $\dot{x}(t)=-x(t)+u(t)$, find the optimal control $u^*(t)$to minimize the following cost function $J=\int_0^{t_f}\left(x^2(t)+u^2(t)\right)dt$ where t_f is not specified and $x(0)=5$ and $x(t_f)=0$.Alsofind t_f. 12M

UNIT-IV

7 Derive continuous time Algebric Riccati Equation that satisfies linear quadratic optimal regulator for LTI systems 12M

OR

8 a. Explain about the simplest variational problems 6M

b. Define time optimal control and derive the expression 6M

UNIT-V

9 a. Explain about Pontrygin's minimum principle 6M

b. Explain time optimal control problem with an example 6M

OR

10 Using the dynamic programming method, minimize the following functional.

J= $x_1^2(k_f)+2x_2^2(k_f)+\int_{k=0}^{k_f-1}$ {(0.5 $x_1^2(k)$ +0.5 x_2^2 (k)+0.5 u^2 (k))} for the second order systems

X_1 (k+1)= 0.8 x_1 (k) +x_2 (k)+u(k); x_2(k+1)=0.6x_2 (k)+0.5u(k) subjected to the initial conditions. X_1(k_0=0) =5; x_2(k_0=0) =3 ; X(k_f) is free ,and k_f=10 12M

***** END *****