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M.Tech (EE) EI-II (2018 Batch) (Sem.-1)

OPTIMAL AND ADAPTIVE CONTROL

Subject Code : MTEE-104D-18

M.Code : 75224

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWELVE marks.

Q1. (a) Define optimal control problem.

(b) Find the curve with the minimum arc length joining the point (0, 0) and line $\theta(t) = 2 - t$.

Q2. (a) Discuss the steps in solving optimal control problem using Hamilton-Jacobi method.

(b) Consider the system

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = u$$

Is to be controlled to minimize the performance index

$$J = \frac{1}{2}\int_0^2 u^2 dt$$

Find a set of necessary conditions for optimal control problem.

Q3. (a) Discuss various performance indices used in optimal control.

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

$$J = \int_0^{t_1} (t\dot{x} + \dot{x}^2)\, dt \;\; ; x(0) = 1, x(1) = 5$$

Q4. What is Hamiltonian? What is the use of Hamiltonian in solving optimal control problem?

For given plant equation $\dot{x}=-x+u$ with boundary conditions x (0) = 0, x (1) = 1 and performance index $J=\frac{1}{2}\int_0^1(3x^2+u^2)dt$ find the optimal control using Hamiltonian method.

Q5. What is Pontryagin's minimum principle? Discuss the procedure for finding optimal control using pontryagin minimum priniciple with control variable and state variable inequality constraints.

Q.6. (a) Discuss Dynamic programming and its use in control.

(b) Discuss the model reference adaptive control and draw one scheme.

Q7. (a) Discuss MRAC using Lyapunov method.

(b) For the process and reference models respectively described by $\dot{x}=Ax+Bu$, $\dot{x}_m=A_mX_m+B_mr$, obtain MRAC with state feedback using Liapunov method.

Q8. (a) The transfer function of a second order plant is

$$G(s)=\frac{(s+b)}{(s^2+a_1s+a_0)}$$

With normal values a_1 = 3, a_0 = 10 and b = 2. Use a suitable control law and determine the response of the MRAC scheme with unit step input $r(t) = u(t)$, if the desired response is specified by the reference models $G_m(s)=\frac{1}{(s+1)}$.

(b) Discuss design of variable structure and adaptive model following control.

NOTE : Disclosure of Identity by writing Mobile No. or making of passing request on any page of Answer sheet will lead to UMC against the Student.