ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)

M.Tech II-Semester Regular Examinations, May 2016

Optimal & Adaptive

(Control Systems Engineering)

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

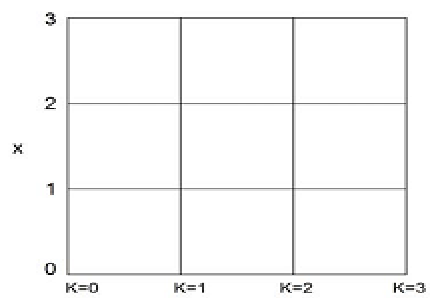
Answer ONE Question from each unit
All questions carry equal marks
All parts of the question must be answered at one place only

UNIT-I

1. a. Discuss the performance measures for different optimal control problems. 6 M

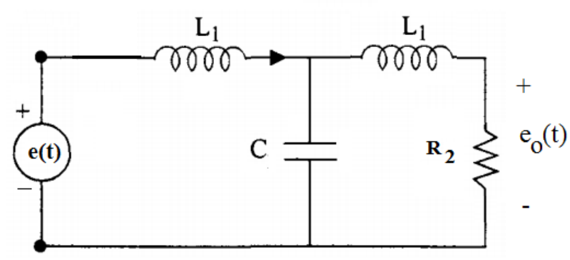
b. Define Principle of Optimality. Solve the optimal control problem by dynamic programming on the indicated grid of values, and summarize the optimal control and state sequences. 6 M

$$MinJ = X_3^2 + \sum_{k=0}^{2}\left[\; |X_k| + 2U_k^2 \; \right] \quad \text{Subject to } X_{k+1} = X_k + U_k \text{ and } X_0 = 3$$



(OR)

2. a. Obtain state variable model of the electrical network. 6 M



. b. Explain about the method for obtaining closed loop optimal control using principal of optimality and hamiltonian jacobi bellman equation. 6 M

UNIT-II

3. In the calculus of variations where the goal is to minimize

$$J(x) = \int_{t_0}^{t_f} [\quad V(x(t), \dot{x}(t), t) \quad] dt$$

Derive the necessary and sufficient conditions. Derive necessary conditions for time free and trajectory free problems. 12 M

(OR)

4. a. Find the curve $x^*(t)$ that minimizes the functional

$$J(x) = \int_{0}^{t_f} [\quad 2\dot{x}^2(t) + 24\,x(t) \quad] dt$$, X (0) =0 and X (t_f) = 1. 6 M

b. Prove that for every function which is continuous

$$\int_{t_t}^{t_t} g(t).\delta x(t)\, dt = 0$$

Where the function $\delta x(t)$ is continuous in the interval [t_o, t_f] then the function g(t) must be zero everywhere throughout the interval [t_o, t_f]. 6 M

UNIT III

5. Prove the Pontryagin's minimum principle for a system with constraints. 12 M

(OR)

6. Explain about the finite time linear quadratic regulator problem based upon calculus of variations. 12 M

UNIT IV

7. What are the different types of adaptive schemes? Explain in detail. 12 M

(OR)

8. Draw the block diagram of Model reference adaptive system and explain the adjustment of system parameters to satisfy selected error criteria. 12 M

UNIT V

9. Consider a system described by a model. $\frac{dy}{dt} = -ay + bu$ Where u is the control variable and y is the measured output. Assume that we want to obtain a closed loop system described by $\frac{dy_m}{dt} = -a_m y_m + b_m u_c$, $u(t) = \theta_1 u_c(t) - \theta_2 y(t)$. Design a Model reference adaptive system (MRAS) using MIT rule. 12 M

(OR)

10. Explain dynamic inversion MRACdesign for scalar systems. 12 M

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