

IV B.Tech II Semester Supplementary Examinations, Apr/May 2006
ADVANCED CONTROL SYSTEMS
(Electrical & Electronic Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. State the basic theorem for determining the concept of controllability of time varying system utilizing state transition matrix. Explain the same with proof. [8+8]
2. For the system

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x$$
 find a suitable Lyapunov function $V(x)$. Find an upper bound on time that it takes the system to get from the initial condition $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ to within the area defined by $x_1^2 + x_2^2 = 0.1$. [16]
3. (a) Explain the design of full-order state observer?
 (b) Consider the system

$$\text{with } A = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad C = [0 \ 1]$$
 Design a full-order state observer. Assume that the desired eigen values of the observer matrix are $\mu_1 = -1.8 + i2.4, \mu_2 = -1.8 - i2.4$. [8+8]
4. A plant is described by the equations

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u, \quad x_1(0) = 1, x_2(0) = 0$$
 Choose the feedback law $u = -K[x_1 + x_2]$
 Find the value of λ so that $J = \frac{1}{2} \int_0^\infty (x_1^2 + x_2^2 + \lambda u^2) dt$ is minimized when
 - (a) $\lambda = 0$
 - (b) $\lambda = 1$
 Also determine the values of minimum J in two cases. [4+4+4+4]
5. Illustrate with an example the problem with terminal time t_1 fixed and $x(t_1)$ free. [16]
6. (a) Explain the merits and demerits of dynamic programming problem.
 (b) For the system

$$\dot{x} = x + 4$$
 find the control vector that minimizes

$$J(x) = \frac{1}{4} x^2(t_1) + \frac{1}{4} \int_0^{t_1} u^2(t) dt$$
 final time t_1 is specified. State and control variables are not constrained by any boundaries. Obtain the Hamilton-Jacobi equation. [4+4+8]

7. Write a programme in MATLAB for drawing root locus plot for the following system whose transfer function $G(s)H(s) = \frac{K(s+6)}{s(s+4)(s^2+4s+8)}$ [16]
8. (a) What is MATLAB ? Explain its merits and demerits and give some its features?
(b) Explain the following in connection with MATLAB.
- i. Command window
 - ii. Command line editing
 - iii. Format command
 - iv. Starting MATLAB.
- [2+3+3+2+2+2+2]

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