

IV B.Tech II Semester Supplementary Examinations, April/May 2005
ADVANCED CONTROL SYSTEMS
(Electrical & Electronic Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE Questions
 All Questions carry equal marks

1. Convert the system

$$\dot{x}(t) = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 1 \end{bmatrix} x(t)$$

- (a) Find, if possible, a control law, which will drive the system

$$x(0) = 0 \text{ to } x^1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \text{ in 2 sec. from}$$

- (b) Find, if possible, the state $x(0)$ when

$$y(t) = \frac{1}{2}e^{-2t} + \frac{3}{2} \text{ for } u(t) = 1, t > 0$$

2. State stability in the sense of Lyapunov. Explain in terms of an example.

3. (a) Consider the system with

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix} \quad B = \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} \quad \text{and } C = \begin{bmatrix} 1 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Obtain equivalent system in controllable companion form

- (b) Obtain equivalent observable companion form for the system given in (a)

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 K so that $J = \frac{1}{2} \int_0^\alpha (x_1^2 + x_2^2 + \lambda u^2) dt$ is minimized when

- (a) $\lambda = 0$

- (b) $\lambda = 1$

Also determine the values of minimum J in two cases.

5. Illustrate with an example the problem with terminal time t_1 fixed and $x(t_1)$ free

6. For the system

$\dot{x} = u$ with $|u| \leq 1$, find the control which drives the system from an arbitrary

initial state to the origin and minimizes $J = \int_0^{t_1} |u(t)| dt$, t_1 is free.

7. Obtain polar plot for the following system by writing MATLAB Programme

$$G(s)H(s) = \frac{40}{s(1+0.2s)(1+0.01s)}$$

8. Explain about control system tool box in connection with MATLAB commands giving examples.

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