Code No: NR321304 **NR**

III B.Tech II Semester Supplementary Examinations,
November/December 2005
ADVANCED CONTROL SYSTEMS
(Electronics & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Convert the system

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

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

   (a) Find, if possible, a control law, which will derive the system from $X(0) = 0$ *to* $x^1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ in 2 sec.

   (b) Find, if possible, the state x(0) when $y(t) = \frac{1}{2}e^{-2t} + \frac{3}{2}$ *for* $u(t) = 1,\ t > 0$ [8+8]

2. (a) Explain the second method of Lyapunov for the stability analysis of control systems.

   (b) Determine the stability of the origin of the following system [8+8]

$$\dot{x}_1 = x_1 - x_2 - x_1^3$$

$$\dot{x}_2 = x_1 + x_2 - x_2^3$$

3. Consider the system where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad and\, C = [1\ 0\ 0]$$

   It is desired to design a full-order observer. Determine the observer gain matrix by use of the direct substitution method.
   Assume that the desired eigen values of the observer gain matrix are
   $\mu_1 = -2 + j2\sqrt{3}, \quad \mu_2 = -2 - j2\sqrt{3}, \quad \mu_3 = -5$ [16]

4. (a) Explain Tracking Problem?

   (b) Explain Minimum fuel Problem? [8+8]

5. (a) Find the extermal for the following functional:

$$J(x) = \int_0^{t_1} \frac{\sqrt{1+\dot{x}^2}}{x} dt$$

   x(0) = 0 and $x(t_1) = t_1 - 5$

(b) Distinguish between functions and functionals. [10+6]

6. (a) Derive the transfer matrix relation from state space representation

   (b) The state space triple (A, B, C,) of a system is given by [6+10]

   $$A = \begin{bmatrix} 0 & 1 & 0 \\ 2 & 3 & 0 \\ 1 & 1 & 1 \end{bmatrix}; \mathrm{B} = \begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix}; \mathrm{C} = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

   Calculate the input and output decoupling zeros, if any. Is the matrix A cyclic? Find out the transfer matrix T(s).

7. Design a phase lead compensator such that a system with $G(s) = \frac{8}{s(s+1)(s+4)}$ has a phase margin of 45^0 and a steady state error of 0.25 due to ramp input Write a MATLAB Programme for the above problem. [16]

8. (a) Write short notes on the following in MATLAB

      i. String evaluation

      ii. Switch giving suitable examples.

   (b) Describe about error and warning message in MATLAB [8+8]

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