Code No: NR420202 **Set No.1**

IV B.Tech. II Semester Supplementary Examinations, July -2005
ADVANCED CONTROL SYSTEMS
(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Suppose you are given a n-dimensional linear time-invariant system. How do you transform into a observability canonical form. State and prove the theorem used.

2. What are the different types of stability? Define and explain each of them with examples.

3. (a) Consider the system of
$$A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 2 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \quad and\, C = \begin{bmatrix} 1 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$
For this system, design an observer of order one. The observer pole is required to be located at -4.

   (b) With a neat sketch explain a full order state observer

4. (a) Explain output Regulator problem?

   (b) Consider the linear plant of a system characterized by the transfer function G(s)0=100/s^2. Make the output C(t) follow a unit step input r(t) minimizing. J=$\int_0^{\alpha} \{(x(t) - c(t)^2 + 0.25u^2(t)\}dt$ where u(t) is the actuating signal of the plant.

5. (a) Derive Euler-Lagrange equation.

   (b) Given $\dot{x} = -\mathrm{x} + \mathrm{u}; \mathrm{x}(0) = \mathrm{x}^0, \mathrm{x}(2) = \mathrm{x}^1.$

   Find $\mathrm{x}*$ that minimizes

$$J = \int_0^2 (x^2 + u^2)dt$$

6. (a) State and prove optimal control problem based on dynamic programming in discrete time system

   (b) Explain the principles of causality and invariant imbedding.

7. Write the MATLAB Programme for finding the error constants for

   (a) step

(b) ramp

(c) parabolic inputs and steady state error of the system for all the inputs whose transfer function is given by G(s) H (s) = $\frac{10(s+4)}{(s+1)\,(s+3)\,(s+5)}$

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

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Code No: NR420202 **Set No.2**

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ADVANCED CONTROL SYSTEMS
(Electrical & Electronic 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 $x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ in2sec.

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

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 $x_1^2 + x_2^2 = 0.1$

3. (a) Find a three - dimensional observer with eigen values -2, -2, -3, for the system
$$\dot{X} = \begin{bmatrix} -1 & -2 & -2 \\ 0 & -1 & 1 \\ 1 & 0 & -1 \end{bmatrix} x + \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix} u$$
$$y = [1\ 1\ 0]\ x$$

   (b) Show that the zeros of a scalar systems are invariant under linear state feedback to the input.

4. (a) Explain Minimum - Time problem?

   (b) Explain State Regulator problem in brief?

5. Illustrate with an example the problem with terminal time $t_1$freeandx(t_1)fixed

6. (a) State and prove optimal control problem based on dynamic programming in discrete time system

   (b) Explain the principles of causality and invariant imbedding.

7. (a) Write a program in MATLAB for conversion of continuous state space to discrete state space using MATLAB commands .Illustrate with an example.
   (b) Write a program in MATLAB convert transfer function in to state space model Explain taking an example.
8. (a) How do you perform the following operations using MATLAB ?
      i. To find eigen values
      ii. Matrix multiplication
      Illustrate with examples.
   (b) Write short notes on
      i. Relational and logic operations
      ii. Matrices operations and functions using MATLAB techniques

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Code No: NR420202 **Set No.3**

IV B.Tech. II Semester Supplementary Examinations, July -2005
ADVANCED CONTROL SYSTEMS
(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks
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1. Define Minimum energy control. State the theorem and prove the same.

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

3. (a) Explain the different methods of determination of observer gain matrix
   (b) Consider the system described by the state model
   $\dot{X} = Ax \quad where\ A = \begin{bmatrix} -1 & +1 \\ 1 & -2 \end{bmatrix};\ C = [1,\ 0]$ Y =Cx
   Obtain the state observer gain matrix using all 3 methods. The desired given values for the observer matrix are $\mu_1 = -5, \mu_1 = -5$.

4. (a) Determine the optimal control law for the system described by
   $\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ x+ $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$ u
   Such that the following performance index is minimized J=$\int\limits_0^{\alpha} (x^T x + u^2) dt$
   (b) Discuss infinite-time state regulator problem?

5. (a) Derive the transversality condition in extermination of functions.
   (b) Prove that for the functional
   $J(x) = \int\limits_{t_0}^{t_1} A(x,t)\sqrt{1 + \dot{x}^2}\,dt$
   the transversality condition reduces to orthogonlity is $\dot{x}\dot{y} = -1$ where y(t) is the curve on which the movable right points lies.

6. (a) State and prove optimal control problem based on dynamic programming in discrete time system
   (b) Explain the principles of causality and invariant imbedding.

7. Obtain Bode plot for the following system and write a programme in MATLAB.
   G(s)H(s) $= \frac{100}{s(1+0.1s)\,(1+0.05s)}$

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

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Code No: NR420202 **Set No.4**

IV B.Tech. II Semester Supplementary Examinations, July -2005
ADVANCED CONTROL SYSTEMS
(Electrical & Electronic 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 $x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ in2sec:

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

2. What are the different types of stability? Define and explain each of them with examples.

3. (a) Consider the system with

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

   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

$$x = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u x_1(0) = 1 x_2(0) =$$ Choose the feedback law $u = -K[x_1 + x_1]$

   Find the value of " k" so that $J = 1/2 \int_0^{\alpha} (x_1^2 + x_2^2 + \lambda u^2) dt$ is minimized when

   (a) $\lambda = 0$

   (b) $\lambda = 1$

   Also determine the values of minimum J in two cases.

5. Formulate the two point boundary value problem which when solved, yields the optimal control $u*(t)$for the system

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

$$\dot{x}_2 = x_1 + (1 - x_1^2)x_2 + u$$

x(0) = [10]T

$$J = \frac{1}{2}\int_{0}^{2} (2x_1^2 + x_2^2 + u^2)dt$$

(a) When u(t) is not bounded

(b) $|U(t)| \leq = 1.0$

6. (a) State and prove optimal control problem based on dynamic programming in discrete time system

   (b) Explain the principles of causality and invariant imbedding.

7. Write the MATLAB Programme for finding the error constants for

   (a) step

   (b) ramp

   (c) parabolic inputs and steady state error of the system for all the inputs whose transfer function is given by G(s) H (s) = $\frac{10(s+4)}{(s+1)\,(s+3)\,(s+5)}$

8. (a) What menu interface to PC MATLAB? How do you perform using MATLAB Commands Giving examples.

   (b) Explain how different functions are used in MATLAB with examples.

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