Code No: RR410205 **RR** **Set No. 2**

IV B.Tech I Semester Examinations,November 2010
ADVANCED CONTROL SYSTEMS
Electrical And Electronics Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain Minimum - Time problem?
   (b) Explain State Regulator problem in brief? [8+8]

2. (a) Consider a linear system described by the differential equation $\ddot{y} + 2\dot{y} + y = \dot{u} + u$ Test for controllability and observability.
   (b) Define and explain the concept of controllability. [8+8]

3. (a) Find U* for the system $\dot{x}$ = -x + u x (0) = 1 which minimizes
   $$J = \frac{1}{2}\int_0^2 (x^2 + u^2)dt$$
   (b) What is a Hamiltonian. Formulate the optimal control problem in terms of Hamiltonian. [8+8]

4. (a) A single-input system is described by the following state equation.
   $$\dot{X} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 0 & 1 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u$$
   Design a state feedback controller which will give closed-loop poles at $1 \pm j2, -6$.
   (b) Draw the block diagram and deduce the expression for transfer function for the controller-observer. [8+8]

5. Obtain the Hamilton- Jacobi equation for the system
   $X_1 = X_2$
   $X_2 = 2X_1 + 4$
   J = X(0) = 0
   To minimize
   $$J = 1/2X^2(t_1)\int_0^{t_1} 1/2(x_1^2 + x_2^2 + u^2)dt$$
   Final t_1 is specified . U(t) and X (t) are not constrained. [16]

6. Check the stability of the system described by
   $\dot{x}_1 = -x_1 + 2x_1^2 x_2$
   $\dot{x}_2 = -x_2$
   by using the variable gradient method. [16]

7. The following equation is called the Van der Pol equation.
   $\ddot{x} - (1 - x)\dot{x} + x = 0$
   Determine the type of the singular point and Draw a phase - plane portrait. [16]

8. (a) Explain the multivalued responses and jump phenomenon
   (b) Determine the describing function for the nonlinear element described by
   y = x^3
   where x = input to the nonlinear element (sinusoidal signal) and y = output of the nonlinear element. [8+8]

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Code No: RR410205 **RR** **Set No. 4**

IV B.Tech I Semester Examinations,November 2010
ADVANCED CONTROL SYSTEMS
Electrical And Electronics Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Check the stability of the system described by
$\dot{x}_1 = -x_1 + 2x_1^2x_2$
$\dot{x}_2 = -x_2$
by using the variable gradient method. [16]

2. (a) Explain the multivalued responses and jump phenomenon
(b) Determine the describing function for the nonlinear element described by
$y = x^3$
where x = input to the nonlinear element (sinusoidal signal) and y = output of the nonlinear element. [8+8]

3. (a) Explain Minimum - Time problem?
(b) Explain State Regulator problem in brief? [8+8]

4. (a) A single-input system is described by the following state equation.
$$\dot{X} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 0 & 1 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u$$
Design a state feedback controller which will give closed-loop poles at $1 \pm j2, -6$.
(b) Draw the block diagram and deduce the expression for transfer function for the controller-observer. [8+8]

5. (a) Find U* for the system $\dot{x}$ = -x + u x (0) = 1 which minimizes
$$J = \frac{1}{2}\int_0^2 (x^2 + u^2)dt$$
(b) What is a Hamiltonian. Formulate the optimal control problem in terms of Hamiltonian. [8+8]

6. The following equation is called the Van der Pol equation.
$\ddot{x} - (1 - x)\dot{x} + x = 0$
Determine the type of the singular point and Draw a phase - plane portrait. [16]

7. (a) Consider a linear system described by the differential equation $\overset{oo}{y} + 2\overset{o}{y} + y = \overset{o}{u} + u$ Test for controllability and observability.

(b) Define and explain the concept of controllability. [8+8]

8. Obtain the Hamilton- Jacobi equation for the system
   $X_1 = X_2$
   $X_2 = 2X_1 + 4$
   $J = X(0) = 0$
   To minimize
   $J = 1/2X^2(t_1)\int_0^{t_1} 1/2(x_1^2 + x_2^2 + u^2)dt$
   Final t_1 is specified . U(t) and X (t) are not constrained. [16]

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Code No: RR410205 **RR** **Set No. 1**

IV B.Tech I Semester Examinations,November 2010
ADVANCED CONTROL SYSTEMS
Electrical And Electronics Engineering

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

Answer any FIVE Questions
All Questions carry equal marks
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1. The following equation is called the Van der Pol equation.
   $\ddot{x} - (1 - x)\dot{x} + x = 0$
   Determine the type of the singular point and Draw a phase - plane portrait. [16]

2. (a) Find U* for the system $\dot{x}$ = -x + u x (0) = 1 which minimizes
   $$J = \frac{1}{2}\int_0^2 (x^2 + u^2)dt$$
   (b) What is a Hamiltonian. Formulate the optimal control problem in terms of Hamiltonian. [8+8]

3. (a) Consider a linear system described by the differential equation $\overset{oo}{y} + 2\overset{o}{y} + y = \overset{o}{u} + u$ Test for controllability and observability.
   (b) Define and explain the concept of controllability. [8+8]

4. Check the stability of the system described by
   $\dot{x}_1 = -x_1 + 2x_1^2 x_2$
   $\dot{x}_2 = -x_2$
   by using the variable gradient method. [16]

5. (a) Explain Minimum - Time problem?
   (b) Explain State Regulator problem in brief? [8+8]

6. Obtain the Hamilton- Jacobi equation for the system
   $X_1 = X_2$
   $X_2 = 2X_1 + 4$
   $J = X(0) = 0$
   To minimize
   $J = 1/2X^2(t_1)\int_0^{t_1} 1/2(x_1^2 + x_2^2 + u^2)dt$
   Final t_1 is specified . U(t) and X (t) are not constrained. [16]

7. (a) A single-input system is described by the following state equation.
   $$\dot{X} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 0 & 1 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u$$
   Design a state feedback controller which will give closed-loop poles at $1 \pm j2, -6$.

(b) Draw the block diagram and deduce the expression for transfer function for the controller-observer. [8+8]

8. (a) Explain the multivalued responses and jump phenomenon

   (b) Determine the describing function for the nonlinear element described by
   y = x^3
   where x = input to the nonlinear element (sinusoidal signal) and y = output of the nonlinear element. [8+8]

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Code No: RR410205 **RR** **Set No. 3**

IV B.Tech I Semester Examinations,November 2010
ADVANCED CONTROL SYSTEMS
Electrical And Electronics Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Obtain the Hamilton- Jacobi equation for the system
   $X_1 = X_2$
   $X_2 = 2X_1 + 4$
   $J = X(0) = 0$
   To minimize
   $J = 1/2X^2(t_1)\int_0^{t_1} 1/2(x_1^2 + x_2^2 + u^2)dt$
   Final t_1 is specified . U(t) and X (t) are not constrained. [16]

2. (a) Explain the multivalued responses and jump phenomenon
   (b) Determine the describing function for the nonlinear element described by
   $y = x^3$
   where x = input to the nonlinear element (sinusoidal signal) and y = output of the nonlinear element. [8+8]

3. The following equation is called the Van der Pol equation.
   $\ddot{x} - (1 - x)\dot{x} + x = 0$
   Determine the type of the singular point and Draw a phase - plane portrait. [16]

4. (a) Explain Minimum - Time problem?
   (b) Explain State Regulator problem in brief? [8+8]

5. (a) Consider a linear system described by the differential equation $\overset{oo}{y} + 2\overset{o}{y} + y = \overset{o}{u} + u$ Test for controllability and observability.
   (b) Define and explain the concept of controllability. [8+8]

6. Check the stability of the system described by
   $\dot{x}_1 = -x_1 + 2x_1^2 x_2$
   $\dot{x}_2 = -x_2$
   by using the variable gradient method. [16]

7. (a) A single-input system is described by the following state equation.
   $$\dot{X} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 0 & 1 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u$$
   Design a state feedback controller which will give closed-loop poles at $1 \pm j2, -6$.
   (b) Draw the block diagram and deduce the expression for transfer function for the controller-observer. [8+8]

8. (a) Find U* for the system $\dot{x}$ = -x + u x (0) = 1 which minimizes

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

(b) What is a Hamiltonian. Formulate the optimal control problem in terms of Hamiltonian. [8+8]

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