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Code No: **RT42022A** 

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2018

ADVANCED CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

[6]

Question paper consists of Part-A and Part-B Answer ALL sub questions from Part-A Answer any THREE questions from Part-B \*\*\*\*\*

## PART-A (22 Marks)

1.	a)	State the significance of state transition matrix.	[4]
	b)	What do you mean by principle of duality?	[4]
	c)	Explain the effect of inherent nonlinearities on static accuracy.	[4]
	d)	What are the different types of stability?	[3]
	e)	State the fundamental theorem of the calculus of variations.	[4]
	f)	What is the difference between the LQR and LQG?	[3]

## <u>**PART-B**</u> (3x16 = 48 Marks)

2. a) Explain the concept of state? Write the observable canonical form?
b) The following facts are known about the linear system x(t) = Ax(t)

The following facts are known about the linear system 
$$\dot{x}(t) = Ax(t)$$
  
If  $x(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ , then  $x(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$   
If  $x(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$ , then  $x(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$  Find  $e^{At}$  and hence A [10]

b) Convert the following state model into the Jordan canonical form and there from comment on controllability and observability.

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -4 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ -1 & 1 \end{bmatrix} u(t), \quad y(t) = \begin{bmatrix} 0 & 1 & -1 \\ 1 & 2 & 1 \end{bmatrix} x(t)$$
[10]

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$$\begin{bmatrix} \dot{x}_1\\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 1\\ 2 & -3 \end{bmatrix} \begin{bmatrix} x_1\\ x_2 \end{bmatrix}$$
[9]

- 6. a) With suitable diagrams illustrate the one point is fixed end, terminal time t<sub>1</sub> is specified and x(t<sub>1</sub>) free end problem and derive the necessary conditions of variational calculus.
  - b) Find the extremals for the functional  $J(x) = \int_0^1 [x^2(t) + \dot{x}^2(t)] dt; \ x(0) = 0, x(1) = 1$ [8]
- 7. How LQG frame work can be used to design optimal controller? Explain with mathematical equations. [16]

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