

Registration No. :

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Total number of printed pages – 2

B. Tech  
PEEC 5414

Seventh Semester Back Examination – 2014

ADVANCED CONTROL SYSTEMS

BRANCH (S) : EC, EEE, ELECTRICAL, ETC

QUESTION CODE : L 161

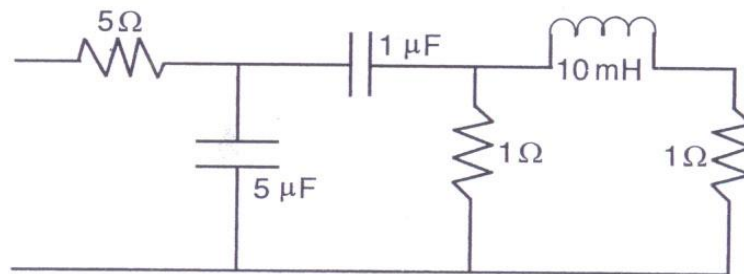
Full Marks – 70

Time : 3 Hours



Answer Question No. 1 which is compulsory and any **five** from the rest.  
The figures in the right-hand margin indicate marks.

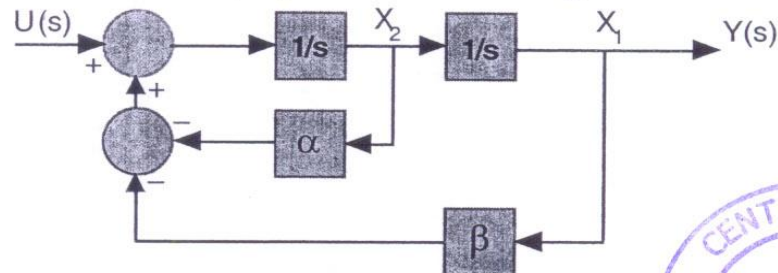
1. Answer the following questions : 2×10
- (a) Write down the definitions of z-transform and Laplace transform. Mention the nature of signals to which they can be applied.
  - (b) What do you understand by a Sample-and-Hold circuit ?
  - (c) Determine the z-transform of a unit step signal.
  - (d) What is the difference between a differential equation and a difference equation ? Give an example of a difference equation.
  - (e) Define Pulse Transfer Function. Is it always true that  $G(z)H(z) = GH(z)$  ?
  - (f) What is the minimum no. of state variables necessary to describe the network shown in figure ?



- (g) A system is described by the differential equation  $\ddot{y} + 2\dot{y} + 3y = 0$ . Write down the system matrix A in  $\dot{X} = AX$  in controllable canonical form.
- (h) What do you mean by the 'State Transition Matrix' ? List its properties.
- (i) What do you understand by 'Phase Trajectory' ? Name two methods used to draw the phase trajectory.
- (j) What is the difference between a memory-less non-linearity and a non-linearity with memory ?

P.T.O.

2. (a) Find the Z-transform of  $e^{-at} \sin wt$ . 5
- (b) Find the inverse Z-transform of  $\frac{(1 - e^{-at})z}{(z-1)(z - e^{-at})}$ . 5
3. (a) Obtain the Laplace Transform of a zero-order-hold. 5
- (b) Obtain the z-transform of a system comprising of a zero-order hold followed by a plant with a transfer function  $G(s) = \frac{1}{s+1}$ . 5
4. (a) A state variable system  $\dot{X}(t) = \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$ . Find out the state transition matrix of the system. 5
- (b) The transfer function of a system is given by  $G(s) = \frac{2s+1}{s^2+7s+12}$ . Obtain the state model of the system in observable phase variable form and diagonal canonical form. 5
5. (a) Consider the closed loop system shown in figure.



- Obtain the state model of the system and determine the eigen values of the system. 5
- (b) Comment on the controllability and observability of the above system. 5
6. (a) Obtain transfer function of the system given below. 6
- $$\dot{X}(t) = \begin{bmatrix} 1 & -2 \\ -2 & 4 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u, y = [1 \ 0] X.$$
- (b) Define the terms 'Controllability' and 'Observability'. 4
7. (a) Describe the various types of stability considered for a non-linear system. 5
- (b) What do you understand by the term 'Jump Resonance'? 5
8. Write short notes any **two**: 5x2
- (a) Bilinear Transformation
- (b) Lyapunov Function
- (c) Common physical non-linearities
- (d) Limit Cycle.