Registration no: | | | | | | | | | | |

Total Number of Pages: 02

B.TECH
PEEC5414

7th Semester Regular / Back Examination 2015-16
ADVANCED CONTROL SYSTEMS
BRANCH: EEE
Time: 3 Hours
Max marks: 70
Q.CODE: T481
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: **(2 x 10)**

a) What is discrete convolution?

b) Show that the eigen values of a system remain invariant under similarity transformation.

c) Determine the Z-transform of $\cos \omega t$.

d) Obtain the z-transform of $X(s) = \frac{1}{s(s+1)}$.

e) The state variable description of a linear autonomous system is $\dot{X} = AX$, where X is the state vector and $A = \begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix}$. Find out the location of the system poles.

f) A system is represented by $\dddot{y} + 2\ddot{y} + 5\dot{y} + 6y = 5x$. If the state variables are $x_1 = y, x_2 = \dot{y}\ and\ x_3 = \ddot{y}$, then write down the coefficient matrix A.

g) Determine the final value $x(\infty)$of

$$X(z) = \frac{1}{1 - z^{-1}} - \frac{1}{1 - e^{-aT}z^{-1}}, \qquad a > 0$$

h) What do you mean by 'Phase Plane' and 'Phase Trajectory'?

i) Differentiate between 'Memoryless non-linearity' and 'Non-linear with memory' with an example in each case.

j) Write down Lyapunov's first method for determining stability of non-linear systems.

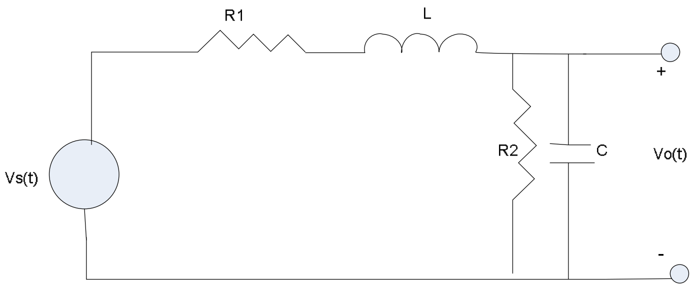
Q2 Find the inverse Z-transform of **(10)**

$$\frac{z^2 + z + 2)}{(z - 1)(z^2 - z + 1)}$$

Q3 a) Obtain the z-transform of a system comprising of a zero-order hold followed by a plant with a transfer function $G(s) = \frac{1}{s^2+1}$. **(6)**

b) What is Bilinear Transformation? Why is it important in the context of discrete-time systems? **(4)**

Q4 a) Select a set of proper state variables and write down the state equations to represent the system shown below. **(5)**



b) The transfer function of a system is given by **(5)**

$$\frac{Y(s)}{R(s)} = \frac{b_2 s^2 + b_1 s + b_0}{s^3 + a_2 s^2 + a_1 s + a_0}$$

Write down the state model in any form and draw the signal flow graph.

Q5 The state equation of a linear time-invariant system is given as **(10)**

$$\dot{X}(t) = \begin{bmatrix} 0 & 5 \\ -1 & -2 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} [u], \qquad y = [1\ 1]X$$

Determine

(i) The characteristic equation and eigen values

(ii) The state transition matrix

(iii) The transfer function

Also draw the state diagram.

Q6 a) A linear time-invariant system is described by the differential equation **(5)**

(5)

$$\frac{d^3 y(t)}{dt^3} + 8\frac{d^2 y}{dt^2} + 17\frac{dy}{dt} + 10y = 2\frac{d^2 u}{dt^2} + +3\frac{du}{dt} + 5u$$

Where $y(t)$ is the output and $u(t)$ is the input. Define the state variables and represent the system in controllable canonical form.

b) Consider the matrix $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$.Compute e^{At} using Cayley-Hamilton Theorem. **(5)**

Q7 a) Define the terms 'Controllability' and 'Observability'. **(4)**

b) Check for 'Controllability' and 'Observability' of the system given below. **(6)**

$$\dot{X}(t) = \begin{bmatrix} 1 & -2 \\ -2 & 4 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 0]\, X$$

Q8 Write short notes on any two: **(5 x 2)**

a) Phase Portraits for different eigen values

b) Diagonalization Techniques

c) Zero Order Hold

d) Jump Resonance