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

Total Number of Pages: 02 **B.Tech**
PEEC5414

7th Semester Regular / Back Examination 2016-17
ADVANCED CONTROL SYSTEMS
BRANCH(S): EE, EEE
Time: 3 Hours
Max Marks: 70
Q.CODE: Y210

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) Write down the expression for the Z-transform of $f\,[(n+k)]$. Prove the same.

b) Define Pulse Transfer function. Draw the block-diagrammatic configuration of a sampled-data system, whose pulse transfer function cannot be determined.

c) Determine the Z-transform of $e^{-at}\sin\omega t$.

d) Where should the z-plane poles be located for stability of the discrete-time control system?

e) The state model of an RLC system is given by the following differential equations.

$$\dot{x}_1 = -\frac{1}{C}x_2 + \frac{1}{C}u(t)$$
$$\dot{x}_2 = -\frac{1}{L}x_1 - \frac{R}{L}x_2$$
$$v_0 = Rx_2$$

f) What do you understand by 'Similarity Transformation'? Do the eigen values change under similarity transformation?

g) If the eigen vales of a system are -1,-1 and -2, write down the state transition matrix.

h) What do you infer about the controllability or observability of a system if the transfer function has pole-zero cancellation?

i) Discuss some of the properties of non-linear systems which they differ from the linear systems?

j) What do you mean by piece-wise linear systems?

Q2 **a)** Obtain the Z-transform of the function $f(k) = \frac{a^k}{k!}$ **(6)**

b) Determine the initial and final value of the following function. **(2+2)**

$$f(z) = \frac{z^2 + 2z + 1}{z^3 + 3z^2 + 3z + 1}$$

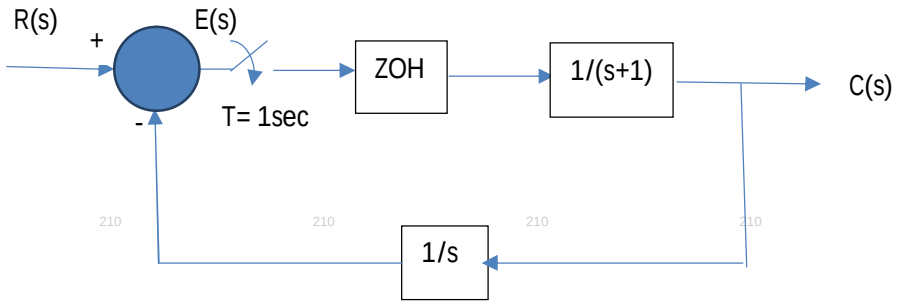
Q3 **a)** Find the inverse Z-transform of **(6)**

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

By Residue method.

b) Explain the function of Sample and Hold device. **(4)**

Q4 Determine the unit step response of a sampled data control system shown in figure. **(10)**



Q5 **a)** Determine the eigen vectors if the system matrix is given by **(6)**

$$A = \begin{bmatrix} 1 & 1 & 2 \\ 0 & 2 & 1 \\ 0 & 0 & 2 \end{bmatrix}$$

b) Obtain the normal form of the state model for the system whose transfer function is given by **(4)**

$$T(s) = \frac{Y(s)}{U(s)} = \frac{s+1}{(s+1)^2(s+2)}$$

Q6 **a)** Find e^{At} for $A = \begin{bmatrix} 0 & 1 \\ -4 & -4 \end{bmatrix}$ using Cayley-Hamilton Theorem. **(5)**

b) Find out the transfer function of a system whose state model is given by **(5)**

$$\dot{X} = \begin{bmatrix} -1 & 0 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$
$$Y = [1 \quad 1]X$$

Q7 **a)** Define controllability and observability of a system. Test the controllability of the following system by Kalman's test. **(6)**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u$$
$$y = x_1$$

b) What is Limit cycle? Explain about stable and unstable limit cycles with suitable diagrams. **(4)**

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) Diagonalisation
b) Describing Function Method
c) Jump Resonance
d) Pole Placement by State Feedback