Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**
PEE6J004

6th Semester Regular / Back Examination 2018-19
CONTROL SYSTEM ENGINEERING - II
BRANCH : ELECTRICAL
Max Marks : 100
Time : 3 Hours
Q.CODE : F752

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Define transfer function and pulse transfer function.
b) Explain the aliasing effect in sampling theorem.
c) What is Eigen value and state its significance?
d) What do you mean by zero input stability?
e) Find the Z-transform of $f(t) = e^{-at}\cos\omega t$.
f) What do you understand by limit cycle?
g) States and prove the properties of state transaction matrix.
h) The transfer function of certain system is $\frac{Y(s)}{U(s)} = \frac{1}{s^4 + 5s^3 + 7s^2 + 6s + 3}$. Write down the matrix A, B of equivalent state model.
i) State and explain the Cayley Hamilton Theorem.
j) Explain the mapping concept between S-plane and Z-plane.

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) The state model of linear time invariant system is given by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & -2 \\ 1 & 0 & -5 \\ 0 & 1 & -9 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix} u$. Determine the canonical form of state variable.
b) Explain the classification of non-linearities and give the example each.
c) A linear time invariant system is characterized by the homogeneous state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Determine the solution of homogeneous equation, assuming the initial state vector

$$x_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}.$$

d) Check the positive definite for given quadratic form as follows $Q = x_1^2 + 4x_2^2 + x_3^2 + 2x_1x_2 - 6x_3x_2 - 2x_1x_3$.
e) Explain the effect of state feedback on controllability and observabilty.

f) Find IZT of $F(Z)=\dfrac{1}{z^2(z-1)^2(z+1)}$ by residue method.

g) Check the observability of the system $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u, y=\begin{bmatrix}3 & 4 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$

h) Investigate the stability of the system described by $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$.. Use Lyapunovv method for stability. Take Lyapunov function $V(x)=x_1^2+x_2^2$.

i) Explain the Isocline method for construction of trajectories.

j) Find the state transition matrix for the following unforced system $\dot{x}=\begin{bmatrix}-2 & 1 & 0\\ 0 & -2 & 1\\ 0 & 0 & -2\end{bmatrix}$

k) Determine the eigen vectors of the given matrix $A=\begin{bmatrix}1 & 1 & 2\\ 0 & 2 & 1\\ 0 & 0 & 2\end{bmatrix}$.

l) Define the stability of the system in Z-domain. Explain the necessary and sufficient conditions for Jury stability to verify the system is stable.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 The state equation of linear time invariant system is $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ -1 & -2 & 1\\ 3 & 0 & -2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}1\\ 2\\ 1\end{bmatrix}u$. **(16)**

Consider the closed loop poles at $-1.5\pm j4, -5.5$, design a state feedback controller.

Q4 What is nonlinear system? Define intentional and incidental non-liearities. Explain the non-linearities from each one and give the example each. **(16)**

Q5 Draw the magnitude and phase response (frequency response) of a zero order hold. Derive the required expression. **(16)**

Q6 Determine the unit step response ofa sampled data control system shown in figure **(16)**