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

Total Number of Pages: 02 **M.TECH**

EIPC201

2nd Semester BackExamination 2016-17

CONTROL SYSTEM DESIGN

BRANCH(S): APPLIED ELECTRONIC & INSTRUMENTATION ENGG, ELECTRONIC&INSTRUMENTATION ENGG.

Time: 3 Hours

Max Marks: 70

Q.CODE:Z481

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 question** (2 x 10)

a) Discuss advantages and disadvantages of feedback control system

b) Derive the relation to convert state space model into transfer function

c) What does it mean to say that a system is uncontrollable? Justify your explanation mathematical formulation.

d) What is the difference between pole placement and state observer.

e) What is the function of control system regulator?

f) Define minimum and non-minimum phase transfer function with example

g) Given A =[0 1 2 3] , B=[0 1] , C[2 4]

Find transfer function of the system

h) Draw the frequency response characteristics of a zero-order hold device

i) Draw the polar plot of simple RC circuit

j) State Ackerman's rule

Q2 a) Write the useful properties of state transition matrix (5)

b) Consider a control system with state model (5)

$$\begin{bmatrix} x1 \\ x2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & 3 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix}, \quad \begin{bmatrix} x1(0) \\ x2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

u= unit step

Compute the state transition matrix and find the state response.

Q3 A system matrix is given by $F = \begin{bmatrix} 1 & 2 & 3 \\ -20 & 3 & 4 \\ 0 & 0 & -2 \end{bmatrix}$, $G = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ (10)

a) Determine whether the system is stable or not

b) If the pole placement controller

$k = [1.649 \quad 3.5032 \quad 10.3]$ Is this close loop system stable?

Q4 Design Lag-Lead compensator for the unity feedback system with feed-forward transfer function G(s)=$\frac{K}{S(S+5)(S+11)}$ to satisfy the following specification (10)

The system operates with damping ratio 0.5, reduce the peak time by a factor of 2% overshoot by a factor of 2and improve the steady state error by a factor of 8.

Q5 a) Given A= $\begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$ (5)

F(A) = e^{At}

Determine F^k using Caley Hamilton Theorm

b) If x(k+1)=Fx(k)+Gu(k) and y(k)=x(k)+Du(k) where ; (5)

F= $\begin{bmatrix} 0.5 & 1 & 0 \\ -1 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$, G= $\begin{bmatrix} 1 & 4 \\ 0 & 0 \\ -3 & 2 \end{bmatrix}$, C= $[1 \quad 0 \quad 0]$

Determine whether the system is completely

i) State controllable ii) Observable

Q6 a) Consider the characteristics polynomial Δ(z) = $8z^4$+ $4z^{3+}$ $2z^2$ + $4z$ = 0 (5)

Determine the stability of the system by Jury's stability

b) Determine the stability of the system in the characteristics equation (5)

F(z) = z^3+ $6z^2$+11z+6=0

By Bilinear Transformation

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

a) Kalman's controllability

b) Design of a Regulator

c) Reduced ordered observer

d) Tuning Rules of Ziegler and Nichol's method