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

Total Number of Pages: 02

M-TECH
EIPC201

2nd Sem M-Tech Regular/ Back Examination – 2015-16
CONTROL SYSTEM DESIGN
Time: 3 Hours
Max marks: 70
Q.CODE:W887
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) Define Pulse transfer function and write the transfer function of Zero order hold.

b) Check Observability $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = Ax + Bu$

c) State Lyapunov theorem.

d) Write the difference between differential equation and difference equation.

e) State the sufficient conditions of Jury stability.

f) Write the relation between Z and S transform with diagram.

g) Explain the term integral reset time and proportional band.

h) State initial and final value theorem.

i) Write the properties of state transition matrix

j) State and explain Ackerman's formula.

Q2 a) Explain the describing function methods of analysis of non-linear control system. (5)

b) A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(s+1)(0.2s+1)}$. (5)

Design a phase–lag compensation for the system to achieve the following specifications: Velocity error constant K_v= 8, phase margin =40 degrees.
Also compare the cross over frequency of the uncompensated and compensated system.

Q3 A discrete time system is described by the stste model $x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -2 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} r(k)$. Design a state feedback controller which will (10) place the closed loop poles at z= -0.5 ± j0.5 and z=0. Verify the result by applying Ackerman’s formula.

Q4 Using the Root locus method to design controller for a plant with transfer function $G(s)=\frac{2}{(S+2)(S+4)(S+6)}$, such that (i) the system has zero steady state error , (ii) a dominant pole pair with a damping factor between 0.6 to 0.8 and the natural frequency range 2 to 4 rad/sec. (10)

Q5 a) State Cayley-Hamilton and Explain. (5)

b) Find the f(A)= e^{At} for $A=\begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$. (5)

Q6 a) Consider the discrete time unity feedback control system (with sampling period T=1 sec) whose open loop transfer function is given by $G(z)=\frac{K(0.3679z+0.2642)}{(z-0.3679)(z-1)}$. (5)

Determine the range of K for stability by using Jury’s stability test.

b) Explain the loss of controllability, Observability and stability due to sampling. (5)

Q7 A process with transfer function $G(S)=\frac{S^2-2S+5}{(S+2)(S+5)}$ is placed under PID controller. Use the Ziegler-Nicolas second method to determine the required tuning parameters. Sketch the closed loop controlled system block diagram. (10)

Q8 Short Notes (Any two) (5 x 2)

a) Digital Servo for Inverted Pendulum

b) Absolute and relative Stability

c) Back lash and Relay