Total No. of Questions : 8]

SEAT No. :

P2289

[Total No. of Pages : 4

[5254]-623

B.E. (Electrical) (End sem)

CONTROL SYSTEM – II

(2012 Pattern)

Time : 3:00 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data if necessary.*

Q1) a) The Open – loop transfer function of a unity feedback system is given by

$$G(s)\frac{1}{s(1+0.2s)}$$

Specifications for the system are :

. *Accuracy for a unit ramp input < 2%, i,e. steady-state error < 0.02.*

. *Phase Margin > 48°.*

The PM obtained from the open loop uncompensated system is 18°. The frequency at which the gain has approximately the value = –6. 1dB is $\omega_m = 22.2\ rad/sec.$

Determine the transfer function of the lead compensator. Assume factor of safety, $\epsilon = 8°$. Draw the Bode plot for the compensated system. **[8]**

b) Find the state model of the system whose transfer function is given as

$$\frac{Y(s)}{U(s)} = \frac{3s^2+7s+15}{s^3+7s^2+14s+8}$$ **[8]**

c) State the necessity of an Observer? **[4]**

OR

P.T.O.

Q2) a) Given the transfer function $\frac{Y(s)}{U(s)} = \frac{10}{s^3 + 3s^2 + 2s}$ Design a state feedback controller so that eigen values of the closed loop system are at $-2, -1 \pm j1$. **[8]**

b) A system is given by the state equations as –

$$x_1 = x_2$$

$$x_2 = -4x_1 - 5x_2 + u$$

Where initial condition is given by $x(0) = [1\ 1]^T$.

Determine

i) Resolvent Matrix

ii) State Transition Matrix

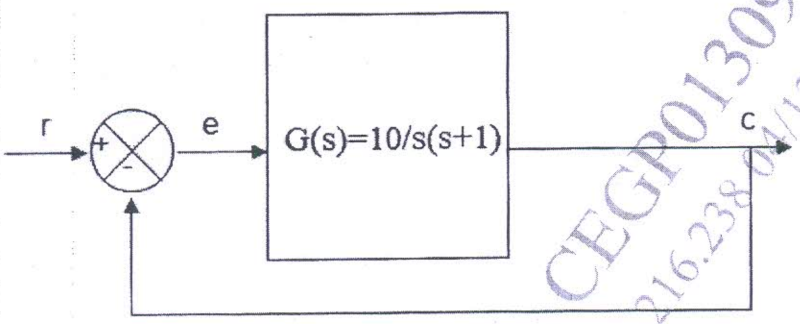
iii) Free (zero) response

iv) Inverse of State Transition Matrix **[8]**

c) State the effect of lag compensator on time domain specifications. **[4]**

Q3) a) State & draw the characteristics of the common types of non linearities observed in physical systems. **[6]**

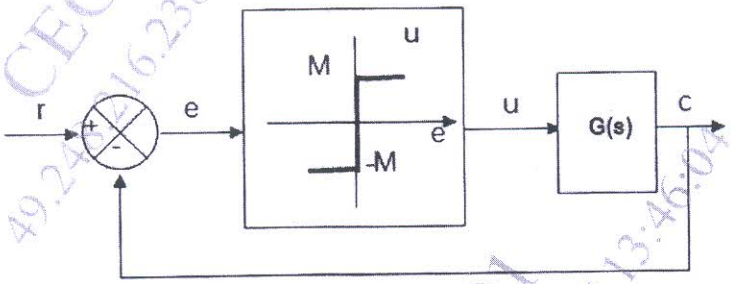
b) For the second order linear control system as shown in the below diagram if the input applied is Unit step, draw the phase trajectories using Method of Isoclines, assuming zero initial conditions. State whether the system is stable or not. **[10]**



OR

Q4) a) Determine the describing function for Ideal relay non – linearity. **[6]**

b) For the nonlinear system shown, determine whether the limit cycle exist or not and why? If exist then determine whether it is stable or not and why? Find the amplitude & frequency of the limit cycle. DF is $N(X) = \frac{4M}{\pi X} \angle 0^o; G(s) = \frac{1}{s(s+1)^2}$ **[10]**



Take M = 1

Q5) a) Explain the concept of sampling process. **[6]**

b) i) Obtain the z-transform using partial fraction method of the following function. **[10]**

$$X(s) = \frac{s}{(s+1)^2\ (s+2)}$$

ii) Determine inverse Z transform of the following function using partial fraction-

$$F(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

OR

Q6) a) What is Zero order hold (ZOH)? State it's transfer function. **[6]**

b) Solve the following difference equation by using z-transform method. **[10]**

$x(k+2) + 3x(k+1) + 2x(k) = u(k)$ where $x(0) = 1;\ x(1) = 3;\ u(k) = 0$ for $k < 0$

Q7) a) State the general procedure for obtaining Pulse Transfer Function. **[8]**

b) Consider the digital filter defined by **[10]**

$$G(z) = \frac{2 + 2.2z^{-1} + 0.2z^{-2}}{1 + 0.4z^{-1} - 0.12z^{-2}}$$

Realize this digital filter in the series scheme & parallel scheme.

OR

Q8) a) Write a short note on Digital PID Controller. **[8]**

b) Prove that the pulse transfer function for the system shown below is **[10]**

$$\frac{C(z)}{R(z)} = \frac{G(z)}{1 + GH(z)}$$