Printed Pages: 7

NEE - 503

(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 2289789 Roll No.

B.TECH.

Regular Theory Examination (Odd Sem-V), 2016-17

CONTROL SYSTEM

Time : 3 Hours *Max. Marks : 100*

SECTION - A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. (10×2=20)

a) Discuss open loop and closed loop system giving suitable examine.

b) Discuss the effect of feedback on the time constant of a control system.

c) Explain the working of A.C servomotor with neat diagram.

d) Give the comparison between PI and PID controller.

e) Discuss the significance of various time domain specifications.

f) Establish the relation between Routh and Hurwitz stability criterion.

g) Explain in brief :.

i) Gain Margin

ii) Phase Margin.

h) What do you understand by relative stability? Explain.

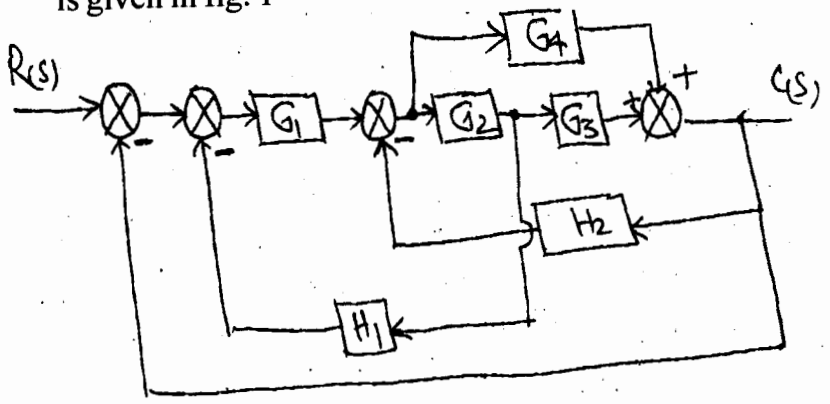
i) Differentiate between lag and lead network in view of their Bode - Plot.

j) Discuss the advantages of state variable technique over transfer function approach.

SECTION - B

Attempt any three questions from this section **(3×10=30)**

1. Using block diagram reduction techniques, find the closed loop transfer function of the system whose block diagram is given in fig. 1



2. Derive the expression for second order system response when subjected to unit impulse input for damping ratio $(\zeta)<1$.

A unity feedback system is characterized by an open loop transfer function.

$$G(s)=\frac{K}{s(s+10)}.$$

Determine the gain 'K' so that the system will have a damping ratio of 0.5. For this value of 'K'. Determine the settling time, peak overshoot and time to peak overshoot for a unit step input

3. For a closed loop system whose transfer is

$G(s)H(s)=\frac{Ke^{-sT}}{s(s+1)}$, determine the maximum value of the gain 'K' for stability.

4. What is closed loop frequency response? Give an account of the correlation between time response and frequency response for a second order system with relevant expressions.

5. i) Derive the transfer function from state model. **(2)**

ii) Obtain the complete solution of nonhomogeneous state equation using time domain method. **(2)**

iii) Discuss the significance of Lag network. Also draw its s-plane representation and bode plot.

SECTION - C

Attempt all questions

1. Attempt any one part of the following. (10×1=10)

a) Find the transfer function of the signal flow graph shown in fig.2, using Mason's gain formulae.

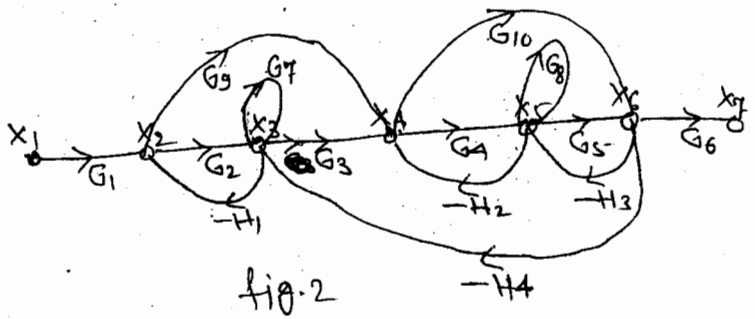


fig.2

b) What do understand by the term sensitivity? Consider the feedback control system shown in fig.3. The normal value of the process parameter 'K' is 1. Determine the sensitivity of transfer function $T(s)=\frac{C(s)}{R(s)}$ to variations in parameter 'K', at w=5.

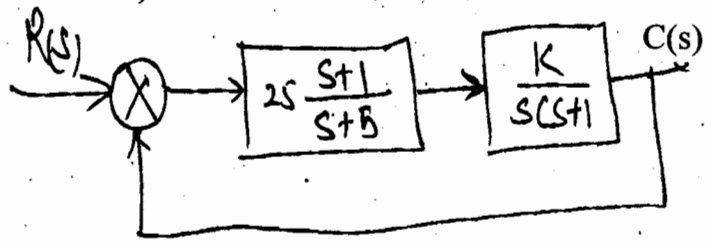


fig.3

2. Attempt any one part of the following: (10×1=10)

a) Discuss different type of test signal used for analysis of control system in time domain.

The reference input to a unity feedback system is shown in fig. 4. 2m open loop transfer function of the system is.

$$G(s)=\frac{400(s+1)}{(s+2)(s+8)}$$

Calculate the steady-state error.

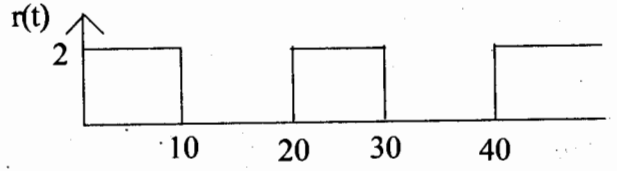


Fig - 4

b) Discuss the effect on the performance of a second order control system of

i) Derivative control

ii) Integral control.

3. Attempt any one part of the following (10×1=10)

a) Explain the working principle of stepper motor with neat diagram.

The characteristics equation for a feedback control is, $s^3+5s^2+12s+k=0$

Find the range of K for all the roots to lie to the left of s = -1

b) Sketch the root locus for the closed loop control system with $G(s)=\frac{K}{s(s+1)(s^2+4s+5)}$

4. Attempt any one Part of the following: (10×1=10)

a) The steady state output of the system for a sinusoidal input of unit magnitude and variable frequency w is given as

$$C(t)=\frac{1}{\sqrt{(1-u^2)^2+4z^2u^2}}Sin\left(wt-\tan^{-1}\frac{27u}{\sqrt{1-u^2}}\right)$$

Determine :

i) Resonant frequency

ii) Resonant Peak

iii) Bandwidth

iv) Phase angle.

b) Draw Bode plot (log magnitude plot) for the transfer function.

$$G(s)=\frac{20s}{s^2+20s+(100)^2}$$

OR

Using Nyquist stability criterion, Investigate the stability of a unity feedback system with open loop transfer function.

$$G(s)=\frac{(s-z_1)}{s(s+p_1))},\ z_1,\ p_1>0$$

Also discuss the significance of M circle.

5. Attempt any one part of the following. (10×1=10)

a) State and explain controllability and observability in view of Kalman and Gilbert test.

The state equation for a system is

$$X=\begin{bmatrix}-3 & -1\\ 2 & 0\end{bmatrix}X+\begin{bmatrix}1\\ -1\end{bmatrix}u$$

check whether the system is completely Controllable .

b) Design a phase lead compensator for a negative unity feed back system with plant transfer function.

$Gp(s)=\frac{K}{s(s+10)(s+1000)}$ to satisfy the conditions :

phase margin is atleast 45^0

static error constant $=1000\ S^{-1}$