Printed pages: 3 **Sub Code: NIC 501**

Paper Id: 3 0 6 3 **Roll No.**

B.TECH
(SEM V) THEORY EXAMINATION 2017-18
CONTROL SYSTEM-I

Time:3 Hours ***Total Marks:100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION-A

Attempt *all* questions in brief. **2 x 10 = 20**

a). Define transfer function.

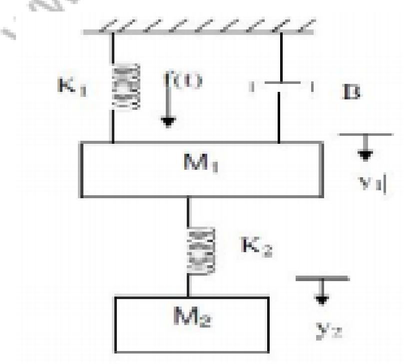
b). Define non-touching loop.

c). Define gain cross over frequency & Phase cross over frequency?
d). What is corner frequency & What is Band width?
e).What is steady state response?
f).List the time domain specifications.
g) . Write the condition of a system to be controllable.
h). What is an asymptote.
i). What is the necessary condition for stability?
j). What do you mean by dominant pole & What is an impulse response?

SECTION - B

2. Attempt any *three* of the following: **10 x 3 = 30**

a) Determine the transfer function Y2(S)/F(S) of the system shown in fig



b). Derive the expressions and draw the response of first order system for unit step input.

c). Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies $G(S) = KS^2 / (1+0.2S)(1+0.02S)$.Determine the value of K for a gain cross over frequency of 20 rad/sec.

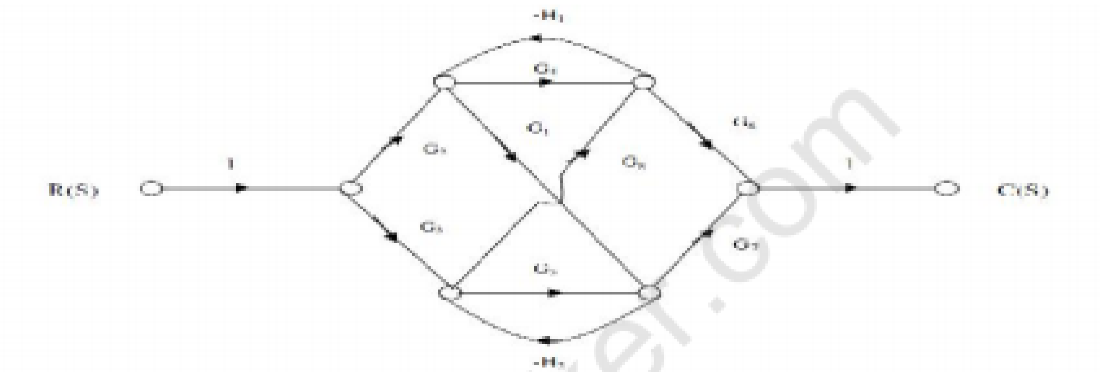
d).Sketch the root locus of the system whose open loop transfer function is G(S)= K / S (S+2)(S+4).Find the value of K so that the damping ratio of the closed loop system is 0.5

e). For a unity feedback control system the open loop transfer function $G(S) = 10(S+2)/ S^2(S+1)$.Find (i) position, velocity and acceleration error constants. (ii)the steady state error when the input is R(S) where $R(S) = 3/S - 2/S^2 + 1/3S^3$

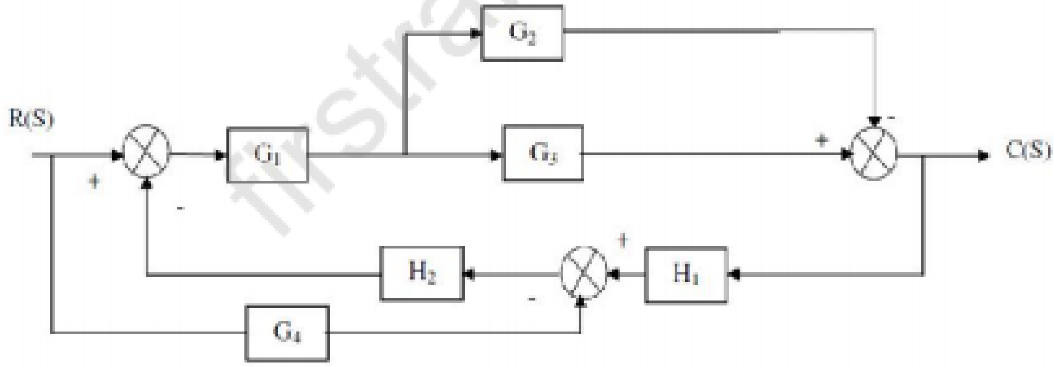
SECTION - C

3.Attempt any one part of the following: **10 x 1 = 10**

a). Find the overall gain of the system whose signal flow graph is shown in fig.

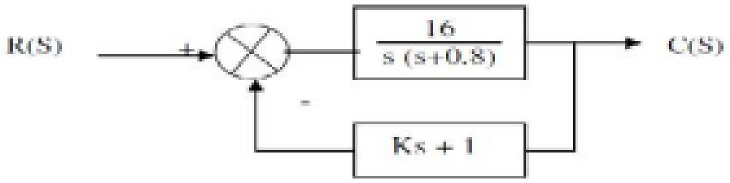


b). Draw a signal flow graph and evaluate the closed loop transfer function of a system whose block is shown in fig.



4.Attempt any one part of the following: **10 x 1 = 10**

a). A positional control system with velocity feedback is shown in fig. What is the response c(t) to the unit step input. Given that ζ =0.5.and also calculate rise time, peak time, Maximum overshoot and settling time.



b). The unity feedback system is characterized by an open loop transfer function is G(S)= 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 settling time,Peak overshoot and time to Peak overshoot for a unit-step input.

5.Attempt any one part of the following: **10 x 1 = 10**

a).A linear time invariant system is characterized by the state variable model. Examine the controllability and observability of the system

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}$$

$$B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} \; ; C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

b). A system is described by the following differential equation . Represent the system in the state space.

$$\frac{d^3x}{dt^3} + 3\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = u_1(t) + 3u_2(t) + 4u_3(t) \text{ and outputs are}$$

$$Y_1 = 4\frac{dx}{dt} + 3u_1, \quad Y_2 = \frac{d^2x}{dt_2} + 4u_2 + u_3$$

6.Attempt any one part of the following: **10 x 1 = 10**

a).Construct the polar plot for the function GH(S) =2(S+1)/ S^2. find Gain cross over frequency ,Phase cross over frequency, Gain margin and Phase margin.

b). Construct Nyquist plot for a feedback control system whose open loop transfer function is given by G(S)H(S) =5/ S(1-S).Comment on the stability of open loop and closed loop transfer function.

7.Attempt any one part of the following: **10 x 1 = 10**

a). Obtain the response of unity feedback system whose open loop transfer function is G(S) = 4 / S (S+5) and When the input is unit step.

b). A unity feedback system has an amplifier with gain K_a=10 and gain ratio G(S) = 1 / S (S+2) in the feed forward Path. A derivative feedback ,H(S)=SK_o is introduced as a minor loop around G(S).Determine the derivative feedback constant ,K_o ,so that the system damping factor is 0.6