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Sub Code: NIC 501

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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.

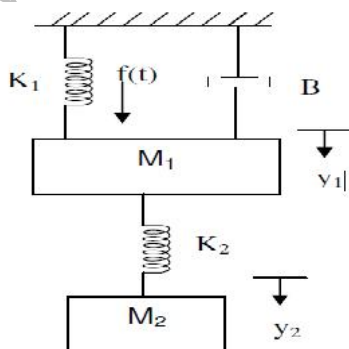
2 x 10 = 20

- 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 $Y_2(S)/F(S)$ 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

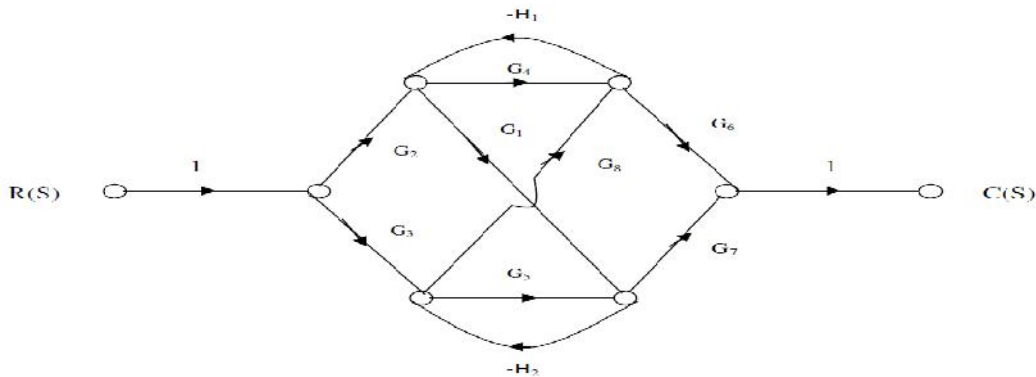
e). For a unity feedback control system the open loop transfer function $G(S) = 10(S+2) / S^2(S+1)$. Find (i) position, velocity and acceleration error constants. (ii) the steady state error when the input is $R(S)$ where $R(S) = 3/S - 2/S^2 + 1/3S^3$

SECTION - C

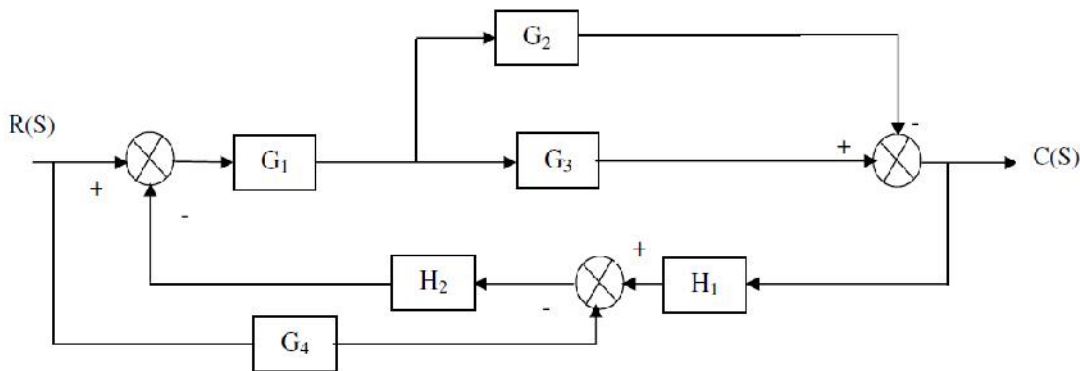
3. Attempt any one part of the following:

10 x 1 = 10

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



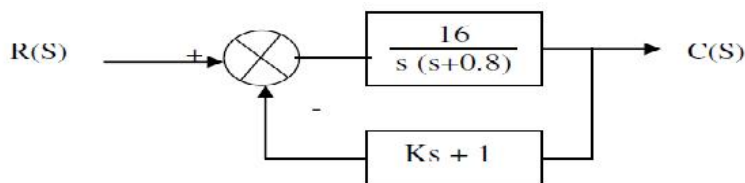
b). Draw a signal flow graph and evaluate the closed loop transfer function of a system whose block is shown in fig.



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 $\zeta = 0.5$ 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

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

$$B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} ; C = [0 \quad 0 \quad 1]$$

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

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

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

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