

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

PAPER ID : 2112

Roll No.

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B.Tech.

(SEM V) ODD SEMESTER THEORY EXAMINATION

2010-2011

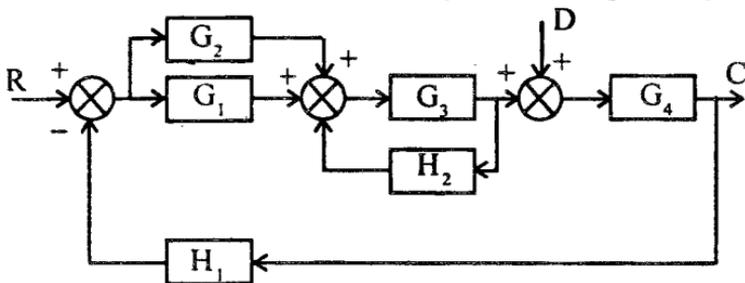
CONTROL SYSTEM

Time : 3 Hours

Total Marks : 100

- Note :- (1) Attempt *all* Questions
 (2) All questions carry equal marks.
 (3) Be precise in your answer.

1. Attempt any **four** parts : (4×5=20)
- Explain open loop & closed loop control system with the help of suitable examples.
 - Explain the principle of servo-mechanism.
 - Explain the effect of feedback on sensitivity, gain and system stability.
 - Using block diagram reduction technique determine the ratio C/R , D/R for the system represented in given figure:



- (e) Construct the signal flow graph for the given set of equations;

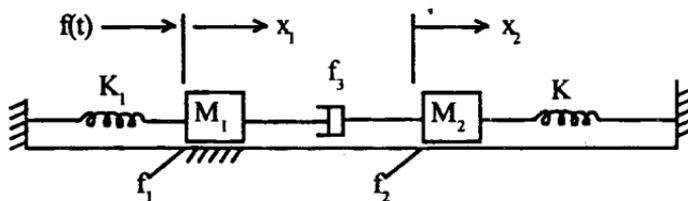
$$X_2 = A_{21}X_1 + A_{23}X_3,$$

$$X_3 = A_{31}X_1 + A_{32}X_2 + A_{33}X_3,$$

$$X_4 = A_{42}X_2 + A_{43}X_3$$

From the Masson's gain formula find X_4/X_1 , X_3/X_2 .

- (f) Draw the mechanical circuit diagram for the following system shown in given fig. & write system equations:



2. Attempt any two parts :

(2×10=20)

- (a) For a general second order system find the time response $c(t)$, when input is unit step. Derive the formula for Peak time and Maximum overshoot.
- (b) A second order control system is represented by a transfer function :

$$\theta_o(s)/T(s) = 1 / [Js^2 + Fs + K]$$

Where θ_o is the proportional output and T is the input torque. A step input of 10 Nm is applied to the system and results are :

- (a) $M_p = 6\%$
- (b) $T_p = 1 \text{ sec}$
- (c) Steady state value of the output (θ_o) is 0.5 rad. Determine the value of J, F and K.

- (c) Discuss the PD, PI & PID controllers with their applications & their error constant. *

3. Attempt any **two** parts : **(2 × 10 = 20)**

- (a) Discuss the constructional feature and working principle of AC Servomotor.
- (b) Determine the stability of the system having following characteristic equation:

$$S^6 + S^5 + 5S^4 + 3S^3 + 2S^2 - 4S - 8 = 0$$

Using Routh-Hurwitz criterion.

- (c) For the open loop transfer function draw the root locus and determine the value of K at $s = -2$ and comment as the stability and time response of the system.

$$G(s)H(s) = K(s+1)/(s^2+0.4s+0.4)$$

Q.4. Attempt any **two** parts : **(2 × 10 = 20)**

- (a) Establish the correlation between time response and frequency response analysis and suitably explain with diagrams.
- (b) Using Nyquist criterion investigate the stability of a closed-loop control system whose open-loop transfer:

$$G(s) H(s) = K/s (sT_1+1)(sT_2+1)$$

- (c) Sketch the asymptotic Bode plot for the T.F. given below:

$$G(s) H(s) = 2(s+0.25)/s^2(s+1) (s+0.5)$$

from the Bode plot determine.

- (i) The phase cross-over frequency
- (ii) The gain cross-over frequency
- (iii) The gain margin
- (iv) The phase margin.

Is the system stable?

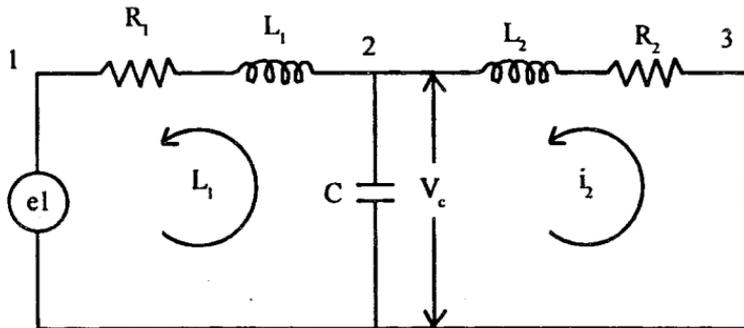
5. Attempt any two parts : (2×10=20)

- (a) Consider a type-1 unity-feedback system with an open-loop transfer function :

$$G(s) = K/s (s+1)$$

It is desired to have the velocity error constant $K_v=10$ and the phase margin of the system be at least 45° . Design a suitable lead compensator.

- (b) Find the state space representation (state transient diagram) using physical variables (I_1, I_2, V_c) of the network given below and also find the state transient matrix.



- (c) Find the state model $\dot{X} = [A]X + [B]U$ & $Y = [C]X + [D]U$ in Controllability Canonical Form and Observability Canonical Form for given transfer function :

$$Y(s)/U(s) = (2s^2+2s+5) / (S^3 + 6S^2 + 11S+4)$$