

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

PAPER ID : 2112 Roll No. | | | | | | | | | | |

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.

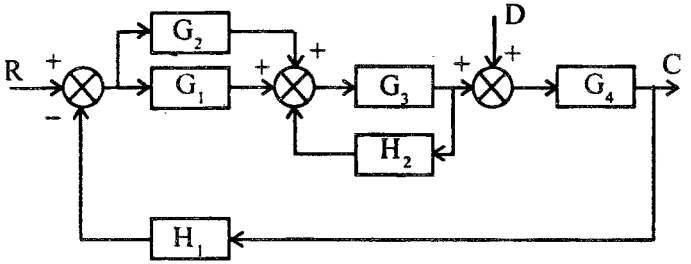
1. Attempt any **four** parts : **(4×5=20)**

(a) Explain open loop & closed loop control system with the help of suitable examples.

(b) Explain the principle of servo-mechanism.

(c) Explain the effect of feedback on sensitivity, gain and system stability.

(d) 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;

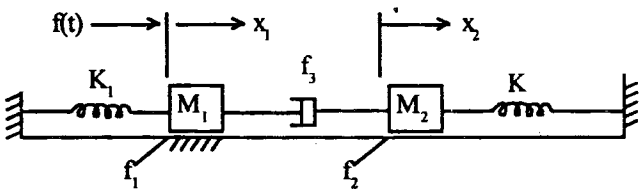
$$X_2=A_{21}X_1+A_{23}X_3,$$

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

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

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 :

$$\theta_0(s)/T(s) = 1/ [Js^2+Fs+K]$$

Where θ_0 is the proportional output and T is the input torque. A step input of 10 Nm is applied to the system and result are :

(a) Mp= 6%

(b) Tp= 1sec

(c) Steady state value of the output (θ_0)

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?

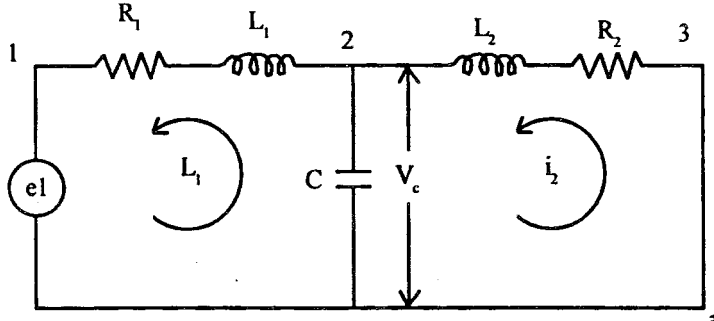
5. Attempt any **two** parts : **(2×10=20)**

(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 45^0. Design a suitable lead compensator.

(b) Find the state space representation (state transient diagram) using physical variables (I_1, I 2, Vc) 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 :

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