B. Tech Degree VI Semester Examination, May 2007

CS/EC/EB/EI 605 CONTROL SYSTEMS ENGINEERING

(1999 Admissions onwards)

Time : 3 Hours Maximum Marks : 100

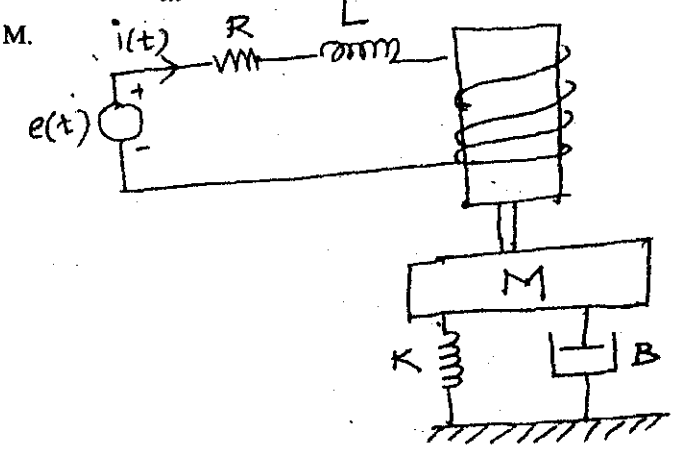
I. (a) Distinguish between open loop and closed loop control systems. Give one example for each. (8)

(b) Explain the following theorems in Laplace Transform.
(i) Initial value Theorem (ii) Final value Theorem
(iii) Convolution Theorem (6)

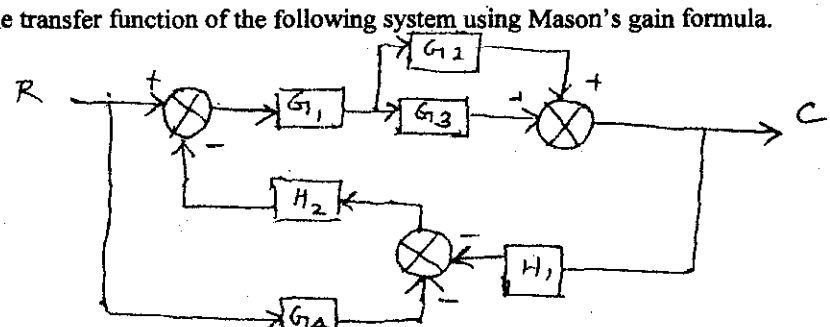
(c) Obtain the Laplace inverse of $F(s)=\dfrac{2s+12}{s^2+2s+5}$. (6)

OR

II. (a) Obtain the transfer function of the following electro mechanical system assuming that the coil has a back emf $e_b = K_b \dfrac{dx}{dt}$ and the coil current produces a force $F \propto i(t)$ on the mass M. (8)



(b) Obtain the transfer function of the following system using Mason's gain formula. (12)



III. (a) What is time constant of a system? Sketch the time response of a first order system subjected to a unit step input. (4)

(b) Measurements conducted on a servomechanism show the system response to be $c(t)=1+0.2e^{-60t}-1.2e^{-10t}$ when subjected to a step of 1V.

(i) Obtain an expression for the closed loop transfer function
(ii) Determine the undamped natural frequency and damping ratio of the systems
(iii) Obtain the unit ramp response of the system. (12)

(c) Distinguish between static and dynamic error constants. (4)

OR

IV. (a) What are the transient response specifications of system? (6)

(b) What are the effects of derivative and integral control in a control system. (4)

(c) The open loop transfer function of a unity feedback control system is given by

$$G(s)H(s)=\frac{K}{s(s+1)(2s+1)(3s+1)}.$$ Determine the value of K

(i) for which the system is stable

(ii) which will cause sustained oscillations in the closed loop system and the frequency of sustained oscillations. (10)

V. (a) What is meant by Frequency Domain analysis? (2)

(b) List the important frequency domain specifications of a system. (6)

(c) Draw the Bode Plot for the transfer function. (12)

$$G(s)=\frac{200(s+2)}{s(s^2+10s+100)}.$$

OR

VI. (a) Which are the advantages of frequency domain analysis? (6)

(b) Using Nyquist stability criterion, investigate the closed loop stability of a system whose open loop transfer function is given by

$$G(s)H(s)=\frac{10}{(s+1)(s+2)}.$$ (14)

VII. Sketch the root locus plot for a negative feed back control system having an open loop transfer function. $G(s)H(s)=\frac{K}{s(s^2+2s+2)}$ for all values of K ranging from 0 to ∞. (20)

OR

VIII. (a) Briefly explain the different types of compensators. (6)

(b) The open loop transfer function of a unity feedback system is

$$G(s)=\frac{K}{s(s+2)(s+30)}.$$ Design a lead compensator given

(i) phase margin $\geq 35^0$ (ii) gain margin $\geq 20db$

(iii) $KV \leq 25$. (14)

IX. (a) What are the advantages of state space technique? (6)

(b) Find the state model for the system with transfer function.

$$\frac{C(s)}{R(s)}=\frac{6}{s^3+6s^2+11s+6}$$ in Jordan Canonical form. (14)

OR

X. Write short notes on:

(i) State Transition Matrix

(ii) Servomotor

(iii) Tachogenerator

(iv) Adaptive Control System. (20)

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