Printed Pages – 5 **TEC – 504**

(Following Paper ID and Roll No. to be filled in your Answer Book)	
PAPER ID : 3088	**Roll No.**

B.Tech.

FIFTH SEMESTER EXAMINATION, 2006-07

AUTOMATIC CONTROL SYSTEM

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **ALL** questions.*

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data wherever not provided.

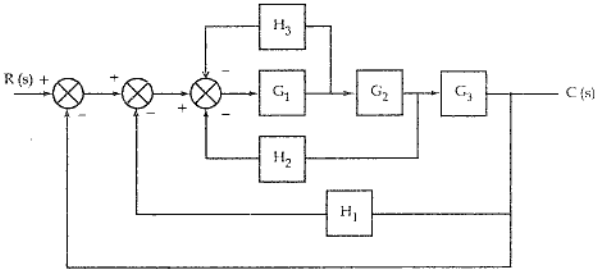
(iv) Be precise in your answer.

1. Attempt *any four* parts of the following : **(5x4=20)**

(a) What is the need of a control system ? Explain the different performance specifications, which the control systems have to meet.

(b) Distinguish with suitable example, between the open loop and closed loop control systems.

(c) Obtain overall Transfer function $\frac{C(s)}{R(s)}$ by block diagram reduction technique of Fig 1.



(Fig. 1)

(d) Construct the signal flow graph for the given set of equations.

$X_2 = A_{21} X_1 + A_{23} X_3$ ---------- (1)

$X_3 = A_{31} X_1 + A_{32} X_2 + A_{33} X_3$ ---------- (2)

$X_4 = A_{42} X_2 + A_{43} X_3$ ---------- (3).

Define Mason's gain formula.

(e) Define force-voltage analogy and force - current analogy of translational mechanical system.

(f) Describe the components and variables of the biological control apparatus involved in walking in a prescribed direction and why is walking a closed-loop operation.

2. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Find out the time response of a first order control system subjected to unit ramp input function. Calculate the error and steady state error.

(b) A unity feedback system has an open-loop

Transfer function $G(s) = \frac{k}{S(S+10)}$.

Determine the gain k so that the system will have a damping ratio of 0.5. For this value of gain find peak overshoot and setting time.

(c) Explain the following terms :
   (i) Peak overshoot
   (ii) Rise time
   (iii) Delay time and
   (iv) Settling time.

(d) A servomechanism is characterized by the differential equation $\frac{d^2c}{dt^2}+6.4\frac{dc}{dt}+160(0.4c-r)=0$ Find the valve of damping ratio. What information does this convey about the transient performance ?

(e) A unity feedback system is given by :

$$G(s)=\frac{8}{S^2(S^2+4S+8)(S^2+3S+12)}$$

Determine the error coefficients with the inputs given by (i) $r(t)=5$ (ii) $r(t)=2t$.

(f) What do you understand by the 'order' and 'type' number of a system transfer function ? Explain the effect of adding zero to a transfer function.

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) The open loop transfer function of a control system is

$$G(s)H(s)=\frac{1}{S(1+0.5S)(1+2S)}$$

   (i) Plot a Bode diagram for the given open loop transfer function.
   (ii) Determine the appropriate value of gain and Phase margin.

(b) Draw the root locus plot for a unity feedback system whose characteristic equation is given by

$$S^3+3S^2+(k+2)S+5k=0$$

(c) Discuss the Basic features of Nyquist criteria and what do you understand by the term 'Stability of the system', explain Relative and Asymptotic stability.

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) Derive the transfer function of Lead and Lag compensating network. Discuss the different aspects of selecting a compensating network.

(b) A unity feedback system has a transfer function of

$$G(s) = \frac{K(S+4)}{(S-1)(S-2)}$$

(i) for $K = 8$ draw the Bode plot and find the phase margin and gain margin.

(ii) What will be the value of K for a phase margin of 30° and what is the corresponding gain margin ?

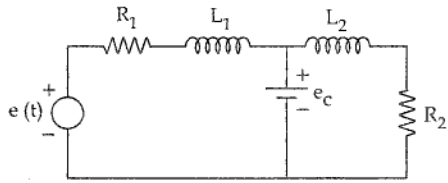
(c) Discuss the time domain Analysis and frequency domain Analysis of control systems and what are the various informations which can be obtained through root locus plots ?

5. Attempt *any two* parts of the following : **(10x2=20)**

(a) What is state variable ? Mention the advantages of state space approach.

(b) What is meant by state transition Matrix ? List the three properties of state transition matrix.

(c) (i) Write the state equations of an electrical network shown in figure.



(ii) What is neural networks state how this network is useful for the biological control system ?

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