

T. E. (EXTC) Sem I (R)  
Principles of Control Systems  
(REVISED COURSE)

Con. 5514-09.

SP-8612

(3 Hours)

[Total Marks : 100

29/12/09

2.30 to 5.30

- N.B. : (1) Question No. 1 is compulsory.  
(2) Answer any four out of remaining six questions.  
(3) Figures to the right indicate full marks.  
(4) Illustrate answers with sketches wherever required.

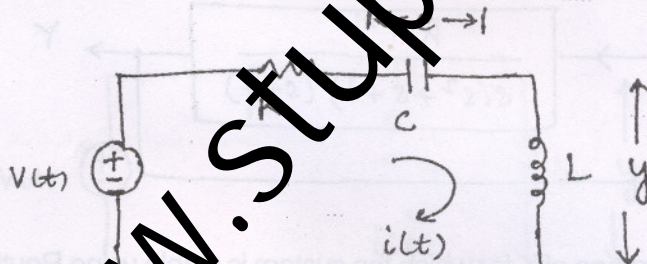
1. Answer the following :-

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- What are the performance parameters of a first order system ? What do they indicate ?
- Why do steady state errors arise ? Derive the steady state error of a closed loop control system.
- Discuss the advantages and disadvantages of the state variable model over the transfer function model for mathematical modelling of systems.
- Define sensitivity. How can we reduce the sensitivity of closed loop system ?

2. (a) Consider the RLC network shown in figure below :-

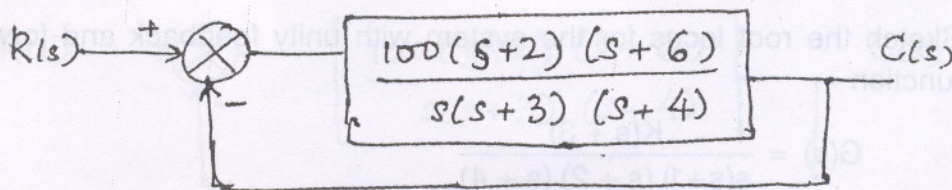
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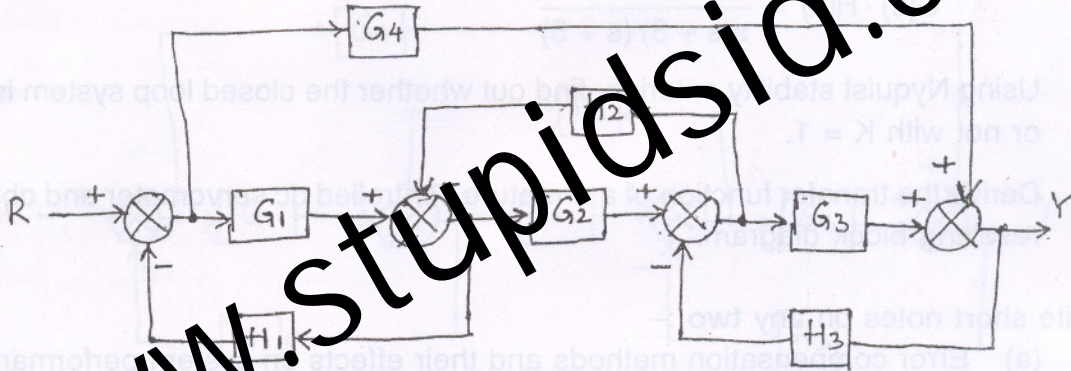
- Obtain its transfer function model.
- Obtain its state space variable model.

(b) Evaluate the number of integrations required in the forward path in order to have zero steady state error for each of the test inputs. Find the steady state errors for the inputs  $5\mu(t)$ ,  $5t\mu(t)$  and  $5t^2\mu(t)$  for the system shown in figure below :-

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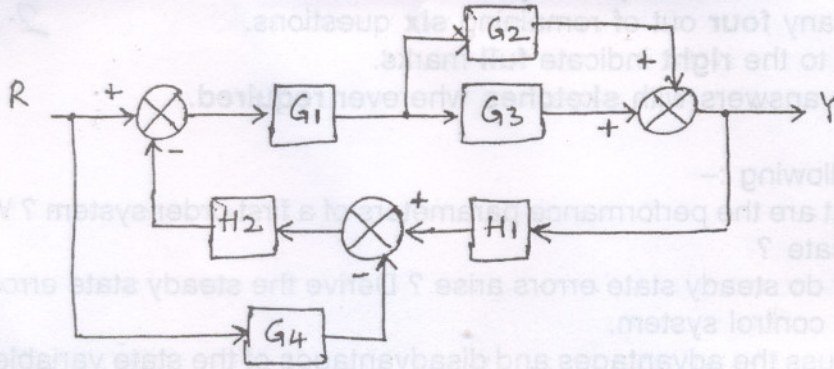


3. (a) Consider the following block diagram shown in **figure** below. Draw its equivalent signal flow graph and find  $\frac{Y}{R}$  using Mason's gain formula. 10

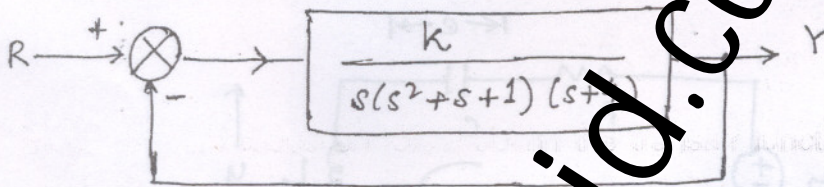


- (b) Explain the effect of an additional zero and additional pole to the standard second order system. 10

4. (a) Using block diagram reduction rules, obtain the transfer function of the system shown in figure below :- 10



- (b) Consider the closed loop system shown in figure below :- 6



- (i) Determine the range of K for which the system is stable using Routh stability criteria.  
 (ii) Determine the value of K that results in marginal stability. Determine the oscillation frequency.
- (c) What causes an entire row of zeros to show up in Routh table? 4
5. (a) Derive and analyse the response of a second order system to a unit step input. 10  
 With the help of graphical plots explain the significance of damping ratio for its various values.
- (b) Sketch the root locus for the system with unity feedback and forward transfer 10  
 function -

$$G(s) = \frac{K(s+3)}{s(s+1)(s+2)(s+4)}$$

Find the frequency and gain K for which the root locus crosses the imaginary axis. For what range of K is the system stable.

6. (a) Consider the feedback system with the following open loop transfer function - 10

$$G(s) \cdot H(s) = \frac{K}{s(s+3)(s+5)}$$

Using Nyquist stability criterion, find out whether the closed loop system is stable or not with  $K = 1$ .

- (b) Derive the transfer function of a armature controlled dc servomotor and obtain the 10  
 resulting block diagram.
7. Write short notes on any two :- 20
- (a) Error compensation methods and their effects on system performance.  
 (b) Finding stability, gain and phase margins using Bode and Nyquist plots.  
 (c) Stepper motor construction and use of stepper motors in control systems.