

Printed Pages – 04

ME – 605

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

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**B. Tech.**

SIXTH SEMESTER EXAMINATION, 2004-2005

**AUTOMATIC CONTROL**

Time : 2 Hours

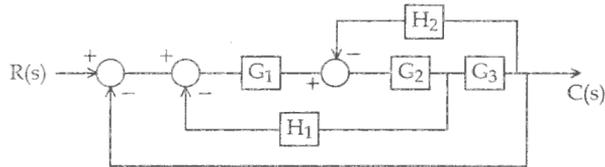
Total Marks : 50

Note : (i) Attempt ALL questions.

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

1. Attempt any four parts of the following : (3.5x4=14)

- (a) Describe the components and variables of the biological control apparatus involved in walking in a prescribed direction. Why is walking a closed-loop operation ?
- (b) What do you understand by servomechanism ? Explain with the help of a suitable example.
- (c) Simplify the given block diagram.

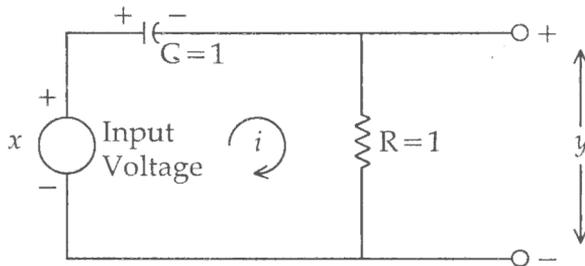


- (d) Determine the expression for the time function f(t) from the s-domain function

$$F(s) = \frac{s^2 + 2s + 2}{(s+1)(s+2)}$$

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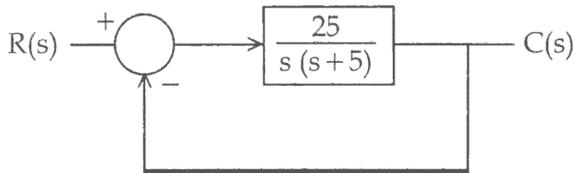
- (e) What are different rotational mechanical components? What are analogous systems? Explain with one suitable example.
- (f) For the RC network given below, let the initial voltage across the capacitor  $C$  be  $V_{CO} = 1$  volts with the polarity shown and let  $x = 2e^{-t}$ . Using the Laplace transform techniques, find  $y$ .



2. Attempt *any four* parts of the following : (3x4=12)

- (a) Draw a typical step-response of a second order system and with the help of this plot explain the following terms :
- (i) Swiftness
  - (ii) Settling lime
  - (iii) Maximum overshoot
- (b) The block diagram representation of a control system is given below :
- (i) Determine whether this system is an overdamped, a critically damped or an underdamped system.

- (ii) Determine the natural frequency, damping ratio and damped natural frequency.



- (c) Transfer function of a second-order system is given by  $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 10s + 25}$ . Determine its time-domain response,  $c(t)$ , to a unit step.
- (d) What is two-position control ? Explain with any suitable example.
- (e) Explain the following terms :
- (i) Derivative time
  - (ii) Tuning the controller
  - (iii) Proportional band of a controller
- (f) What is a PID controller ? How can it be implemented for a mechanical actuator ?

3. Attempt *any two* parts of the following : (6x2=12)

- (a) How many roots does the following polynomial have in the right half of the  $s$ -plane ?  
 $s^5 + 2s^4 + 3s^3 + 6s^2 + 10s + 15$
- (b) What is the difference between transient and steady state response of a control system ? What is steady-state error of any closed-loop system ?

- (c) With a neat sketch, discuss the generation of proportional as well as integral action in a proportional plus integral hydraulic actuator.

4. Attempt *any two* parts of the following : (6x2=12)

- (a) For the open-loop transfer function given below, calculate :
- (i) break-away point
  - (ii) intersection with imaginary axis, using root locus technique

$$G(s)H(s) = \frac{K}{s(s+4)(s+5)}$$

- (b) Obtain the polar plot of the following transfer

function  $G(j\omega) = \frac{e^{-j\omega L}}{1+j\omega T}$ .

- (c) What are gain margin and phase margin ? How, using these margins, stable or unstable system can be identified from a Bode magnitude and phase-angle plot.