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

PAPER ID : 4053 Roll No. | | | | | | | | | | |

B. Tech.

SIXTH SEMESTER EXAMINATION, 2004-2005

AUTOMATIC CONTROL

Time : 2 Hours *Total Marks : 50*

Note : *(i) Attempt ALL questions.*

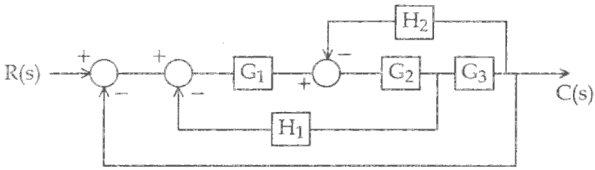
(ii) In case of numerical problems assume data wherever not provided.

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.

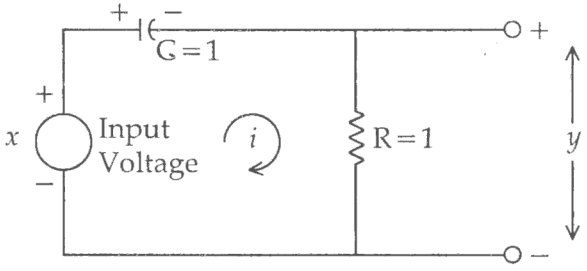


(d) Determine the expression for the time function f(t) from the s-domain function

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

(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

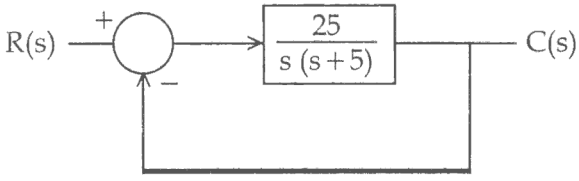
(ii) Settling lime

(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 $G(jw) = \frac{e^{-jwL}}{1+jwT}$.

(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.

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