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(Following Roll No. to be filled by candidate)

Roll No. 1 0 0 4 3 5 1 0 0 7

B TECH
SIXTH SEMESTER EXAMINATION 2012-13
ECH602
PROCESS DYNAMICS AND CONTROL

Time: 3 Hour **Max. Marks: 100**

Note:
- Attempt all questions.
- Marks and number of questions to be attempted from the section is mentioned before each section.
- Assume missing data suitably. Illustrate the answers with suitable sketches

1. Attempt **any four parts** of the following: [4×5]

a. Why do we study the dynamic behavior of system in the study of process dynamic control?
b. Differentiate between positive feedback and negative feedback control taking suitable examples?
c. What do you understand by translation function? What is its importance in the study of control system?
d. Discuss the types of roots of a characteristics equation of a control system, with suitable examples.
e. What is the importance of initial and final theorem in the study of process dynamic control?
f. Find the inverse Laplace transform of the following function:

$$F(s) = \frac{S+1}{S^2+2S+4}$$

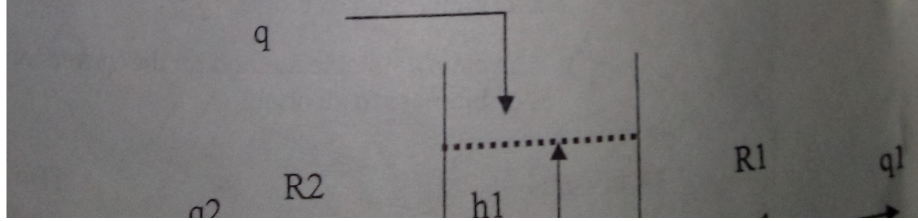
2. Attempt any **four** parts of the following: [4×5]

a. A thermometer follows first-order dynamics with a time constant of 0.2 min. It is placed in a temperature bath at 100 ^{0}C and is allowed to reach steady state. It is suddenly transferred to another bath at 150 ^{0}C at time t = 0 and is left there for 0.2min. It is immediately returned to the original bath at 100 ^{0}C. Calculate the reading at t = 0.1 min and t = 0.4 min.
b. What is the importance of transportation lag in the study of process dynamic control system?
c. A step change of magnitude 4 is introduced into a system having the transfer function.

$$\frac{Y(s)}{X(s)} = \frac{10}{(S^2+1.6S+4)}$$

i. Percent over shoot
ii. Decay ratio
iii. Maximum value of Y(t)
iv. Ultimate value of Y(t)
v. Period of oscillation

d. Taking example of a first order system, find its transfer function of the mixing process.
e. Discuss the behavior of a first order system for a unit step change in input.
f. For the liquid level tank system shown below in figure. Find $\frac{H1(S)}{Q(S)}, \frac{Q1(S)}{Q(S)}$ and $\frac{Q2(s)}{Q(s)}$.



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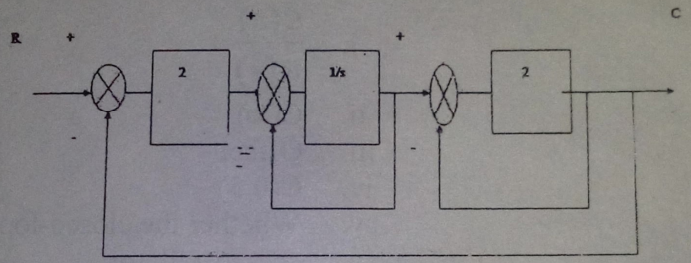
3. **Attempt any four parts of the following:** [4x5]

a. Differentiate between servo control and regulator control with the help of suitable examples?

b. What are the modes of control action? Discuss the advantages and limitations.

c. Find the transfer function $\frac{C(s)}{R(s)}$ of the system shown in figure below.



d. What do you understand by closed loop and open loop control system?

e. Taking example of a temperature control show its signal flow diagram and block diagram.

f. What do you understand by transfer function? Show with suitable examples.

4. Attempt any **two** parts of the following: [2x10]

a. Explain the Routh test for stability of a control system? Given the suitable examples?

b. Enumerate the detailed procedure for plotting the root locus of a control system? Take the help of suitable examples.

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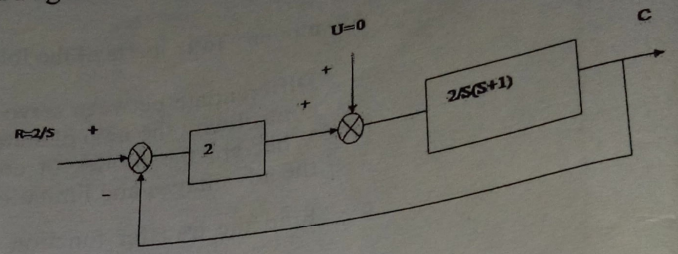

Determine:

i. $\frac{C(s)}{R(s)}$

ii. $C(\infty)$

iii. Offset

iv. $C(0.5)$

v. Whether the closed-loop response is oscillatory

5. Attempt any **two** parts of the following: [2x10]

a. Evaluate the amplitude ratio and phase difference for the following by substitution rule:
   (i) First order and Second order system
   (ii) PI and PD controller

b. How the frequency response analysis is used in the design of a stable control system. Discuss with suitable examples.

c. Explain the following terms and give their importance in stable control system design.
   (i) Gain margin
   (ii) Phase margin
   (iii) Cross over frequency