U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

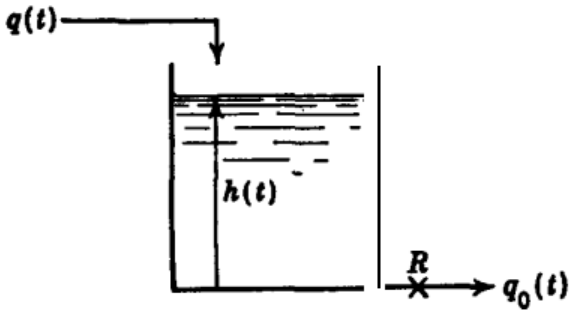
May 2023 Semester End Make-Up Examinations

Programme: B.E. **Semester: V**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 19CH5DCPCE **Max Marks: 100**
Course: Process Control Engineering **Date: 17.05.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Develop the transfer function for the first order liquid level system as shown in figure and derive the response expression for a unit impulse input to the liquid level system. **10**



b) A thermometer having first-order dynamics with a time constant of 1 min is placed in a temperature bath at 100°F. After the thermometer reaches steady state, it is suddenly placed in a bath at 110°F at t = 0 and left there for 1 min, after which it is immediately returned to the bath at 100°F. Calculate the thermometer reading at t = 0.5 min and at t = 2.0 min. **10**

UNIT - II

2 a) Determine the transfer function $\frac{H_2(s)}{Q(s)}$ for the two tank non-interacting system shown in the Figure 1. **12**

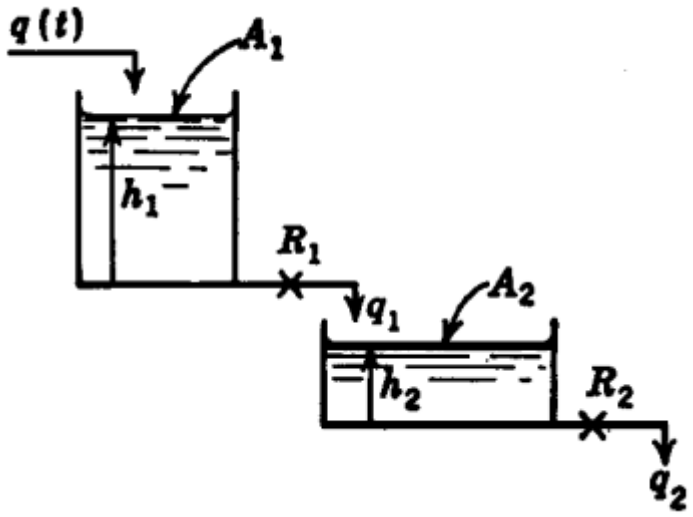


Figure 1.

b) The overall transfer is given as $G(s) = \frac{16}{1.5s^2+2.4s+6}$ **08**

A step change of magnitude '6' is introduced into the system. Calculate the following parameters.

(i) Time constant (ii) Damping coefficient (iii) Overshoot (iv) Decay ratio (v) Period of oscillation

OR

3 a) Derive the dynamic response to a step forcing function for a critically damped second order system. **10**

b) Plot the response of unit step forcing function for an underdamped system second order system with respect to t/τ [with damping coefficient of 0.4 and t/τ changing from 1 to 10]. **05**

c) What is transportation lag? Give the transfer function for transportation lag. **05**

UNIT - III

4 a) A system consists of a process, a measuring element and a control valve, and the corresponding transfer functions are given below. **10**

$$G_p(s) = \frac{2}{2s+1};\ G_m(s) = \frac{1}{5s+1};\ G_v(s) = \frac{1.5}{3s+1}$$

In this system, the input and output responses are denoted as R(s) and C(s) respectively. A proportional controller with a gain K_c = 1 is used for this analysis.

(i) Draw the block diagram and determine $\frac{C(s)}{R(s)}$

(ii) Determine offset, if the unit step change magnitude is given to the set point variable.

(iii) Draw the rough sketch of the output response and indicate the offset in the graph.

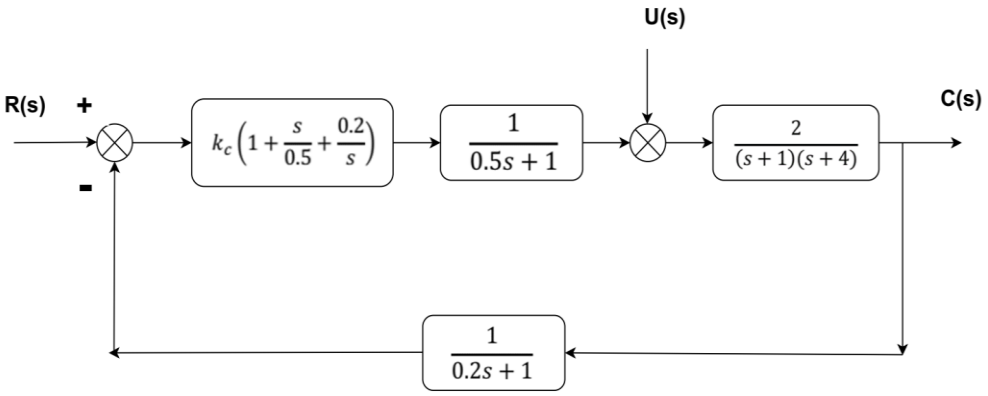
(iv) How do you eliminate the offset? Suggest your answer.

b) Distinguish between servo and regulatory problems. **05**

c) Illustrate the typical control system's response showing the effects of various modes of controller using the response graph. **05**

UNIT - IV

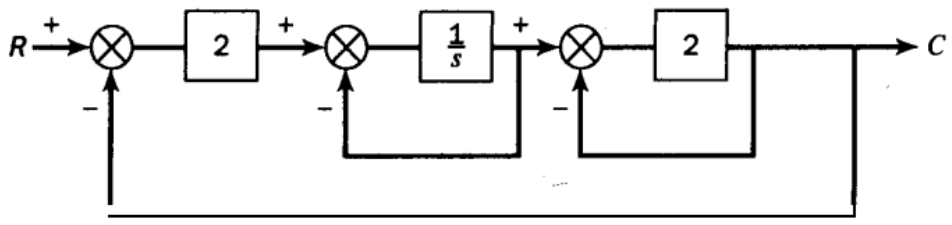
5 a) Consider the closed loop feedback controller system. **10**



Identify the transfer functions/variables for the following parameters from the block diagram.

(i) Controller (ii) Measuring element (iii) Control valve (iv) Process tank (v) Values of measuring element time constant, integral and derivative time constant (vi) Load variable (vii) Error (viii) Comparator (ix) set point (x) output function.

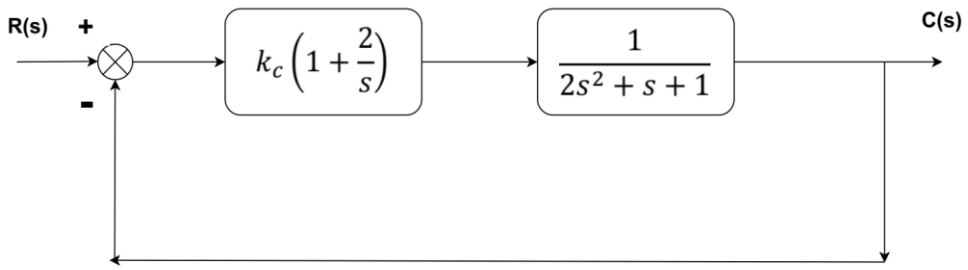
b) Determine the transfer function $\frac{C(s)}{R(s)}$ for the below system. Calculate C(0.8) for unit step forcing function. **10**



UNIT - V

6 a) Give step by step process to construct the Root Locus diagram. **10**

b) Consider the closed loop system as given below. **10**



Apply Routh stability test, determine the value of K_c at which the system just becomes unstable.

OR

7 a) Describe the boded stability criteria conditions based on phase margin and gain margin. **10**

b) How do you analyze Ziegler-Nichols and Cohen-Coon tuning parameters for stability analysis. **10**

******