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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

FIFTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER DEGREE EXAMINATIONS, NOVEMBER - 2019

SUBJECT: PROCESS INSTRUMENTATION AND CONTROL [ICE 3106]

TIME: 3 HOURS MAX. MARKS: 50

Instructions to candidates :*Answer ALL questions and missing data may be suitably assumed.*

1A. With a neat sketch, explain the function of each of the blocks in a Process control system.

1B. Derive the final mathematical model of a mixing process which has two feeds with different concentrations and temperatures.

1C. Find the transfer function $H_2(s)/Q(s)$ and $H_3(s)/Q(s)$ for a three tank system shown in Fig. Q1C, where H_2, H_3 and Q are deviation variables. For a unit step change in Q, determine the initial and final heights in tank 3.

(2+3+5)

2A List the advantage and limitation of derivative controller with respect to the first order process.

2B Prove that integral controller will result in zero offset for servo and regulatory response on the first order process.

2C The error shown in Fig. Q2C is applied to a proportional-integral-derivative controller with K_P = 5, K_I= 0.5 sec^{-1}, K_D=0.6 sec and P(0) = 30%. Draw a graph of the resulting controller output and also calculate controller output for every time instants.

(2+3+5)

3A Define ratio controller with an example.

3B Illustrate the dynamic feed forward controller with necessary mathematical proof.

3C The task assigned to a control engineer is to maintain the reactor temperature constant irrespective of the disturbance load entering the process. Design a conventional and advanced control system with and without the coolant water temperature involvement. Also write the servo and regulatory transfer function for this problem.

(2+3+5)

4A Differentiate feed forward and feedback systems.

4B Brief the operation of I/P converter with necessary diagrams and model it in the linear region.

4C Design a control system with necessary diagrams, which improves the system closed loop performance even in the presence of dead time. Also, write the advantages of the control algorithm with respect to frequency domain.

(2+3+5)

5A What is the need for using relative gain array for the multiple interacting system?

5B Design the invertible controller for the first order process with and without dead time. Explain the design procedure with necessary steps.

5C In a multivariable process the interaction between the individual loops effects the closed loop performance. Design the necessary elements to reduce the interactions to improve the closed loop

performance.

(2+3+5)

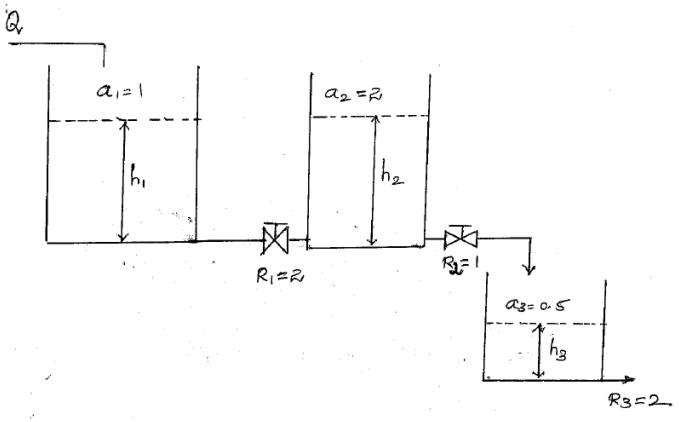

Fig. Q1C

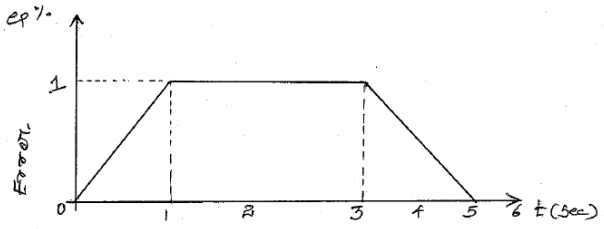

Fig.Q2C

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