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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

FIRST SEMESTER M.TECH. (CONTROL SYSTEMS)

END SEMESTER DEGREE EXAMINATIONS, FEBRUARY - 2021

Process Dynamics and Control [ICE 5154]

TIME: 3 HOURS 01-03-2021 MAX. MARKS: 50

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

1A. With neat circuit diagram explain electronic proportional controller.

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

1C. A tank has an area of 1.0 ft^2, a normal depth of 4 ft, and normal discharge rate of 20 ft^3 /hour. How does the depth change with time if the flow to the tank is suddenly increased to 25ft^3 /hour?

(2+3+5)

2A List the advantages and limitations of derivative controller with a first order process.

2B Prove that integral controller results zero offset with servo and regulatory operation on a 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.

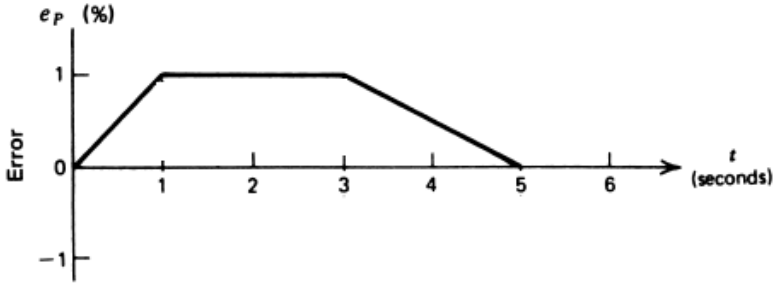

Fig. Q2C

(2+3+5)

3A Describe ratio controller with an example.

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

3C Water is heated continuously from about 70 to 110^o F in a steam jacked kettle shown in Fig. Q3C. A proportional controller is used to regulate the steam flow. The steam flow is directly proportional to valve opening. The valve has equal percentage trim. One percent of full stroke valve position changes the flow rate by 4% through the control valve. The temperature controller has a scale from 60 to 150^o F. Calculate offset for 5^{0}F change in feed temperature for controller gains of 1 and 5.

Note : Load gain and measurement gain is equal to 1.

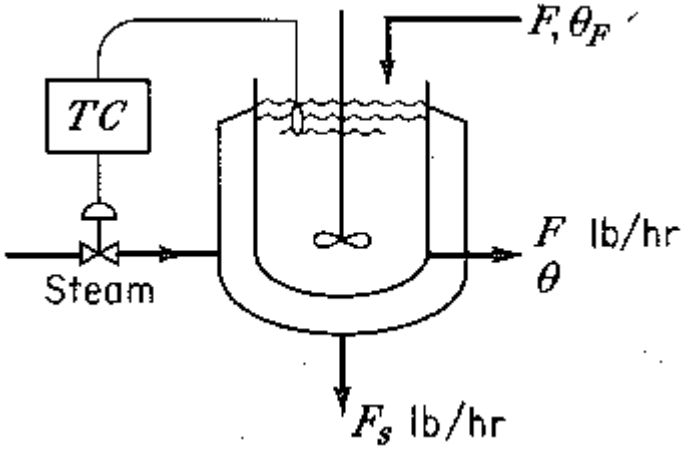

Fig. Q3C

(2+3+5)

4A Illustrate working of rotatory control valves.

4B With a neat diagram, explain the constructional details of pneumatic P+D controller.

4C Design a control system with necessary diagrams that 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 of 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 With necessary diagrams and equations, explain the function of model predictive controller.

(2+3+5)

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