Reg. No. | | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

FIFTH SEMESTER B.TECH. (ELECTRONICS & INSTRUMENTATION ENGG.)

END SEMESTER DEGREE EXAMINATIONS, JANUARY - 2021

SUBJECT: PROCESS INSTRUMENTATION AND CONTROL [ICE 3154]

TIME: 3 HOURS 04-02-2021 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 various blocks in a general process control system.

1B. Derive the final mathematical model of a Thermal process with three cases of heat input into the system.

1C. Consider three tank system, where the first two tanks are connected in series and the third tank is connected as non-interacting with the second tank. Find the transfer function model of the level in tank-3 for the step input given on the tank-1. Let A1, A2, A3 be the area of the respective tanks and R1, R1, R3 be the restriction between each tank and h1, h3, h3 be the heights of the respective tanks.

(2+3+5)

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

2B. What is the limitation of proportional controller on servo and regulatory response of a first order process? Justify your answer with proof.

2C. A liquid-level control system linearly converts a displacement of 0 to 5 m into a 1 to 5V control signal. A relay serves as the two-position controller to open or close an inlet valve. The relay closes at 2.8V and opens at 3.2V. Find (a) the relation between displacement level and voltage (b) the neutral zone or displacement gap in meters.

(2+4+4)

3A. Extend the concept of ON-OFF controller to implement a three position controller using OpAmp and explain the operation with necessary equations.

3B. A liquid-level system converts a 4–10-m level into a 4- to 20-mA current. Design a three-mode controller that outputs 0–5 V with a 50% PB, 0.03-min reset time, and 0.05-min derivative time. Fastest expected change time is 0.8 min.

3C. Design a two-position controller that provides an output of 5 V when a type-J TC junction reaches 250^0 C and drops to a low of 0 V when the temperature has fallen to 240^0 C. Assume a 0^0 reference.

(5+3+2)

4A. For the cascade control system shown in figure 4A, draw the closed loop block diagram and derive the transfer function equation.

4B. Write a note on tuning rules for feed forward feedback control.

4C. Identify the control loop given in Figure 4C and discuss about the plant structure. Also derive the transfer function.

(4+3+3)

5A. Design an IMC controller for a first-order plant with transport lag.

5B. Draw the block diagram of a multi loop control system with two primary controllers and two cross-controllers and discuss the response of the system.

5C. Write a note on ZN closed loop tuning.

(4+4+2)

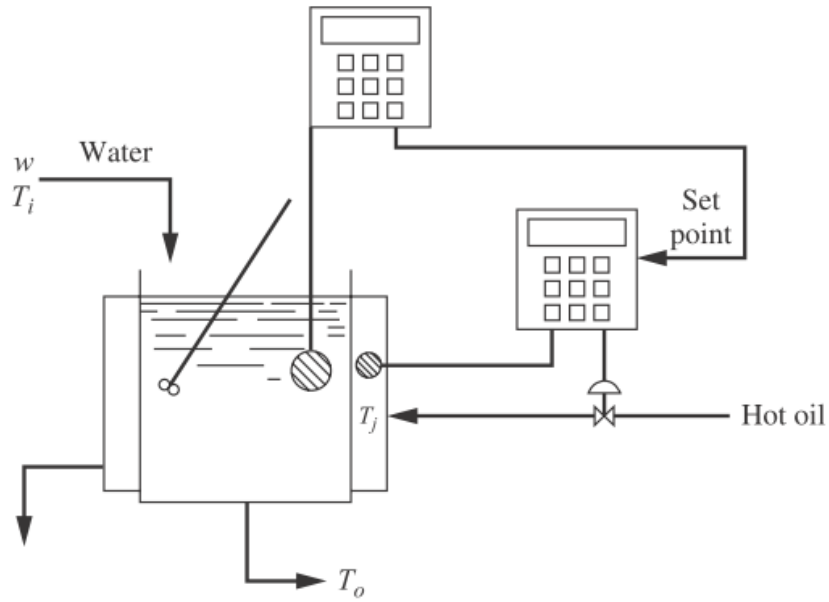

Fig 4A

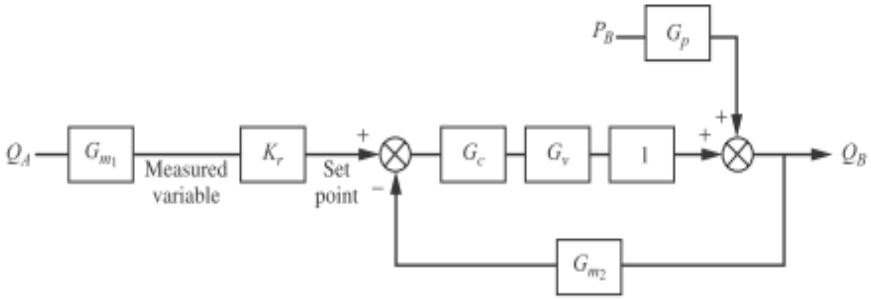

Fig 4C

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