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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, NOVEMBER - 2019

SUBJECT: PROCESS DYNAMICS AND CONTROL [ICE 5154]

TIME: 3 HOURS MAX. MARKS: 50

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

1A. List an advantage and a disadvantage each of ON-OFF control scheme.

1B. Derive the mathematical model for the height 'h_2'in Tank-2 of the two tank interacting system. Assume the step change is given in F_{in} in Tank-1.

1C. Explain the process reaction curve method for PID controller tuning with respective diagrams. Also tabulate the controller tuning formulae of P, PI and PID modes.

(2+3+5)

2A. What are the advantages of quarter decay ratio method of tuning PI and PID controller.

2B. State the difference between steady state and dynamic performance criteria with its types.

2C. For an unity feedback system, process transfer function is given by $G_p(s) = \frac{1}{s(s+4)(s+10)}$. The controller is of PID mode. Calculate the optimal values of controller parameters based on ultimate gain method of tuning.

(2+3+5)

3A. State the features of cascade control.

3B. Explain cavitation and flashing in control valve. How can it be avoided in valves?

3C. With necessary derivations and schematic diagrams, explain the steady state and dynamic feed-forward control application for a CSTR process.

(2+3+5)

4A. Design the compensator to improve the closed loop performance in servo and regulatory mode with presence of large dead time. Also comment on the frequency response specifications with necessary diagrams.

4B. Explain the necessity of 2DOF control scheme. Explain any two configurations with set-point filter structures.

4C. A PI Controller is used to control temperature in a CSTR. The temperature in CSTR varies from 10-210 Deg. Cel. The control valve on steam inlet goes from fully open to fully closed state when pressure signal varies from 15psi to 3psi. A temperature variation of +/- 20 Deg. Cel around the setpoint of 110 Deg. Cel changes the pressure signal of valve by 12psi. When the error changes by 5 Deg. Cel, the control valve gets fully closed after 1 min. Calculate K_p , PB and K_i. Assume that the valve was 50% open and Temp. was at setpoint in the beginning.

(2+3+5)

5A. Write a short note on Integral windup with solution.

5B. With the control law formulation explain the Model Predictive Control for a MIMO process.

5C. What are the recommended control configurations to improve the distillate product in a oil refinery? Explain in brief.

(2+3+5)

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