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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, DECEMBER - 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. Explain the need of Process control in chemical industries, with a suitable example.

1B. Derive the mathematical model of a single tank system which involves nonlinear valve at the outlet.

1C. Find the transfer function $h(s)/F_{in}(s)$ for a system shown in Fig.1C. Where F_1 and F_2 are outlets from the tank.

(2+5+3)

2A List the advantages and limitations of P+I controller with respect to the first order process.

2B Prove that proportional controller will result with offset for servo and regulatory operation on the first order process.

2C The error shown in Fig. 2C is applied to a proportional-integral controller with K_P = 3, K_I= 1.5 sec^{-1}, K_D=0.8 sec and P(0) = 10%. Draw a graph of the resulting controller output and also calculate controller output for every time instants.

(2+3+5)

3A Define integral windup action in controller.

3B With a neat sketch analyse the feed forward – feedback control loops with necessary equations.

3C The transfer functions of a cascade systems are given as $G_{p1}(s) = \frac{4}{(2s+1)(4s+1)}; G_{p2}(s) = \frac{5}{(s+1)}; G_{l2}(s) = \frac{1}{(3s+1)}$ G_{c1} is a proportional controller; G_{c2}=3; G_{m1}=0.2 and G_{m2}=0.05. Calculate the ultimate value of K_{p1} for primary controller for which simple feedback and cascade loop going to oscillations.

(2+3+5)

4A Write the need for two degree of freedom in control loops.

4B Design an electronic PID controller using Op-Amp, input error given in the range is 0-4V. The output to final control element is 0-8V. Given K_p=2.4%/%, K_i=9(%/min)/%, K_d=0.7 %/(%/min).

4C Derive the conditions for pairing of inputs and outputs of a MIMO system for the controller design with minimum interaction.

(2+3+5)

5A Draw two configurations of the ratio controller.

5B Design the IMC based PI controller for a first order process. Derive the controller parameters for the K_p and K_i.

5C Explain the control of overhead composition of a distillation column with necessary diagrams.

(2+3+5)

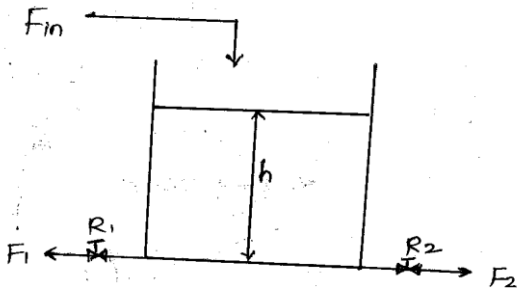

Fig. 1C

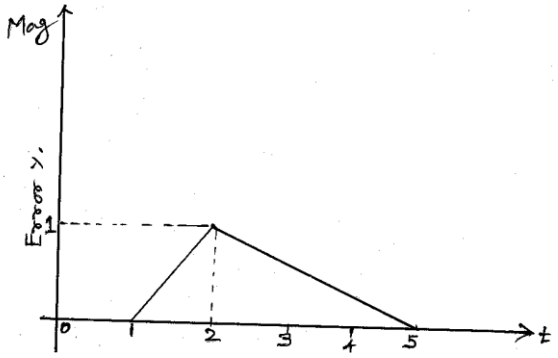

Fig.2C

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