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Question Paper Code: 41603

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

Sixth Semester

Instrumentation and Control Engineering

14UIC603 - PROCESS CONTROL

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Servo and Regulatory response is used to analyze the performance of the

   (a) Process (b) Sensor (c) Controller (d) Control valve

2. The thermal time constant of most simple thermal process is

   (a) $T = \frac{W}{Q}$ (b) $T = \frac{W}{t*Q}$ (c) $T = \frac{W*t}{Q}$ (d) $T = \frac{t}{Q}$

3. A process has time constant of T_1=10 sec and T_2=20 sec. The outlet resistance R_1 is 10 sec per sq ft. Calculate the proportional sensitivity for damping ratio of one third.

   (a) 0.80 sq ft/sec (b) 0.30 sq ft/sec (c) 0.91 sq ft/sec (d) 0.70 sq ft/sec

4. Control lag refers to the time for the process-control loop to make necessary adjustments to the

   (a) Final Control Element (b) Feed back action
   (c) Measurement Sensor (d) Controller

5. The controller which has a smooth, linear relationship exists between the controller output and the error is

   (a) I (b) PI (c) P (d) PD

6. The _____ is never used alone because it cannot provide a controller output when the error is zero.

   (a) Integral (b) proportional (c) Derivative (d) PID

7. A _____ strategy is often used in situations where one or more valves may be used

   (a) Ratio (b) Cascaded (c) Split range (d) Feedback

8. Integral of the absolute value of error (IAE) has been denoted by

   (a) $\int_0^\infty |e|dt$ (b) $\int |e|dt$ (c) $\int_0^\infty |e|tdt$ (d) $\int_0^\infty |e^2|dt$

9. The reactor energy balance, assuming constant volume, heat capacity (c_p) and density (ρ), and neglecting changes in the

   (a) Kinetic and Potential Energy (b) Kinetic
   (c) Potential (d) Heat capacity

10. Control valve sizing depends on

    (a) C_v factor (b) Flow rate (c) Fluid property (d) Line pressure

PART - B (5 x 2 = 10 Marks)

11. Define self-regulation.

12. Draw the schematic diagram of an electronic PI controller with its equation.

13. Define one quarter decay ratio.

14. Draw the inherent valve characteristics of an equal percentage valve.

15. A controller outputs a 4- to 20-mA signal to control motor speed from 140 to 600 rpm with a linear dependence. Calculate (i) current corresponding to 310 rpm, and (ii) the value of (i) expressed as the percent of control output.

PART - C (5 x 16 = 80 Marks)

16. (a) Obtain the mathematical model of a simple first order thermal and level processes. (16)

Or

(b) (i) Derive the mathematical model for the pressure process. (10)

(ii) Write a short note of self-regulation. (6)

17. (a) Design and realize the P, PI and PID electronic mode controllers. (16)

Or

(b) Explain in detail about IAE, ITAE, ISE and one quarter decay ratio. (16)

18. (a) Consider the third order system of having the model $H(s) = \frac{1}{(3s+1)(2s+1)(s+1)}$ using Z-H tuning method find the controller gain for the three-term controller. (16)

Or

(b) Explain in detail about ratio, selective and split range control with suitable example. (16)

19. (a) Design a proportional-integral controller with a proportional band of 30% and an integration gain of 0.1%/(%s). The 4- to 20-mA input converts to a 0.4- to 2-V signal, and the output is to be 0–10 V. Calculate values of G_p, G_i, R_1, R_2 and C respectively. (16)

Or

(b) (i) Explain in detail about single and double seated control valve. (10)

(ii) Derive the relationship between the parameters C_v and K_v. (6)

20. (a) Describe the process of distillation column and its feature response to reflux change. (16)

Or

(b) Explain the control loops used in mixing process. (16)