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206603

May, 2019

B.Tech. VI SEMESTER

Industrial Process Control (EI-308-C)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) A deviation variable is defined as a difference between the variable value and its expected value. True or False. Explain in brief. (1.5)

(b) For a purely capacitive process with negative gain, what will be the effect if a step change in input is applied? (1.5)

(c) Consider that pressure inside a gas-phase CSTR is controlled by manipulating vent stream flow-rate. If a P controller is used to regulate this pressure, then explain that corresponding controller gain will be positive or negative. (1.5)

(d) What is the Crossover frequency for a first order purely capacitive system? (1.5)

(e) Can a direct synthesis-based controller eliminate inverse response? (1.5)

(f) Differentiate between manipulated variable and control variable. (1.5)

(g) What is one-way decoupling of two control-loops? (1.5)

(h) What is meant by controller tuning? (1.5)

(i) When one can say that certain output is unmeasured? (1.5)

(j) What is the purpose of Final control Element in the system? (1.5)

PART–B

2. (a) When is an inferential control configuration needed? What do you think is its Primary weakness? Compare it to a simple feedback control configuration. Which one is preferable? (07)

(b) Define the term "Control Configuration" and develop three different control configurations for the pH control in a tank. (Assume relevant data) (08)

3. (a) Give the response of a first order lag to a unit impulse input. (05)

(b) Describe the characteristics of undammed system. (03)

(c) Show that as the number of non-interacting first-order systems in series increases, the response of the system becomes more sluggish. (07)

4. (a) Consider a fist-order system. Could you have almost the same closed-loop responses with PI and PID controllers and appropriate values of their adjustable parameters? (10)

(b) What is the order of closed-loop dynamic response for a first-order system with PI control? Can the PI control destabilize such a process? (05)

5. (a) What is the effect of dead time in the response of simple feedback control loops? How it can be eliminated/compensated? (5)

(b) Explain adaptive control? Where it can be used? Explain different methods of deploying the adaptive control. (10)

6. (a) In chemical processes, flow control loops are almost always cascaded with other control loops. Why does it happen?

Note : take into account the following facts :

(i) the flow rate itself is subject to changes and is regulated by the flow control loop,

(ii) flow rates are the most common manipulated variables in chemical process. (10)

(b) Give three specific examples of ratio Control. (05)

7. (a) What are the properties of a relative-gain array? How many relative gains do you need to compute in order to specify completely the relative-gain array of a process with

(i) Three inputs and three outputs.

(ii) N inputs and N outputs. (10)

(b) Consider a process with the following transfer function;

$H_{12}(s) = H_{21}(s) = H_{12}(s) = 0$ and $H_{11}(s), H_{22}(s) \neq 0$.

Show that the Relative gain-array is given by :

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

(consider it as Two input (m_1, m_2) and Two output (y_1 and y_2) system

H_{ij} = transfer function between i^{th} output and j^{th} input.)

(05)
