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May 2024

B.Tech. (EIC) (Re-apear) (Sixth Semester)

Industrial Process Control (El-601)

Time : 3 *Hours*] [*Maximum Marks :* 75

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

Part A

1. (a) What is an inverse response of a system and what cause it ? **1.5**

(b) What is the main reason for the presence of dead time in the process ? What is the effect of dead time in the response of simple feedback control loops ? **1.5**

(c) If a closed loop response is stable with respect to change in set point value, is it stable to change in load. If yes, why ? **1.5**

(d) Assuming that all the variables can be measured, how many measurements do you need for the design of control system with N controlled variables **1.5**

(e) "To suppress errors that persists for long times, Integral of Time Weighted Absolute Error (ITAE) criterion will tune the controller." Justify this statement. **1.5**

(f) Consider a plant with one manipulated variable and two measured output. Can you control both outputs using single manipulated variable ? Justify your answer. **1.5**

(g) "Processes having the term $1/s$ in their transfer function, do not exhibit offset for set point change when controlled using proportional controller." (True/False) Justify your answer. **1.5**

(h) What is feedforward control ? Why is it needed in chemical process control ? **1.5**

(i) What are the properties of relative gain array ? **1.5**

(j) What is the role of sampler and hold elements in digital computer control of a process ? **1.5**

Part B

2. (a) How many state variables do you need to describe a system that is composed of N phases and N components. Write a relationship that will give the specific enthalpy of a multi component liquid at temperature T and pressure p with non-composition for the N components. **8**

(b) Can we design a controller that minimizes both overshoot and settling time simultaneously ? If yes, justify your answer. **7**

3. (a) Draw and explain the time response of first order lag system to a Sinusoidal input. What do you observe in its behavior after a long time as $t \rightarrow \infty$? **8**

(b) Integral control action makes a process : **7**

(i) faster or slower

(ii) more oscillatory or less

(iii) with larger derivation from the set point or smaller. Explain your answer

4. (a) Describe the Ziegler Nichols tuning methodology. This procedure is often called the continuous cycling tuning method. Why ? **8**

(b) Is the dead time of a process constant or does it vary with time ? If it varies give *two* relevant physical examples. What is the effect of changing dead time on the design of dead time compensator ? **7**

5. (a) What is the ratio control and how do you select the desired value of ratio in the ratio control system ? **8**

(b) What is adaptive control ? Differentiate between programmed adaptive control and self-adaptive control ? Give example of each. When would you recommend the programmed and when the self-adaptive scheme ? **7**

6. (a) What do you mean by interacting and non-interacting current loops ? Can we tune two interacting loops separately and retain the stability of overall process ? Explain why and why not ? **8**

(b) What is one way de-coupling of two control loops and why could it be acceptable ? **7**

7. (a) What do you mean by digital computer control of a system ? With a block diagram describe the important elements of a computer-based process control system. **8**

(b) In what sense, is the control of a complete chemical plant different from the control of a single processing unit ? **7**