

May 2023

B.Tech. EIC 6th Semester (Re-Appear)

Industrial Process Control (EIC-310)

Max. Marks:60

Time: 3 Hours

- 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.
 4. Assume relevant data if not mentioned.

PART-A

- Q.1.a State the modelling objectives and the end use of the model. (02)
- Q.1.b What are the classes that a control system has to satisfy? (02)
- Q.1.c Define servo and regulator problems. (02)
- Q.1.d Identify the two sources of instability in closed-loop responses. (02)
- Q.1.e What is the effect of dead time in the response of a simple feedback control loops? (02)
- Q.1.f Identify the functions and hardware components of a computer-process I/O interface. (02)
- Q.1.g What is one-way decoupling of two control loops? (02)
- Q.1.h What type of controllers would you use for the two controllers of a cascade system? (02)
- Q.1.i Draw three different feed-forward control configurations for the mixing process. (02)
- Q.1.j What is the difference between ISE and ITAE (02)

PART-B

- Q.2.a Define the term "control configuration" and develop three different control configurations for the pH control problem of your choice. (05)
- Q.2.b How many state variables do you need to describe a system that is composed of M phases and N components? Give the advantages of mathematical modelling. (05)
- Q.3.a Why do most of process reaction curves have an over-damped, sigmoidal shape? Can you develop a physically meaningful system which has a reaction curve with an under-damped, oscillatory shape? (05)
- Q.3.b What are the basic hardware components of feedback control loop? Identify the hardware elements present in a feedback loop for the temperature control of a stirred tank heater. (05)
- Q.4.a What is the impact of model inaccuracies on the effectiveness of dead-time compensators? (05)
- Q.4.b Explain in your own words what we mean when we say that phase and gain margins constitute safety margins (safety factors) in tuning a feedback controller. Why do we need a safety margin in tuning a feedback controller? (05)

- Q.5.a Consider a process with one controlled output and two active manipulated variables. (05)
Under what conditions could you use both manipulated variables to control single output?
- Q.5.b If, in addition to the unmeasured disturbance there are measured disturbances in a system, we can develop a combined inferential-feed forward configuration; develop such a configuration for a system of your choice. (05)
- Q.6 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 (10)
with
(a) three inputs and three outputs, and (b) N inputs and N outputs?
- Q.7 What size computers would you use for DDC and supervisory control? Why? (10)
How do the DDCs communicate with the supervising computer?