



# Birla Institute of Technology & Science, Pilani

## Hyderabad Campus

### SECOND SEMESTER 2022-2023 COURSE HANDOUT PART II

**Date: 16.01.2023**

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

**Course No.** : INSTR F343  
**Course Title** : Industrial Instrumentation & Control  
**Instructor-in-charge** : R. N. Ponnalagu  
**Instructor** : R. N. Ponnalagu

- 1. Course Description:** Importance of process control, elements of process loop, mathematical modeling, dynamic closed loop characteristics, controller principles & tuning, direct digital loop, hydraulic controllers, pneumatic controllers, electronic controllers, complex & multivariable control schemes, final control elements, P&I diagrams, PLCs, Distributed Control Systems (DCS), AI techniques: expert systems, neural networks, fuzzy logic, genetic algorithms & applications.
- 2. Scope and Objective of the Course:** This course aims to develop an insight of the industrial instrumentation and control aspects for UG students of Electronics and Instrumentation Engineering. The uses of different controllers, their types, their implementation aspects are detailed in the course. The course starts from the basic control loop element identification and understanding of various elements. Further, an exposure to various control configurations often found in industrial control loops will be discussed so as to enable the student to have an effective understanding of the real industrial control loops and justify their use. The next module of the course deals with programmable logic controllers and also discusses the digital control and distributed control aspect from a higher level, which will make the students to comprehend the control layers in an industry with a recent advancement i.e. industry 4.0 along with basic concepts of IIoT. The last part of the course is intended to make the students familiarize with advanced sophisticated control techniques with the help of intelligent control which includes fuzzy and neural based control techniques. After learning the course, the students will be able to understand the control loop architecture for an industrial use and will be able to design a low-level control algorithm as well.
- 3. Text Books:** Surekha Bhanot, Process Control: Principles and Applications, Oxford University press, Fourth Impression 2010.
- 4. Reference Books:**  
R1: C.D. Johnson, Process Control Instrumentation Technology, Prentice Hall of India, New Delhi, 1993  
R2: Krishan Kant, Computer Based Industrial Control, Prentice Hall of India, New Delhi, 1997.  
R3: Stephanopoulos George, Chemical Process Control, Prentice Hall of India  
R4: Ogata K., Modern Control Engineering, Pearson Education Asia  
R5: Sigh, S. K., Industrial Instrumentation & Control, Tata McGraw-Hill Education

## 5. Course plan

Lecture No.	Learning Objective	Topics to be covered	Chapter in the Text Book
1, 2	To understand and appreciate the needs, objectives of process control	Basic Control loop, variables, requirements, aims, parameters, dynamics of the process	T-CH1 R4 (1.9)
3	To understand the dynamics of processes	Terms, concepts used in process dynamics	T-CH2
4, 5	Understanding the need and ways to develop mathematical modelling	Modelling aspects of different processes	T-CH2, R3
6	To understand steady state and transient analysis	Transient and steady state analysis of first order, second order and higher order systems and numerical to highlight concepts	R5-CH5
8 - 11	To understand different controller modes	On-off, on-off with neutral zone, Proportional, Integral, derivative, PI, PD, PID	T-CH3, R4(9), R3 – CH1
12 - 14	Student will be able to realize analog electronic PID controllers	Electronic realization of P, PI and PID controllers through operational amplifiers	T-CH7, R1
15,16	To learn dynamic behavior of feedback-controlled systems	Effect on dynamic behavior of process with different controller modes in closed loop mode	T-CH4, R4(14)
17,18	To learn about controller tuning and their effects on control loop performance	Ziegler, Cohen-Coon, Integral performance	T-CH4, R4
19, 20	Understanding of digital implementation of control algorithms	Sampling and reconstruction, DDC structure, position & velocity algorithm	T-CH5
21	To realize controller modes in pneumatic and hydraulic controllers	Pneumatic and Hydraulic controllers	T-CH6, R5 (4.3 and 4.4)
22, 23	Understanding of the function of final control elements	Functions of control valves, Types of control valves, actuators	T-CH8, R3 CH4
24	Student Will be able to understand and draw P&I diagrams	Piping & Instrumentation Diagrams	T-CH9, R1
25 - 29	Students will be able to understand different control configuration	Cascade control and Ratio control, Inferential control and Adaptive control, feed forward control	T-CH10, R3
30, 31	Student will be able to understand multivariable control problems	Multi variable control	T-CH12, R3
32 - 36	Students will be able to understand and develop sequential	PLC vs relay Logic, PLC vs PCs, hardware components	T-CH13, R3(5), R2

	programming for control aspects	Ladder diagram, selection of PLCs	
37, 38	To learn application of AI and fuzzy techniques in process control	Neural networks and their application in control, Fuzzy based control, Fuzzy PID control	T-CH14, CH17, R3(13), R2
39, 40	Student will understand the concept of distributed digital control systems	Distributed digital control system: Functional requirements, system architecture	T-CH18, R2, R3, R5
41 - 42	Student will understand the basics of Industry 4.0 and IoT use in industries	Industry 4.0: Concepts, Terms and definitions; Industrial Internet, IIoT	Class notes

## 6. Evaluation Scheme

Components	Duration	Weightage	Marks	Date & Time	Nature of Component
Midsem	90 minutes	30 %	60	18/03 2.00 - 3.30PM	Closed Book
Quizzes (3)	20 minutes	15 %	30	TBA	Closed Book
Term Paper / Assignments	-	15 %	30	Take Home	Open Book
Comprehensive	180 minutes	40 %	80	20/05 FN	10 % Open book and 30% Closed book
Total		100 %	200		

**7. Chamber Consultation Hour:** To be announced in the class.

**8. Notices:** Will be displayed on the course page in CMS

**9. Make-up Policy:** No make-up will be given for the quizzes, however, for other components, make-up examination will be given ONLY in cases of sickness (hospitalization) or urgency for going out of station. In such a case, the student must produce sufficient proof or must have taken the prior permission from the IC of the course.

**10. Academic Honesty and Integrity Policy:**

Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor-in-charge**  
**INSTR F343**