Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2023-2024
Course Handout Part II

Date: 09.01.2024

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

Course No.	**: INSTR F343**
Course Title	**: Industrial Instrumentation & Control**
Instructor-in-charge	**: Joyjit Mukherjee**
Instructor	**: Joyjit Mukherjee**

1. **Scope and Objective of the course**
   This course offers study of various aspects of automatic control for industrial processes, including some recent developments in the field of process control.

2. **Course Description:**
   Introduction to process control; Elements of process loop; Controller principle; Hydraulic, pneumatic, electronic controllers; Controller tuning; Final control elements; Control loop characteristics; Complex control systems; Intelligent controllers; Programmable logic controllers; Distributed control systems; Digital control principles.

3. **Textbook:**
   Surekha Bhanot, *Process Control: Principles and Applications,* Oxford University press, Fourth Impression 2010

4. **Reference Book**:
   R1: C.D. Johnson, *Process Control Instrumentation Technology,* Prentice Hall of India, New Delhi, 1993
   R2: Liptak B.G., *Process Control: Instrument Engineer's handbook,* Butterworth Heinemann
   R3: Krishan Kant, *Computer Based Industrial Control,* Prentice Hall of India, New Delhi, 1997
   R4: Stephanopoulos George, *Chemical Process Control,* Prentice Hall of India
   R5: Ogata K., *Modern Control Engineering,* Pearson Education Asia

5. **Course plan**

Lecture No.	Learning Objective	Topics to be covered	Chapter in the Textbook
1,2	To appreciate the needs,	Basic Control loop,	T-CH1

	objectives of process control	variables, requirements, aims, parameters, dynamics of the process	R4(1.9)
3	To understand the dynamics of processes	Terms, concepts used in process dynamics	T-CH2
4	To understand/review the concepts of Transfer function	Transfer functions, block diagram and signal flow representation	R5-CH4
5	To understand need and concept of mathematical modeling	Model of lumped and distributed parameter systems	T-CH2, R3 – CH11, R5-CH2,3 &4
6,7	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	To understand different controller modes	On-off, on-off with neutral zone	T-CH3 , R4(9), R3 – CH1
9,10,11	To understand different controller modes	Proportional, Integral, derivative, PI, PD, PID	T-CH3, R4(9), R3 – CH1
12,13	To learn dynamic behavior of feedback-controlled systems	Effect on dynamic behavior of process with different controller modes in closed loop with	T-CH4, R4(14)
14,15	To learn about controller tuning	Ziegler, Cohen-Coon, Integral performance	T-CH4, R4
16	To learn about DDC loop	Sampling and reconstruction, DDC structure, position & velocity algorithm	T-CH5
17	To realize controller modes in pneumatic controllers	Controller modes in Pneumatic controllers	T-CH6, R5 (4.3)
18	To realize controller modes in hydraulic controllers	Controller modes in Hydraulic controllers	T-CH6, R5 (4.4)
19	To realize controller modes in electronic controllers	Controller modes in electronic controllers	T- CH7, R1(10.3)
20,21	To learn the evolution, hardware of Programmable Logic Controllers	PLC vs relay Logic, PLC vs PCs, hardware components	T-CH13, R3(5), R2
22,23	To learn ladder diagram programming	Ladder diagram, selection of PLCs	T-CH13, R3(5), R2
24	To learn application of AI techniques in process control	Role of AI	T-CH14, R3(13), R2
25,26	To learn ES structure & Application	ES structure, Design & Applications	T-CH15, R3(13)

27,28	To learn concept & applications of FLC	Fuzzy controllers	T-CH17, R3(13), R2
29	To learn about different final control elements	Functions of control valves, Types of control valves, actuators	T-CH8, R3 – CH4
30	To understand P&I diagrams	Draw P&I diagrams	T-CH9
31,32	To understand complex control schemes	Cascade control, Ratio control,	T-CH10, R4(20, 21)
33,34	To understand complex control schemes	Feedforward, Adaptive control, Inferential, Model reference adaptive control, Self tuning regulator	T-CH10, R4 (21)
35,36	To understand complex control schemes	Override, Auctioneering, Split Range	T1-CH11, R4(22)
37,38	To understand interaction and decoupling of control loops	Design of cross controllers and selection of loops using RGA	T-CH12, R4(24)
39,40	To understand distributed digital control systems	History, functional requirements, system architecture, configuration	T-CH18, R3(6), R2

6. Evaluation Scheme

Components	Duration	Weightage	Marks	Date & Time	Nature of Component
Midsem	90 minutes	30 %	60	14/03 - 9.30 - 11.00AM	Closed Book
Quizzes	To be announced	15%	30	To be announced	Closed Book
Term Paper / Assignments	-	15%	30	Take Home	Open Book
Comprehensive	180 minutes	40 % (10 % Open book and 30% Closed book)	80	13/05 FN	10 % Open book and 30% Closed book
Total		100%	200		

7. **Chamber Consultation Hour:** To be announced in the class.
8. **Course Notices:** Notices will be displayed in CMS.
9. **Make-up Examination**: Make-up will be given on *extremely genuine* grounds only for those receiving prior approval. No make up for quizzes
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.

Joyjit Mukherjee
Instructor-in-charge
INSTR F343