Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Diploma Engineering College
Semester 5 (Diploma)

Subject: Process and Instrumentation Control- DETCH15213

Type of course: Professional Core

Prerequisite: Calculations of Material and Energy Balances, Fundamentals of Differential Equations

Rationale: Fundamental knowledge of industrial process control systems, instrumentation devices, and automation techniques, enabling them to monitor, regulate, and optimize various engineering processes efficiently. It covers essential topics such as sensors, transducers, control valves, PID controllers, ensuring students develop practical skills for maintaining process stability, improving system performance, and enhancing safety in industries like chemical, manufacturing, and power plants.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI - Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE - Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No.	Course content	Hrs	Weightage
1	**Introduction:** Definition and Importance of Process Control, Basic Elements of a Process Control System, Types of Process Variables (Flow, Pressure, Temperature, Level, etc.), Open-loop vs. Closed-loop Control Systems, Concept of Feedback and Feedforward Control, Block Diagram Representation of Control Systems	15	25%
2	**Measurement Systems & Basics Instrumentation:** Introduction to Sensors, Transducers, and Actuators, Classification of Sensors (Analog & Digital), Pressure Measurement Devices (Bourdon Tube, Diaphragm, Strain Gauge), Temperature Measurement Devices (RTD, Thermocouple, Thermistor), Level Measurement Techniques (Float Type, Ultrasonic, Capacitive), Flow Measurement Techniques (Orifice, Venturi, Rotameter, Electromagnetic)	15	25%

3	Controllers & Control Modes: Introduction to Process Controllers (P, PI, PID), Characteristics of Proportional Control (P), Working of Integral Control (I), Derivative Control (D) and its Role in Stability, Tuning Methods of PID Controllers (Ziegler-Nichols, Trial & Error), Comparison of ON-OFF Control and Continuous Control	15	25%
4	Control Valves & Final Control Elements: Introduction to Final Control Elements, Types of Control Valves (Globe, Butterfly, Ball, Diaphragm), Actuators – Pneumatic, Hydraulic, and Electric Actuators, Valve Positioners, Characteristics of Control Valves (Linear, Equal Percentage, Quick Opening)	15	25%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1.	**Process Control System Analysis:** Understand the working of different process control systems and their applications and upload on GMIU Web portal.	10
2.	**Sensor & Instrumentation Case Study:** Identify and analyze different types of sensors used in industrial process control and upload on GMIU Web portal.	10
3.	**PID Controller Tuning Experiment**: Understand the effect of PID control parameters on system stability and upload on GMIU web portal.	10
	Total	30

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	20%	25%	15%	20%	0%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Understand the fundamentals of process control systems and their applications in industrial automation
CO2	Identify and explain various measurement instruments and sensors used for process variable monitoring
CO3	Analyze different control modes and tuning techniques for effective process regulation
CO4	Evaluate the working principles, selection criteria, and applications of control valves and actuators

List of Practicals:

Sr. No.	Description	Hours
1	Response of first order system: thermometer	4
2	Response of first order liquid level system	4
3	Response of mixing process	2
4	Reponses of second order system: U-tube manometer or damped vibrator	4
5	Response of Interacting tanks	4
6	Characteristics of Control Valves (Globe, Butterfly, Ball Valves)	4
7	Study and Tuning of a PID Controller for Temperature Control	4
8	Study of Pneumatic and Electrical Actuators in Process Control	4
Total		30

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Coughanowr, D. R., LeBlanc, S. "Process Systems Analysis and Control", 3rd edition, McGraw-Hill (2008).

[2] Stephanopoulos, G. "Chemical Process Control: An Introduction to Theory and Practice", Pearson Education (1984)

[3] R. P. Vyas, "Process Control and Instrumentation", Denett & Co.

[4] Donald .P. Eckman, "Industrial Instrumentation", John Wiley & Sons Inc, New York.