SEMESTER S5

PROCESS CONTROL LAB

Course Code	**PCAEL507**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCAEL307: Transducers and Measurements Lab., PCAET502: Process Dynamics and Control	**Course Type**	Lab

Course Objectives:

1. To study the responses of various controllers and valves
2. To simulate various types of controller using SIMULINK/MATLAB/Labview
3. To provide experience on control of various industrial processes using different control paradigms

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Expt. No.	Experiments
PART A (Minimum 8 experiments are mandatory)	
1	Study of responses of P, PD, PI and PID controllers on Level/ Flow/ Thermal/ Pressure processes
2	Study of responses of ON-OFF controller and ON-OFF controller with dead zone.
3	Controller tuning using continuous cycling method
4	Controller tuning using Process Reaction curve method
5	Characteristics of Linear, Equal percentage and Quick opening valves
6	Control of Stepper motor/Water level/Bottle filling plant using PLC
7	Experiment to determine non-linearity if any, in a plant.
8	Data acquisition with ADC/DAC card and control applications using LabVIEW (Speed control / Temperature control)
9	Design and testing of a RTD based Temperature transmitter on a prototyping board.

10	Design and testing of an analog PID controller on a prototyping board.
	Part B (Minimum 2 experiments are mandatory)
	Experiments (1-4) shall be done using Arduino/Python/LabVIEW/MATLAB/SIMULINK
1.	PC based control of robotic arm
2.	Simulation study of feed-forward, cascade, and ratio control systems using MATLAB/SIMULINK
3.	PID controller design using MATLAB/SIMULINK
4.	Simulation of PID controller using MATLAB/SIMULINK/LabVIEW

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

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End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Make use of basic transducers for the measurement of physical variables like pressure, temperature etc.	**K4**
CO2	Familiarize various simulation tools -MATLAB, Labview, SIMULINK	**K3**
CO3	Tune controllers using Ziegler- Nichols & Cohen- Coon techniques	**K4**
CO4	Implement sensor-based measurement systems using modern tools	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2					3			3
CO2	3	2	3	2	3				3			3
CO3	3	2	3	3					3			3
CO4	3	2	3	3	3				3			3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Process Control: Modeling, Design and Simulation	B.Wayne Bequette	PHI	1st edition, 2002
2	Process Instrumentation and control Handbook	Considine	McGraw Hill	5th edition., 2009

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (7 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

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- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

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5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted.