SEMESTER S6

PROCESS SIMULATION LAB

Course Code	**PCCHL607**	**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)	PCCHT205, PCCHT302, PBCHT304, PCCHT402, PCCHT403, PCCHT401, PCCHT501, PCCHT503, PBCHT504, PCCHT601, PBCHT604	**Course Type**	Lab

Course Objectives: Process Simulation Lab prepares students for real-world challenges, fosters creativity, and enhances their problem-solving abilities. Fundamental concepts of mathematical models in chemical processes; simulation of chemical units such as flash drum, heat exchanger, continuous stirred tank reactor, plug flow reactor, distillation column, absorption column and so on; and sensitivity analysis are covered in detail.

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1. To equip students to conceptualize and develop flow sheet for chemical engineering process.
2. To introduce different commercial softwares to simulate the chemical processes.
3. To integrate and apply knowledge from prior courses to solve open-ended problems.
4. To interpret the results of the simulation problems.

Experiments can be done using Excel, MATLAB/ Scilab, UniSim Design/ DWSIM or any other chemical process simulation software.

Expt. No.	Experiments
1	**Equations of State:** Solve various equations of state and study the effect of pressure and temperature on molar volume.
2	**Property Estimation:** Calculation of physical and thermodynamic properties of compounds

3	**Phase equilibrium:** Vapour- Liquid equilibrium for binary mixtures
4	**Chemical Reaction Equilibrium:** Study of various possibilities of finding theproduct composition in an equilibrium reaction
5	**Mass Balances with Recycle Streams:** Study of material balance of chemical processes involving recycle of material streams
6	**Compression System:** Steady-state simulation of two stage compression system
7	**Simulation of Reactor:** Steady state simulation of conversion, and equilibrium reactors
8	**Simulation of Reactor:** Steady state simulation of CSTR
9	**Simulation of Reactor:** Steady state simulation of plug flow reactor
10	**Simulation of Heat Exchanger:** Steady state simulation of heat exchanger
11	**Simulation of Flash operation:** Steady State simulation of flash drum for binary mixture
12	**Simulationof Mass Transfer Equipment:** Steady-state simulation of shortcut and rigorous distillation column
13	**Simulation of Mass Transfer Equipment:** Steady-state simulation of absorption column
14	**Simulation of Mass Transfer Equipment:** Steady-state simulation of extraction column
15	**Simulation of Refrigeration system:** Steady-state simulation of refrigeration gas plant
16	**Simulation of Chemical Process:** Steady-state simulation of chemical process involving unit process and/or unit operations.
17	**Simulation of Chemical Process:** Steady-state simulation of chemical process involving unit process and/or unit operations.
18	**Dynamic Simulation:** Dynamic simulation of heat exchanger

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19	**Dynamic Simulation:** Dynamic simulation of distillation column
20	**Dynamic Simulation:** Dynamic simulation of absorption column

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	Plan the numerical techniques to solve the engineering problems.	**K3**
CO2	Select an appropriate property package, operation or a group of operations to simulate a unit operation, a unit process or part of the process plant.	**K3**
CO3	Predict the physical and thermodynamic properties of a compound/mixtures.	**K6**
CO4	Analyse and simulate various types of unit operations and unit processes there by simulating an entire plant using process simulators.	**K4**
CO5	Analyze the dynamic simulation of an operation or a small portion of a process plant to predict the variation of operating parameters on a servo or regulator problem of process control.	**K4**
CO6	Interpret and make use of the results from commercial process simulation software.	**K5**

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**3**	**3**				**2**			**3**
CO2	**3**	**3**	**3**	**3**	**3**				**2**			**3**
CO3	**3**	**3**	**3**	**3**	**3**				**2**			**3**
CO4	**3**	**3**	**3**	**3**	**3**				**2**			**3**
CO5	**3**	**3**	**3**	**3**	**3**				**2**			**3**
CO6	**3**	**3**	**3**	**3**	**3**				**2**	**3**		**3**

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Chemical Engineering Computing	Bruce.A.Finlayson	Wiley Interscience	
2	Hysys: An introduction to Chemical Engineering Simulation	Mohd. Kamaruddin Abd Hamid.		
3	ProcessPlantSimulation	B.V. Babu	OxfordUniversity Press	2004

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Chemical Process Modelling and Computer Simulation	Amiya K. Jana	PHI Learning Pvt. Ltd.	Second edition, 2011
2	Chemical Engineering Process Simulation	Nishanth G. Chemmangattuvalappil, Chien Hwa Chon, Denny Ng Kok Sum, Rafil Elyas, Cheng-Liang Chen, I Lung Chien, Hao-Yeh Lee, Rene D Elms	Elsevier	First Edition, 2017
3	Chemical Engineering Process Simulation	Editor: Dominic C.Y. Foo	Elsevier	Second Edition, 2022
4	Computational techniques for process simulations and analysis using MATLAB	Niket S. Kaisare	CRC Press	2018

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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.

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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.
    - 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.
5. **Record (5 Marks)**

Completeness, clarity, and accuracy of the lab record submitted

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