155: 415 **Process Engineering I** **Fall 2015**

Web page: https://sakai.rutgers.edu
Lectures: Wednesday 8:55-9:50am, SEC 118
Lab: Tuesday (01); Thursday (02) 8:30am–1:30pm (+4 hrs by arrangement)
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Course Description: The chemical and biochemical engineering process laboratory is a two-semester course that provides an introduction to various unit operations that are characteristic of the chemical and biochemical process industries. The course includes a one-hour recitation section and an extended time period (up to 9 hrs/week) that allows for hands-on operation in a modern pilot-scale setting. As an instructional laboratory, research projects are not envisioned. Instead, the laboratory introduces new perspectives on material learned or first seen in the classroom as well as an opportunity to become familiar with those things that practicing engineers are expected to know. The laboratory emphasizes objective-driven experiments and detailed protocols should not be expected. You will develop the ability to design experiments as well as analyze them. This is a 4 credit course.

Students work in groups of 4-6 and will be carrying out two experiments this semester. The groups change with each rotation and the experimental plan is guided by a group-initiated specification of objectives. Experimental planning and design, analysis of results, presentations (both oral and poster), adherence to safety protocols and guidelines that includes satisfying all REHS requirements, and active participation in the laboratory exercises are required of all students. Grades are primarily based on the group's performance.

Course Objectives:

By completing the laboratory, students will be able to achieve the following objectives:

1. apply appropriate sensors, instrumentation and software tools to measurements of physical quantities;
2. identify strengths and limitations of theoretical models as predictors of real-world behaviors;
3. devise an experimental approach to meet self-defined objectives and interpret the experimental data to characterize the system and assess relevant physico-chemical parameters;
4. demonstrate the ability to collect, analyze and interpret data, and to form and support conclusions. Make order of magnitude estimates and use appropriate units and their

conversions;
5. develop SOPs and P&IDs for the supporting equipment and procedures;
6. propose solutions to unsuccessful outcomes;
7. demonstrate creativity and sound judgment;
8. identify health and safety concerns and follow all requirements related to safe and responsible laboratory practice;
9. communicate effectively about the work in writing and in oral presentations;
10. work effectively in the team structure and meet deadlines, monitor progress and integrate individual contributions into a coherent outcome; and
11. behave ethically and interact with integrity.

Textbooks:

155:415/416 Process Engineering I/II Laboratory Manual
by Henrik Pedersen, available as an interactive pdf file on the course website.

Software:

Matlab/Simulink: This is an interactive environment for system simulation and design. Utilizing a block diagram interface, it can be used to model, simulate, and analyze multidomain systems for process control and understand system dynamics. It is installed on all PCs in the Microcomputer Lab (room C233). *Excel/VBA*: This is the standard Microsoft product that can be used to generate graphs, figures and other presentation materials as well as handle data analysis. *Maple*: This is useful for symbolic analysis and numerical computations. The software is found on all lab computers. *LabVIEW*: This software is used for data acquisition in the laboratory and also has extensive analysis features. It is installed on computers connected to the relevant laboratory equipment.

Class Participation:

All students must contribute to the group effort. Evaluation of a student's participation in the group will be done by the TAs with input from group peers. All students must attend the Wednesday lecture hour. The Wednesday lectures will include 2 exams.

Assessment: *Group project reports (2): 60%; Individual presentations or reports (2): 10%; TA/peer evaluation: 10%; Quizzes/exams (2): 20%*

Basics of Laboratory Safety Course: All students must complete the on-line "Basics of Laboratory Safety" Course offered by AIChE Academy (http://www.aiche.org/academy/courses/ela909/basics-laboratory-safety#undefined). This course is free for AIChE undergraduate members. Upon completion of this course, you will receive a Certificate of Completion which must be submitted to the TA's. This is a requirement for this course, and must be completed by October 2, 2015.

Course Context:

Week	Date	Lecture Topic
1	Sep. 2	Course Organization–Introduction, LabView: data acquisition fundamentals
2	Sep. 9	REHS safety
3	Sep. 16	Methods of data analysis. Descriptive statistics, error propagation, significant digits, inferential statistics, confidence intervals, t-tests
4	Sep. 23	Guide to written reports and oral presentations
5	Sep. 30	Analytical techniques: Titration analysis, GC, sensors
6	Oct. 7	Design of experiments; Evaporation
7	Oct. 14	Test #1
8	Oct. 21	LabView: control systems; Liquid level control
9	Oct. 28	Pumps and pipe flow; pump curves, K-factors
10	Nov. 4	Equilibrium models; Batch distillation
11	Nov. 11	Test #2 - AIChE Annual Meeting
12	Nov. 18	Oral Presentations
13	Dec. 2	Oral Presentations
14	Dec. 9	Oral Presentations

ABET Outcomes and Assessment:

Program outcomes achieved in this course

(b)	an ability to design and conduct experiments, as well as to analyze and interpret data;
(d)	an ability to function in multi-disciplinary/multi-functional teams (defined as a mix of students working on different roles of a project);
(g)	an ability to communicate effectively;
(h)	the broad education necessary to understand the impact of engineering solutions in a global and societal context; and
(k)	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The achievement of outcomes b), (d), (g), (h) and (k) will be assessed in this course as follows:

Outcome (a): an ability to apply knowledge of mathematics, science and engineering

Demonstration of the ability to apply knowledge of mathematics, science and engineering in problem solving is assessed in the evaluation of laboratory reports and through questions during oral presentations.

Outcome (b): an ability to design and conduct experiments, as well as to analyze and interpret data

The laboratory experiments will require the formulation of a problem objective, identification of the experimental methods required to achieve that objective, a description of the data analysis to be applied, and a discussion of the result in relation to published literature data.

Outcome (d): an ability to function in multi-disciplinary/multi-functional teams (defined as a mix of students working on different roles of a project)

The laboratory experiments are done in groups of 3 or 4. Students have roles in the group, for example, as lead engineer, process engineer and information engineer. All students must understand all aspects of the work and contribute collectively to the successful completion of the laboratory. Teams receive the same grade on the report, but can distinguish themselves through individual (oral) presentations and through interactions with the TA.

Outcome (g): an ability to communicate effectively

The presentations will be used to assess communication skills. Feedback will be given from instructor evaluations in a formalized manner. The reports will also assess effective communication and a form will be used to summarize skills.

Outcome (h): the broad education necessary to understand the impact of engineering solutions in a global and societal context

The presentations and written reports must contain sections related to the broader impact of

the work on society and how the project approach and methods might have use in other areas around the world. These sections will be used to demonstrate achievement of this outcome.

Outcome (k): an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Assignments and reports will require the use of modern computer tools. Interactions with team members and the TAs will be done electronically using a course interaction software portal. Word processing is expected for all reports and sophisticated computational tools should be employed as needed. All the packages are available to all students. If some students require help on the use of modern engineering tools that are new or experiment-specific, this will be provided by the TA or suitable expert. For example, not everyone will be familiar ahead of time with LabVIEW , the data acquisition program used in the lab. We will have a LabVIEW application scientist or the instructor present material to the students early in the course.