CM4110
Unit Operations Laboratory

Curricular Designation: Required

Catalog Description:
Provides a rigorous introduction to experiments focused in the unit operations of fluid mechanics, heat transfer, mass transfer, and chemical reaction engineering.

Credits: 3.0, Lec-Rec-Lab: (0-1-6), Semester Offered: Fall

Textbooks(s) and/or Other Required Materials:
None.

Prerequisites by Topic:
CM 3120 Transport/Unit Operations II – Master principles underlying the transport of mass and energy

and CM3215 Fundamentals of Chemical Engineering Lab- Master basic laboratory methods and instrumentation used in the measurement of fluid flow, heat transfer, and mass transfer.

and CM 3230 Thermodynamics for Chemical Engineering – Mastery principles underlying phase equilibrium and energy conservation.

and CM3410 (C) Technical Communications- Master applications of technical communications used in the chemical engineering profession.

and CM3510 Chemical Reaction Engineering- Master principles underlying chemical reaction engineering/kinetics.

and CM4310 (C) Chemical Process Safety/Environment- Master underlying chemical process safety and environmental concerns.

Course Objectives:
Students enrolled in this course are expected to achieve the following objectives:

- Develop a constant awareness of safety in the laboratory so that all laboratory work is carried out in a safe manner.

- Develop the ability to carry out experimental investigations of pilot- scale processes. This includes:

  Creating equipment diagrams and comprehensive safe operating procedures for various unit operations;
Developing a specific set of experimental object
Planning an experimental strategy for collecting the data to meet the objectives;
Obtaining the experimental data required to satisfy the objectives;
Gaining competency in analyzing experimental data and in comparing the results to data and theories in the literature;
Reporting the results of the experiment in a concise, well-written, well-documented report;
and, presenting the results in a professional oral presentation using current technology.

• Develop the ability to work in a team by:
  Actively participating as a member of a professional group;
  Leading a peer group of professional chemical engineers;
  and, managing conflicts within the team as they arise.

• Develop confidence through the application of previously acquired knowledge of unit operations, chemical reactions, process safety, and process control.

• Learn to apply software tools typically used by Chemical Engineering professionals.
Topics Covered:

1. Unit Operations Experiments including:
   1.1. Heat Exchangers (shell and tube)
   1.2. Pumping and Pipe Flow (variable and constant speed pumps)
   1.3. Reactors (CSTR and PBR)
   1.4. Membrane Separation (air separation into oxygen/nitrogen)
   1.5. Vacuum drying (granular materials)
   1.6. Mineral Processing (air cyclone, flotation, electrowinning)
   1.7. Liquid- Liquid Extraction
   1.8. Cooling Tower/Water Treatment
2. Chemical Process Safety
3. Special topics including piping, valves, pumps, and process control

Class/Laboratory Schedule (note: 1 hour = 50 minutes):

Lecture: 1 hour/week for 14 weeks, Lab = 6 hours/week for 14 weeks

Contribution of Course to Curriculum: Engineering Topics
## Relationship of Course to Program Outcomes:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) An ability to apply knowledge of mathematics, basic science and engineering science</td>
<td>Substantial</td>
</tr>
<tr>
<td>b) An ability to design and conduct experiments as well as to analyze and interpret data</td>
<td>Substantial</td>
</tr>
<tr>
<td>c) An ability to design a system, component or process to meet needs within realistic constraints</td>
<td>Minimal</td>
</tr>
<tr>
<td>d) An ability to function on multidisciplinary teams</td>
<td>Minimal</td>
</tr>
<tr>
<td>e) An ability to identify, formulate, and solve engineering problems</td>
<td>Substantial</td>
</tr>
<tr>
<td>f) An understanding of professional and ethical responsibility</td>
<td>Moderate</td>
</tr>
<tr>
<td>g) An ability to communicate effectively</td>
<td>Substantial</td>
</tr>
<tr>
<td>h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context.</td>
<td>Moderate</td>
</tr>
<tr>
<td>i) A recognition of the need for, and the ability to engage in lifelong learning</td>
<td>Substantial</td>
</tr>
<tr>
<td>j) A knowledge of contemporary issues</td>
<td>Moderate</td>
</tr>
<tr>
<td>k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>Substantial</td>
</tr>
</tbody>
</table>

**Prepared by:**

Julia A. King, Professor of Chemical Engineering, June 19, 2017