COURSE SYLLABUS
CHEG 3043 – Separations
Spring 2020

TIME:  TR 12:30-1:50 PM  Credit Hours: 3

DESCRIPTION:  Equilibrium Stage Separation Processes. (3-0)
Credit 3 semester hours. Applications of heat and mass
balances and phase equilibria to the design of staged
separation processes. Use of graphical methods such as
McCabe Thiele for the treatment of binary systems.
Application to distillation, absorption, stripping, and
extraction.

PREQUISITE:  CHEG 2053 and 3053.

INSTRUCTOR  Dr. Irvin W. Osborne-Lee
Professor of Chemical Engineering
C. L. Wilson Building, Room 200A1
Phone (936) 261-9406
Email: oslee@pvamu.edu

OFFICE HOURS:  Office hours M-F 9:00-10:20 a.m.

REQUIRED TEXTBOOK:  Geankoplis, C.J., Transport Processes and Separation

OPTIONAL REFERENCES:  McCabe, Smith and Harriott, “Unit Operations of Chemical


SYNOPSIS:  Separation processes are an integral part of all chemical
manufacturing plants. They may represent a significant or
dominant source of energy consumption in the plant. This
course introduces methods of analyzing separations
processes on the basis of thermodynamic equilibrium,
mass balances, and energy balances, applied to to
distillation, absorption, and other modern separation
processes. The design project will enable students to apply
these principles to an open-ended problem.
Course Objectives and Anticipated Outcomes

COURSE OBJECTIVES: Expressed as anticipated outcomes with regard to student skills and abilities, the objectives for this course are as follows:

1. Demonstrate knowledge of nomenclature, dimensions, and units relevant to this course topic.

2. Apply key equations to single and multiple stage separation processes, as follows:
   A. Thermodynamic equilibrium
   B. Conservation of mass, and
   C. Conservation of energy.

3. Develop and apply equations and solution methods for analyzing equilibrium staged separation processes.

4. Simulate equilibrium staged separation processes to determine the degree of separation achieved, and design equilibrium staged separation processes to achieve a desired degree of separation using the following methods:
   A. Graphical analysis methods
   B. Computer based simulation

5. Decide between alternative methods of separation to determine which is most applicable for a given separation process.

MEASURED STUDENT OUTCOMES: a, c, and e as described below.
   a. Student will demonstrate an ability to apply knowledge of mathematics, science and engineering
   c. Student will demonstrate an ability to design a system, component, or process to meet desired needs
   e. Student will demonstrate an ability to identify, formulate and solve engineering problems

ATTENDANCE:
Attendance at all class meetings is mandatory. Unexcused absences amounting to more that one week’s worth of class meeting time earns the student a failing grade (F) for the course. (Note that if an absence is not documented as excused, then it is unexcused.) Please see the official university policy on class attendance. Note: class meetings may be rescheduled as agreed by students and instructor.
GRADING POLICY:
The overall grade will be based on in class and out of class assignments, including homework, quizzes, major exams, tests and project reports, as shown in the table below. The major exams are the midterm and final exams. Homework and quizzes will occur on a daily to weekly basis. There will be at least one report, based on a project assignment. The grade will be composed as shown below.

Typical Grade Composition

<table>
<thead>
<tr>
<th>Grade Element</th>
<th>Weight</th>
<th>Actual</th>
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<tbody>
<tr>
<td>Quizzes</td>
<td>20%</td>
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<tr>
<td>Tests &amp; Project, including midterm</td>
<td>60%</td>
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<tr>
<td>Final Exam or Project</td>
<td>20%</td>
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<tr>
<td>Overall Grade</td>
<td>100%</td>
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<tr>
<td>Class Participation</td>
<td>-10%</td>
<td></td>
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<tr>
<td>Extra Credit</td>
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<tr>
<td>Adjusted Grade</td>
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</tbody>
</table>

1 The Actual column may be used to record your grade elements and your overall grade (calculated as a weighted sum of the elements).

2 The diagnostic exam does not affect the grade unless the student does not take it, in which case there will be a deduction for lack of participation.

3 The attendance policy notwithstanding, the overall grade may be discounted up to 10% for lack of (1) attendance, (2) punctuality, or (3) participation.

4 Extra credit assignments may be applicable to this course and would consist of extra project work. Discuss with instructor.

Letter grades will be assigned based on the numeric value of your adjusted grade (above) using a scale similar to the one below:

- A 90-100%
- B 80-89%
- C 70-79%
- D 60-69%
- F 00-59%

SCHOLASTIC DISHONESTY:
Please note that scholastic dishonesty will not be tolerated. Cheating or other such behaviors will result in a grade of zero (0) being assigned. All assignments are to be completed and turned in individually, unless otherwise specified by the instructor.
**TOPICS:**

The topics to be covered are listed below in the approximate sequence in which they will be address. Note that the scope and sequence of topics covered are each subject to change at the instructor’s discretion.

<table>
<thead>
<tr>
<th>Calendar*</th>
<th>Topics</th>
<th>Reading Assignments</th>
<th>Daily Quizzes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 1</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Mass Transfer and diffusivity concepts and examples</td>
<td>Geankoplis 6, MSH 17, Wankat 15</td>
<td>Practice quiz</td>
</tr>
<tr>
<td>2</td>
<td>Mass Transfer and diffusivity problem solving</td>
<td></td>
<td>Quiz</td>
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<tr>
<td><strong>Week 2</strong></td>
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<tr>
<td>3</td>
<td>Evaporation and drying concepts and examples</td>
<td>Geankoplis 8&amp;9, MSH 16&amp;20</td>
<td>Quiz</td>
</tr>
<tr>
<td>4</td>
<td>Evaporation and drying operations problem solving</td>
<td></td>
<td>Quiz</td>
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<tr>
<td><strong>Week 3</strong></td>
<td></td>
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<tr>
<td>5</td>
<td>VLE review and flash calculations</td>
<td>Geankoplis 11, S&amp;H 4, Wankat 2</td>
<td>Problem Solving Test 1</td>
</tr>
<tr>
<td>6</td>
<td>Cascades, distillation columns</td>
<td>Geankoplis, S&amp;H 5, Wankat 3</td>
<td>Quiz</td>
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<tr>
<td><strong>Week 4</strong></td>
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<tr>
<td>7</td>
<td>McCabe-Thiele analysis</td>
<td>Geankoplis 11, S&amp;H 7, Wankat 4</td>
<td>Quiz</td>
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<tr>
<td>8</td>
<td>Multiple feeds and side streams</td>
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<td>Quiz</td>
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<td><strong>Week 5</strong></td>
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<tr>
<td>9</td>
<td>Multicomponent distillation</td>
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<tr>
<td>10</td>
<td>Column design (sizing)</td>
<td>Geankoplis 10&amp;11, S&amp;H 6&amp;7, Wankat 10</td>
<td>Quiz</td>
</tr>
<tr>
<td><strong>Week 6</strong></td>
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<tr>
<td>11</td>
<td>Packed column separations (absorbers and strippers)</td>
<td>Geankoplis 10, MSH 7, Wankat 12</td>
<td>Quiz</td>
</tr>
<tr>
<td>12</td>
<td>Packed column separations (absorbers and strippers)</td>
<td></td>
<td>Quiz</td>
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<tr>
<td><strong>Week 7</strong></td>
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<tr>
<td>13</td>
<td>Liquid-Liquid Extraction – Ternary Systems</td>
<td>Geankoplis 12, MSH 8, Wankat 13</td>
<td>Problem Solving Test 3</td>
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<tr>
<td>14</td>
<td>Liquid-Liquid Extraction – Graphical Methods</td>
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<td>Quiz</td>
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<td><strong>Week 8</strong></td>
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<tr>
<td>15</td>
<td>Adsorption</td>
<td>Geankoplis12, S&amp;H 15, Wankat 18</td>
<td>Quiz</td>
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<tr>
<td>16</td>
<td>Adsorption (cont.)</td>
<td>Chap. 15, pp. 831-848.</td>
<td>Quiz</td>
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<td><strong>Week 9</strong></td>
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<tr>
<td>17</td>
<td>Membrane Processes</td>
<td>Geankoplis 13, MSH 14, Wankat 17</td>
<td>Problem Solving Test 4</td>
</tr>
<tr>
<td>18</td>
<td>Project work</td>
<td></td>
<td>Quiz</td>
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<tr>
<td><strong>Week 10</strong></td>
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<tr>
<td>19</td>
<td>Project work</td>
<td></td>
<td>Quiz</td>
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<tr>
<td>20</td>
<td>Upload video presentation &amp; paper style report for final exam grade</td>
<td></td>
<td>Project Due</td>
</tr>
</tbody>
</table>

*Schedule of topics and readings are subject to change by the instructor.*
CLASSROOM CONDUCT

- Students will conduct themselves in a manner that is respectful to their fellow classmates and the instructor at all times.
- Cell phones be silent and put away during class time, unless called into action by the instructor.
- Use of certain devices will be prohibited during exam periods to include but not limited to cell phones. Failure to comply will result in a zero grade on the exam.
- Students will arrive to class prepared to discuss and participate in the lesson. NOTICE: Class participation is required to avoid the course grade discount.
- Smoking and vaping are not allowed.

UNIVERSITY RULES AND PROCEDURES

Disability statement (See Student Handbook)
Students with disabilities, including learning disabilities, who wish to request accommodations in class should register with the Services for Students with Disabilities (SSD) early in the semester so that appropriate arrangements may be made. In accordance with federal laws, a student requesting special accommodations must provide documentation of their disability to the SSD coordinator.

Academic misconduct (See Student Handbook)
You are expected to practice academic honesty in every aspect of this course and all other courses. Make sure you are familiar with your Student Handbook, especially the section on academic misconduct. Students who engage in academic misconduct are subject to university disciplinary procedures.

Forms of academic dishonesty
1. Cheating: deception in which a student misrepresents that he/she has mastered information on an academic exercise that he/she has not mastered; giving or receiving aid unauthorized by the instructor on assignments or examinations.
2. Academic misconduct: tampering with grades or taking part in obtaining or distributing any part of a scheduled test.
3. Fabrication: use of invented information or falsified research.
4. Plagiarism: unacknowledged quotation and/or paraphrase of someone else’s words, ideas, or data as one’s own in work submitted for credit. Failure to identify information or essays from the Internet and submitting them as one’s own work also constitutes plagiarism.

Nonacademic misconduct (See Student Handbook)
The university respects the rights of instructors to teach and students to learn. Maintenance of these rights requires campus conditions that do not impede their exercise. Campus behavior that interferes with either (1) the instructor’s ability to conduct the class, (2) the inability of other students to profit from the instructional program, or (3) campus behavior that interferes with the rights of others will not be tolerated. An individual engaging in such disruptive behavior may be subject to disciplinary action. Such incidents will be adjudicated by the Dean of Students under nonacademic procedures.

Sexual misconduct (See Student Handbook)
Sexual harassment of students and employers at Prairie View A&M University is unacceptable and will not be tolerated. Any member of the university community violating this policy will be subject to disciplinary action.

Attendance Policy
Prairie View A&M University requires regular class attendance. Excessive absences will result in lowered grades. Excessive absenteeism, whether excused or unexcused, may result in a student’s course grade being reduced or in assignment of a grade of “F”. Absences are accumulated beginning with the first day of class.

Student Academic Appeals Process
Authority and responsibility for assigning grades to students rests with the faculty. However, in those instances where students believe that miscommunication, errors, or unfairness of any kind may have adversely affected the instructor's assessment of their academic performance, the student has a right to appeal by the procedure listed in the Undergraduate Catalog and by doing so within thirty days of receiving the grade or experiencing any other problematic academic event that prompted the complaint.
MORE ABOUT COURSE OUTCOMES

Three major course outcomes will be assessed in this course using a number of performance criteria. The Course outcomes and their performance criteria are detailed below:

Course Outcome 1: Students will have the ability to apply knowledge of mathematics, science, and engineering.

The two performance criteria used to measure this outcome include:

1. **Ability to apply knowledge of mathematics.**
   - (i) Ability to solve for an unknown process variables using general algebra and linear algebra techniques.
   - (ii) Ability to apply calculus and differential equation principles.
   - (iii) Ability to read and construct graphs and tables such as a triangle plot.

2. **Ability to apply conservation laws.**
   - Students are able to:
     - (i) Write mass balance equations around trays, stages, or overall processes.
     - (ii) Write energy balance equations around trays, stages, or overall processes.

Course Outcome 2: Students will have the ability to design a system, a component, or a process to meet desired needs.

The two performance criteria used to assess this outcome consist of:

1. **Ability to use computer software for the design of separation units.**
   - (i) Graph equilibrium data using Excel.
   - (ii) Simulate separation processes using computer software such as Aspen/Hysys.
   - (iii) Graph operating lines such as the stripping line and enriching line in Excel.

2. **Ability to design separation processes.**
   - Students are able to:
     - (i) Identify the phases present.
     - (ii) Identify the type of separation process needed.
     - (iii) Evaluate design parameters.
     - (iv) Determine the number of stages or trays needed for a process.
     - (v) Find feed points for columns and towers.
     - (vi) Present design results in memos and reports based on guidelines.

Course Outcome 3: Students will have the ability to identify, formulate, and solve complex engineering problems.

The three performance criteria used to measure this outcome include:

1. **Ability to identify and formulate the separation process.**
   - Given a problem, the student is able to:
     - (i) Describe each separation process covered.
     - (ii) Identify the component(s) that will separate under operating conditions.
     - (iii) Depict the process in a flowchart.
     - (iv) Identify phases associated with the separation processes.
     - (v) Label separation streams.

2. **Ability to solve complex separation problems.**
   - Given a problem, the student is able to:
     - (i) Determine phase composition based on operating conditions.
     - (ii) Utilize Henry's and Raoult's laws to determine vapor and liquid composition.
     - (iii) Calculate compositions for single stage and multiple stage systems.
     - (iv) Calculate mass fluxes and overall fluxes.
     - (v) Calculate tower heights.