Chemical Process Component Design 06401.01

Syllabus and Schedule for Fall 2008

INSTRUCTORS: Dr. Mariano J. Savelski
Associate Professor

Jesse VanKirk
Adjunct Professor

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OFFICE HOURS: You are free to stop by Dr. Savelski's office as needed.
Email Prof. VanKirk for an appointment with him.

COURSE SESSIONS: Mondays 9:25 – 10:40 AM (ROW 340), Wednesdays 9:25 – 10:40 AM (ROW 340) Thursdays 9:25 – 12:05 PM (ROW 340)

REQUIRED TEXTBOOK AND SUPPLIES

Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design. Authors: Gavin Towler and Ray Sinnott. Publisher: Elsevier. Year: 2008. ISBN: 978-0-7506-8423-1

Textbooks from all previous ChE courses will be useful as well.

ABSOLUTE GRADING SCALE

In this course, we would like to create an atmosphere of positive cooperation between students. In addition, most of the exercises in this course will require you to work in teams, and you will be expected to help one another learn the material. To encourage and support cooperative learning, you will be graded on an absolute grading scale as given below. The net result is that it is in your interest to help your classmates become successful engineers. You will learn through teaching others.

Letter Grade ranges	Percentages between	
A	90	100
B	80	89
C	70	79
D	60	69

Your final numerical grade in the course will be determined as follows:

Exam 1	20 %
Exam 2	20 %
Exam 3	20 %
Final exam	25 %
Homework, Workshops, and Labs	15 %

WORKSHOPS
These are in-class problem solving sessions. The class will be randomly divided into groups of 2 or 3 students. Problems related to the past week's material will be distributed to each group. Each group will work on their problem, develop their solution, and submit the problem solution to the instructor. Groups may help each other, but each group must write up its own solution and submit it. All submissions are due 15 minutes before the end of the class period.

If a student is absent on a day a workshop is given he/she will receive a zero on that workshop. There are no makeups for these workshops.

TEAM HOMEWORK
Each student will be assigned to a collaborative study group of 3-4 students. If every member of that group scores above 83 on an exam, each group member will receive four bonus points on the exam.

Homework will be periodically assigned. Each team/study group should only submit one homework assignment, and all listed team members will receive the same grade. Late work of any kind will not be graded. Collaboration on homework is acceptable and encouraged, but all tests must be done independently. All students will periodically be asked to submit evaluations of how well their peers performed as team members. These evaluations will be used at the end of the semester to adjust the final grading. Also, this periodic assessment will help identify problems in teams. The grade received on all team assignments is a "raw score". Raw scores will be adjusted according to each individual's contribution to the overall team effort. Each team member will be evaluated by every member of the team, including him/herself. The adjusted score (not the raw score) will be used in calculation of course grades. Thus, the student who consistently demonstrates a higher level of effort may be rewarded. Likewise, the student who does not contribute substantially to team assignments may be penalized.

> ***Please be aware that the adjustment of grades for team assignments can substantially impact the overall course grade, either positively or negatively.***

Since most homework and workshop problems have no unique solution (problems are usually open ended), no solutions will be posted.

WORKSHOPS AND HOMEWORK GRADING
Solutions will be scored according to the following scale:

- 4 points – Correct solution method, equations and tables properly cited, units clearly shown throughout the entire problem, and correct numerical answer.
- 3 points – Correct solution method, equations and tables properly cited, units clearly shown throughout the entire problem, and incorrect numerical answer.
- 2 points – Partially correct solution method, equations and tables properly cited, units clearly shown throughout the entire problem.
- 1 point – Incorrect solution method.
- 1 point – Equations and/or tables are NOT all properly cited.
- 1 point - Units are missing in two or more instances.
- 0 points - Problem not done.

At the end of the semester, homework and workshops points will be added and normalized based on the maximum attainable points.

EXAMS
Three exams and a *comprehensive* final exam will be given. All exams will be open-book and notes unless otherwise announced. Absence at examination time is excusable only in case of well-documented illness of the student or similar emergency. An unexcused absence from an exam will result in a zero grade on that exam.

If an error has been made in grading your exam, you must resubmit your entire exam for re-grading within 48 hrs of getting your graded exam back.

ATTENDANCE POLICY
Attendance to lectures is recommended but all labs are mandatory and will be graded. The instructor will also keep track of attendance and participation in class activities, and this information will be used at the end of the semester for borderline grade decisions. If you know that you will be absent from class for a valid reason, let your instructor know 24 hours before the class period. The only exception to this rule is a medical emergency.

ACADEMIC CONDUCT: Any student engaged in an act of academic misconduct, which includes but is NOT limited to, cheating, plagiarism, use of written or oral offensive language, tampering with other student's files or computer accounts will receive a grade of ***F*** for the course and will be reported to the Provost's Office for appropriate academic sanctions.

If another student is knowingly involved in the offense, he or she will receive the same penalty.

PROFESSIONAL BEHAVIOR
All students are expected to behave professionally, unprofessional behavior includes but is NOT limited to, being late to class (see below), walk in and out of class while in session, cell phone ringing in class, working on assignments foreign to the class, electronic texting, sleeping in class, chatting in class, and horseplay.

Students are expected to be ready for class at the beginning of the class period.
We have a ***zero tolerance policy*** to being late to class (including examination days)
No student will be admitted late as this constitutes a disturbance to class activities.

STUDENTS WITH DISABILITIES
If you have a documented disability that may have an impact on your work in this class, please contact the instructors. Students must provide documentation of their disability to the Academic Success Center in order to receive official University services and accommodations. The Academic Success Center can be reached at 856-256-4234. The Center is located on the 3rd floor of Savitz Hall.

IMPORTANT DATES

Date	**Time**	**Room**	**Event**
10-02	9:25 AM	ROW 340	Exam 1
10-30	9:25 AM	ROW 340	Exam 2
12-04	9:25 AM	ROW 340	Exam 3
Finals Week	TBA	TBA	Final Exam

WITHDRAW SIGNATURE SCHEDULE

Sept 9 to Oct 20	(W)	Student, Professor
Oct 21 to Nov 24	(WP/WF)	Prof, Dept Chair
Nov 25 to Dec 19	(WP/WF)	Prof, Dept Chair, Dean

INSTRUCTIONAL OBJECTIVES

Part I: Introduction to Design and Design of Systems for Homogenous and Heterogeneous Mixtures

After completing this section, you should

- Be familiar with how design projects are planned, carried out, and documented in industry.
- Be familiar with the sources of information on manufacturing processes
- Be able to obtain chemical and physical properties needed for the design calculations
- Be able to know how commercial simulators predict properties
- Be able to select the appropriate thermodynamic method to solve a design problem.
- Be familiar with the more widely used of industrial separation methods and their basis for separations.
- Understand the concept of separation factor and be able to select appropriate separation methods for vapor, liquid mixtures.
- Be able to solve vapor-liquid equilibrium problems for ideal and non-ideal systems.
- Be able to design gas-liquid separators and decanters
- Be able to solve liquid-liquid equilibrium problems for isothermal two-phase systems
- Be able to plot and interpret ternary extraction diagrams.
- Be able to find the mixing point and solve single stage and cross flow extraction problems.
- Be able to solve countercurrent extraction problems using McCabe-Thiele methodology.
- Be familiar with the features and applications of the more widely used industrial extractor designs.
- Be able to solve extraction problems using simulation tools.

Part II:

Design of Distillation Systems for Homogenous Mixtures without Azeotropes

After completing this section, you should

- Be able to explain the total, minimum reflux, and finite reflux conditions for Multicomponent mixtures.
- Be able to choose operating conditions for multicomponent distillation
- Be able to design multicomponent distillation column using short cut methods and simulation tools.
- Be able to explain how different type of trays and packing work.
- Be able to calculate pressure drop, tray efficiencies and flooding conditions for either trays or packing
- Be able to derive expressions for *Number of Transfer Units* (NTU) and *Height of a Transfer Unit* (HTU) in the gas and liquid phases, and use them to solve for the height of packing
- Be able to calculate the height of packing using the concept of the *height equivalent to a theoretical plate* (HETP)
- Be able to size multicomponent distillation column using simulation tools

Part III: Design of Heat Transfer Equipment

After completing this section, you should

- Be able to explain the terms in the *Overall Heat Transfer Coefficient* (*U*)
- Be able to derive the expression of the *Mean Logarithmic Temperature Difference* for co-current and counter current flow.
- Be familiar with the advantages and disadvantages of countercurrent flow
- Be able to draw T-Q diagram for different configurations in Shell-and-Tube heat exchanger

- Be able to calculate the heat transfer coefficients and pressure drop for a Shell-and-Tube heat exchanger
- Be able to solve the energy balances for the fluids and the heat exchanger design equation to obtain the duty, missing temperatures, *U* value, and heat transfer area.
- Be familiar with the heuristics for the allocation of fluids in Shell-and-Tube heat exchanger
- Be able to design or retrofit a Shell-and-Tube heat exchanger with no-phase changing fluids
- Be able to design or retrofit a condenser and a reboiler and other heat transfer equipment (e.g.: air coolers and fired heaters)