

ChE460 - Separation Processes II
Fall 2009

Otto H. York Department of Chemical, Biological & Pharmaceutical Engineering
New Jersey Institute of Technology

Course Schedule: Tuesday/Friday, 1:00-2:25 PM, Kupfrian Hall 106

Instructor: Dr. Ecevit Bilgili, Assistant Professor

Instructor Contact: Tiernan Hall 382, 1.973.596.2998, ecevit.a.bilgili@njit.edu

Office Hours: Monday/Wednesday 1:00-2:00 PM and other times strictly by appointment

Teaching Assistant: Fola Afolabi, aa266@njit.edu, Tuesday 12:00-1:00 PM and Thursday 3:00-4:00 and other times strictly by appointment, Tiernan Hall 323D (to be confirmed)

Catalog Description

ChE460 - Separation Processes II (3-0-2) This second course in separations examines nontraditional methods and technologies such as fixed-bed processes, membranes, crystallization, and mechanical separations.

Prerequisites by Course: ChE360 - Separation Processes I (or ChE471)

Prerequisites by Topic: Thermodynamics, Heat/Mass/Momentum Transfer, Calculus and Differential Equations

Textbooks: Required: Separation Process Principles, J.D. Seader, E.J. Henley, 2nd Ed., Wiley

Recommended: Separation Process Engineering, P.C. Wankat, 2nd Ed., Prentice Hall

Recommended: Transport Processes and Separation Process Principles, C.J. Geankoplis, 4th Ed., Prentice Hall

Recommended Software: Matlab 2009a, Minitab15, Office 2003, Adobe Reader (all can be downloaded from NJIT IST webpage). Student Mall labs and ChE department PC lab have most of these software. Use of high-end handheld calculators is strongly recommended, where appropriate.

Grading

Graded HW Assignments — 15%

Exam # 1 — 20%

Exam # 2 — 20%

Final Exam — 30%

Term Project / Presentation — 15%

Final letter grades will be awarded based on your weighted average score (see weighting above) and a table of raw/curved average score-letter grade correlation categories. Curving is at the discretion of the instructor. Utilization of curving and average score-letter grade categories will be communicated to the class.

There may be a **gray area** between each two letter grades in the final distribution, so that two students getting the same weighted average, especially at the border of grade categories, could get different letter grades. If you are in one of these gray areas, whether you get the higher or lower grade depends on

- a) Class attendance and participation in class
- b) Whether your performance has been improving or declining over the course period

Important Dates

Exam # 1 — October 06, 2009

Exam # 2 — November 10, 2009

Term Project / Presentations — December 04 and 08, 2009 (2 Days, ~8 projects)

Final Exam — Final exam period (December 11-17, 2009, Day TBD)

Dr. Bilgili's Workshop — potential class cancellation on October 13, 2009

AIChE Annual Meeting — November 08-13, 2009 (no class cancellation)

Thanksgiving Week — Follow the recess schedule (No classes on November 26-27, 2009, class to be held on November 25, Wednesday!)

Course Outline and Corresponding Reading Material

1. Introduction (Course Review, Math Review, Canned Software Review, Overview of Separation Processes), PN*, ICN, SH: Ch.1
2. Drying of Solids, PN, ICN, SH: Ch.18, G: Ch.9
3. Crystallization and Evaporation, PN, ICN, SH: Ch.17, G: Ch.8, Ch.12.11 & Ch.12.12
4. Adsorption, Ion Exchange, Chromatography, PN, ICN, SH: Ch.15, G: Ch.12.1 through 12.4
5. Membrane Separations, PN, ICN, SH: Ch.14, G: Ch.13
6. Leaching and Washing, PN, ICN, SH: Ch.16, G: Ch.12.8 through 12.10
7. Selected Mechanical-Physical Separation Processes (Comminution, Filtration, and others as time permits), PN, ICN, G: Ch.14

The contents of the course are tentative and subject to revision. The amount of time devoted to each topic will vary as the semester progresses. At the discretion of the instructor, subtopics under a given topic will not be given equal emphasis. Your class attendance is critical to following what subtopics have been covered in the class.

Policies, Norms, and Expectations

- Most course notes (PN), HW assignment, HW solutions, etc. have been (will be) posted on the web (Highlander Pipeline, MyCourses, ChE460). Critical announcements will be made through that system as well. You are required to visit the site on a regular basis to get recent homework assignments and other relevant announcements. Students are expected to bring the relevant PN to the class and to take additional supplementary notes in the class.
- Starting from the first week of the semester ATTEND all the lectures, be sure that you understood the subject of the lecture, otherwise do not hesitate to ASK QUESTIONS during the lecture, be sure to REVIEW the material of the previous lecture before you come to the class, otherwise you will have difficulty to understand the lecture. You are expected to read relevant sections of Seader and Henley, as covered in the class.
- Assignments are due on the date assigned. Late assignments will only be accepted under extraordinary circumstances and will be penalized at the discretion of the TA/Instructor (max. score 60%). Students are expected to work on all assignments independently, except the Term Project, which will be conducted in groups. Plagiarism will not be tolerated. Violations will be subject to the NJIT Academic Honor Code.

* PN: posted notes on the web (Highlander Pipeline, MyCourses, ChE460), ICN: in-class notes, SH: Seader and Henley (required reading), G: Geankoplis (recommended reading)

- Homework, term paper (report), and exam papers must be written legibly in an organized, structured fashion. Students are responsible for potential loss of points due to sloppy, unclear, or illegible work on the papers.
- Make-up exams will only be given under extraordinary circumstances and at the sole discretion of the instructor. Students bear the responsibility of due proof and documentation of the circumstances. It is the student's responsibility to inform the instructor of any conflicts.
- Students must attend all classes. Absences from class will inhibit your ability to fully participate in class discussions and problem solving sessions and, therefore, can affect your grade negatively. Attendance will be recorded regularly.
- Students are expected to behave, communicate, and interact with the instructor and peer students with respect and dignity as a candidate, professional chemical engineer.
- Tardiness to class is very disruptive to the instructor and students, and it will not be tolerated.
- Unless otherwise indicated, use of canned software such as Matlab, Minitab, etc. for HW problem solutions and Term Paper is strongly encouraged. You are expected to develop the necessary skills to solve problems using such software. Many example codes are in MyCourses/Pipeline, so you can learn the software while using the already-existing codes. Although no software is strictly endorsed for the problems in the course, the use of Matlab and Minitab is strongly recommended. TA and instructor will provide additional support if issues arise in the use of these recommended software. If students elect to use other software, then they may not get adequate TA and instructor support. Besides, no partial credit will be given for wrong answers obtained with such software. In exams, you are encouraged to use high-end calculators.
- You will be assigned to a group for the Term Project. The group members will either be assigned the topic or will determine the topic in consultation with the instructor (early in the semester), at the discretion of the instructor. Topics will be selected from those specific, advanced separation processes which are not covered in the class in depth. In addition, advanced modeling of the separation processes covered in the class can be chosen as topics for a Term Paper.
- Besides the technical quality of your work (content, presentation, and report), your soft skills (effective planning, time management, communication, ability to work in the assigned group) will be assessed by your peer group members as well as the instructor. You will have a composite score for the Project.

Reference Books

- Unit Operations of Chemical Engineering, W.L. McCabe, J.C. Smith, P. Harriott, 7th Ed., McGraw-Hill.
- Coulson and Richardson's Chemical Engineering, Vol.2. Particle Technology and Separation Processes, J.F. Richardson, J.H. Harker, J.R. Backhurst, 5th Ed., Elsevier.
- Handbook of Separation Process Technology, Edited by R.W. Rousseau, Wiley.
- Elementary Principles of Chemical Processes, R.M. Felder, R.W. Rousseau, 2nd Ed., Wiley.
- Schaum's Mathematical Handbook, M.R. Spiegel, McGraw-Hill.
- Matlab and Minitab tutorials (see Pipeline and web)

Prepared by:
Dr. Ecevit Bilgili, August 2009

Course Objectives

- To introduce students to a variety of separation processes (unit operations) utilized in chemical, petrochemical, pharmaceutical, food, and biotechnology-based industries.
- To develop a fundamental understanding of the separation processes by simultaneous application of previously learned heat/mass/momentum transfer principles and thermodynamic relations while using applied mathematics and numerical techniques
- To build on previously-learned separation techniques to conceptually design processes
- To enhance skills in hands-on use of computational software in the solution/analysis/optimization/modeling of separation processes
- To enhance student's soft skills (effective planning, time management, communication, ability to work in a group) via the activities involved during the term project and homework

ABET Course Outcomes

Upon completion of this course, the student should achieve the following:

- an ability to apply knowledge of mathematics, science, and engineering [a]
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability [c]
- an ability to identify, formulate, and solve engineering problems [e]
- an ability to communicate effectively through written reports and oral presentation [g]
- an introduction to contemporary issues in chemical engineering [j]
- an ability to use the techniques, skills, and modern engineering tools necessary for chemical engineering practice [k]
- breadth across the field of chemical engineering [l]
- depth in the fields of chemical engineering areas of biotechnology and chemical reaction engineering, thermodynamics of physical and chemical equilibria, separations, controls and simulations, materials and process development of design [m]

Assessment Methods/Metrics

Exams, homework (with purposeful use of computational software), term project/presentation (with the potential use of numerical methods and computational software), and student evaluations will be used as the main assessment methods.