ChE460 - Separation Processes II
Fall 2015
Otto H. York Department of Chemical, Biological & Pharmaceutical Engineering
New Jersey Institute of Technology

Lectures: Tue. 4:00-5:25 PM, Wed. 11:30 AM-12:55 PM, Kupfrian Hall (KUPF) 209
Instructor: Dr. Ecevit Bilgili, Associate Professor
Contact: York Building 234, 973.596.2998, bilgece@njit.edu
Office Hours: Wed. 9:30-11:30 AM in Tiernan Hall Rm. 373, (for other times, usually for extenuating circumstances, an appointment must be made by sending an e-mail to the instructor at least three days in advance)
Teaching Assistant: Name/contact info will be announced, if assigned one

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
Prerequisites by Topic: Thermodynamics, Heat/Mass Transfer, Calculus/Diff. Equations

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

Other Learning Material: My class notes and PowerPoint presentations give a summary of the material in Seader and Henley, and have been posted on the web (My Courses, Highlander Pipeline). Please print them and bring them along with your book and calculator before coming to each lecture.

Required Software: Matlab 2012a, Minitab 16, MS Office 2007, Adobe Reader. All software can be downloaded from NJIT IST webpage. Student Mall labs and ChE department PC lab have the software. Please refer to My Courses, Highlander Pipeline for Matlab codes and tutorials provided by the instructor.
Calculator: Use of high-end calculators is required. Instructor provides support for TI-83/84/84+SE only (no support for others). You are required to learn your own calculator. Please refer to My Courses, Highlander Pipeline for useful resources for TI-83/84/84+SE.

Grading
Quiz/HW Assignments — 15% (Only select HW will be collected/graded)
Exam #1 — 20%; Exam #2 — 20%; Final Exam — 25%
Term Project / Presentation — 20%

Final letter grades will be awarded based on your weighted average score (see weighting above) and a table of average score–letter grade categories, which will be communicated via Pipeline. Attendance may affect your final grade as described under Policies/Norms.
Important Dates (*Please record on calendar, see Timetable document for details)

Exam # 1 — Sept. 29, Exam # 2 — Oct. 29, Final — Dec. 15-21, Day TBD by registrar

Term Project/Presentations — Sept. 22 (3 topics due), Oct. 22 (title+3 articles due), Dec. 08 (report/PPT due), Dec. 08 & 10 (Presentation Days 1 and 2, must attend both)

Cancelled Lectures — Oct. 06 (FDA Mtg.), Nov. 10 & 12 (AIChE Mtg.), Nov. 26 (Thanksgiving)

Pre-set Make-up Lectures — Oct. 10 (Sat. 10:30-12:00 AM), Nov. 14 (Sat. 1:00-4:00 PM), and Dec. 05 (Sat. 10:30-12:00 AM), all in KUPF209. Make-up for any lectures potentially cancelled due to inclement weather will be communicated separately.

Last Day to Withdraw — Nov. 02, Monday, (no special permission is given to withdraw thereafter)

Reading Days — Dec. 11&14

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. Selected Mechanical-Physical Separation Processes (Comminution, Filtration, and others as time permits), PN, ICN, G: Ch.14

Due to the nature of the material, there is no direct relation between different topics. Topic #6 above may be covered either stand-alone or as part of Topic #3. 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.

To be successful in this course, you must be able to

- describe what the separation process is about and how it is carried out, and list types of equipment used
- develop a fundamental understanding of the physics behind transport phenomena (momentum, heat, and mass transport) occurring in the specific separation process
- derive or select the basic conservation/rate equations for simulating or designing a specific unit operation
- translate a verbal unit operation problem into a mathematical model by drawing a diagram of the process, identifying input-output streams, applying a relevant conservation/rate equation, and solving the mathematical model
- use knowledge in Calculus & Differential Equations to solve the model analytically
- acquire/develop skills to use canned software and high-end scientific calculators for the solution of mathematical models numerically
- check results (dimensional homogeneity, physical plausibility, and satisfaction of the ICs and BCs as well as of the field equations)

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

Academic integrity and honesty are of paramount importance. The NJIT Honor Code will be upheld, and that any violations will be brought to the immediate attention of the Dean of Students.

Rules and Expectations during the Lectures/Course

- Students are strongly recommended to attend ALL lectures. You have to sign in the attendance sheet during the lecture; otherwise, considered absent. More than 2 absences (excluding immediately accountable, extenuating circumstances) may negatively affect your grade if your weighted score is border-line between grades. More than 4 absences may lower your final grade to the adjacent letter grade. You may get an F for more than 8 absences!
- Please come to the class before the lecture starts or at least ON TIME. Under no circumstances, you should distract other students and the lecturer.
- No cell phone/laptop use, no video/audio recording, and no eating any time during the lecture. Laptops can only be used if openly requested by the instructor.
- Make sure to pair with another student(s) to join in-class group activities (few minutes each). You are expected to participate when asked by the instructor.
- Students are expected to behave, communicate, and interact with the instructor and peers with respect and dignity as a candidate, professional chemical engineer.
- ATTEND all lectures, ASK questions, PARTICIPATE in group activities, SHOW UP during official office hours, DO homework, COORDINATE/LEAD project with group members/instructor, 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 MASTER the class/posted notes and read covered sections of S&H.
- For success, you have to WORK OUT all derivations and examples in my notes on your own after each lecture. In case of questions, please see me in my Office Hour or raise questions in the class. Do not delay this to the exam week.

Rules, Policies and Expectations about Course Materials, E-mails & Office Hours

- The instructor encourages all students to show up during the official office hours.
- Most course notes (PN), HW assignment, HW solutions, etc. have been (will be) posted on the web (Highlander Pipeline, MyCourses, Separation Processes II). Critical announcements will be made through that system as well. You are required to visit the website on a daily basis to get recent homework assignments and other relevant announcements. Students are expected to bring the relevant PN, the book, and calculator to the class and to take additional supplementary notes in the class.
- E-mail is for quick questions, not for the solution of complex problems. Students are first encouraged to check MyCourses for information. Then, they should discuss the problems among their peers or study group. In the end, they are welcome to use the Office Hours fully. If a student misses the Office Hours for a serious reason, he/she may want to set up an appointment via e-mail at least 3 days in advance for alternate time depending on instructor’s availability at that time. Since the instructor cannot guarantee availability, it is best for students to contact the instructor during the Office Hours.
- The instructor reserves the right not to respond to all e-mails. Improperly written e-mails with lax attitude will not be replied. Also, e-mails will only be answered if it takes less than 5 min to respond and/or usefulness of the inquiry to the whole class.
Instructor-originated information is communicated via e-mail/Pipeline (check daily).

Policies and Expectations about Grading and Exams
- You will receive a grade based on your weighted average score, a table of average score-letter grade categories, and possibly your attendance record. This will be performed automatically by an Excel code (no emotions attached) in view of the attendance record. The assigned letter grade is FINAL without subject to negotiation!
- You have to plan, study and do well in exams/project/HW if you want to get a good grade in this class. **Instructor will NOT change letter grades to accommodate any special circumstances.**
- You are allowed to dispute your exam scores within a week following the announcement of your score. After first review of your dispute, if your score does not change, but you are unconvinced and ask for an additional review, then you assume the possibility of instructor reviewing the whole exam paper and removing points as well as giving points. You cannot dispute your prior exams or HWs after one week or at the end of the semester!
- You may be asked to return your graded exam papers within a week.
- **No extra credit will be allowed (no need to ask) under any circumstances.**
- Exams are open notes and open books. You are required to bring PN/ICN, the required textbook, any other Separations Book(s) of your choice, a Mathematics Handbook and/or comprehensive Advanced Mathematics/Diff. Eqs. Book(s), Math Review Document, and a high-end calculator.
- No cell phones (to be turned off), I pads, laptops, etc. can be used during the exam.
- You have to write legibly while showing all work; otherwise, loss of points is likely. If two solutions are given for a problem including the correct and incorrect ones, the student gets 0. Please erase or cross out the incorrect solution.
- You get 0 for no-show to exams/presentations. Make-up exams may only be given under extreme circumstances (e.g., major close-family emergency, serious accident or acute medical problem) 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/Dean of Students (preferred) ASAP.
- Read the Study Guide to be posted before each exam and attend the Review Session (if there is one). Some exam questions can be of multiple-choice type or of assay type requiring verbal explanations, while others will be derivation type with symbolic manipulation or pure calculation type requiring calculators.
- **Show all work, otherwise no partial credit** means you cannot simply skip important intermediate steps during a calculation/derivation. You will lose significant points even if your final answer is correct.

Policies and Expectations about Homework/Quiz and Projects
- **Quizzes will not be announced. Only select HW will be graded.** You are required to do ALL HW as if all will be collected/graded on the assigned due date. **Late assignments will get 0 independent of circumstances.**
- Students can discuss HW questions with peers/study group without copy-pasting answers. The Term Project is to be done among the project group. **Plagiarism will not be tolerated. Violations will be subject to the NJIT Academic Honor Code.**
- 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.

- You will be assigned to a group for the Term Project. The group members will select first a project topic and then a specific project title consulting with the instructor.
- Up to 25% of project grade is lost for each failure not to meet project deadlines.
- 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 (peer & instructor) score for the Project.

Expectations for the Use of Mathematics, Canned Software, and Calculators

- Mathematics is the language of engineers and the course will rely on some background in Calculus and Differential Equations. You are required to read the “Math Review” document and improve on the gap areas. Keep a Math Handbook such as Schaum’s Mathematical Handbook handy for study and exams. While going through the course material and solving quantitative and theoretical problems, try to relate to the math in the “Math Review” and Math Handbook.
- Where indicated, use of canned software such as Matlab, Minitab, etc. for HW problem solutions and Term Project is required. You are expected to develop the necessary skills to solve problems using such software. The instructor provides tutorial material and example codes in MyCourses/Pipeline, so you can learn the software while using the already-existing codes. Instructor will provide additional support if issues arise in the use of these software.
- In exams and HW, you are required to use high-end calculators. Specifically, you will have to learn about
  - solution of a non-linear equation (e.g. adiabatic saturation temperature)
  - linear regression (e.g. fitting parameters of adsorption isotherms)
  - numerical integration (e.g. time needed to complete a batch adsorption)
  - numerical solution of a differential equation (e.g. adsorber modeling)
There will be plenty of examples using calculators in the course material. The instructor also provides resources in the Pipeline, and you have to consult with the user manual and web sources of your specific calculator model.
- In the past, students lost points because of their inability to solve a first-order differential equation and to integrate/differentiate a function analytically, to use their calculator toward solving a nonlinear equation or finding linear regression parameters, etc. So, please consider the aforementioned expectations seriously.
- For derivations and analytical solutions, you should consult with your Math Handbook, Math Review Document, Calculus Textbook, and a Differential Equations Textbook. For numerical problems, you will use your calculator.

Reference Books

- Matlab and Minitab tutorials as well as TI calculator resources (Pipeline and web)