ChE 433 – Design of Chemical Processing Units
Fall 2009-2010
http://www.che.boun.edu.tr/courses/che433/che433.html

Course information:

Instructor: Dr. Ahmet K. Avcı, Assistant Professor of Chemical Engineering
Office hour: whenever available. e-mail: avciahme@boun.edu.tr
Teaching assistants:
Gamze Gümüşlü. B.Sc. in ChE. Office: KB404. Office hours: M M 6 7. e-mail: gamze.gumuslu@boun.edu.tr
M. Selcen Başar. B.Sc. in ChE. Office: KB403. Office hours: Th Th 6 7. e-mail: selcen.basar@boun.edu.tr
Textbook:
- Sinnott, R.K., Towler, G., *Chemical Engineering Design*, 5th ed., Butterworth-Heinemann, 2009.

Supplementary reading & useful resources (Later editions can be used):
- Peters, M. S., Timmerhaus, K. D., West, R. E., *Plant Design and Economics for Chemical Engineers*, 5th Ed., McGraw-Hill, 2003.
- Perry, R. H., Green, D. W., Maloney, J. O., *Perry's Chemical Engineers' Handbook*, 7th Ed., McGraw-Hill, 1997.
- Fogler, H. S., 1999, *Elements of Chemical Reaction Engineering*, 3rd Ed., Prentice Hall, New Jersey.
- Geankoplis, C. J., 1993, *Transport Processes and Unit Operations*, 3rd Ed., Prentice Hall, New Jersey.
- Wilkes, O. J., 1999, *Fluid Mechanics for Chemical Engineers*, 1st Ed., Prentice Hall, New Jersey.
- Incropera, F.P. and DeWitt, D.P., 1996, *Introduction to Heat Transfer*, 3rd Ed., John Wiley & Sons, New York.
- Turton, R., Bailie, R. C., Whiting, W. B., Shaeiwitz, J. A., *Analysis, Synthesis and Design of Chemical Processes*, 2nd Ed., Prentice Hall, 2003.

Lecture hours: T T 7 8 at KB 433, Th Th 3 4 at KB 433 (2h + 2h: 4h per week)
Number of credits: 3
Prerequisite courses: ChE 334, ChE 342
Course content: Engineering Design 100%
Computer use: 100% (ChemCad Process Simulator, other auxiliary software)

Course objectives:

- Give a basic understanding of the engineering design concept and of the methodology of the flow of the design projects conducted at industrial scale.
- Introduce fundamentals of equipment selection for continuous, batch and semi-continuous processing plants. Make students more efficient in process flow sheet representation, equipment numbering and spreadsheet representation of the material and energy flows. Improve effectiveness in making meaningful assumptions.
- Introduce basic concepts in equipment and system operability and health, safety and environmental considerations, as well as the efficient operating principles of some basic processing equipment.
- Develop the basics of equipment sizing calculations, keeping in mind the choice of materials of construction and technological limitations for chemicals processing equipment.
- Execute a detailed technology search using all kind of available resources, including patents, for the plant to be designed as the term project.
- Learn the fundamentals of using a process simulator package (ChemCad) in flow sheeting, in balance calculations and in equipment sizing (design) calculations. Give a basic understanding of differentiating between simulation and design algorithms.
- Develop the ability to do the flow sheeting and equipment sizing calculations on a complex chemicals plant via hand and ChemCad calculations using a known process, chosen by the students on the basis of commercial validity, technological competence, operability, safety and environmental consciousness.
- Improve the techniques for communicating the project outputs at industrial standards by written reports and by oral presentations.

Prerequisites by topic:

- Chemical reaction kinetics and reactor design
- Fundamentals of fluid flow, heat and mass transfer operations
- Mass and energy balances on process flow sheets
- Chemical engineering thermodynamics

Course contents:

- Introduction to engineering design and its applications in chemical engineering design (1-2 hours).
- Empirical relationships for estimation of physical/chemical properties of pure compounds and their mixtures to calculate design characteristics of unit operations (2 hours).
- Fundamental design methodologies, types and characteristics of chemical reactors (4-6 hours).
- Types and design features of transportation equipments used in chemical processes (4 hours).
- Design of piping systems (3 hours).
- Health, safety and environmental regulations in chemical process industries (2 hours).
- Types and selection of materials of construction for process equipments (2 hours).
- Design of stagewise equilibrium separation equipments (4-6 hours).
- Design of heat transfer equipments (4-6 hours).
- Design of storage equipments (4 hours).
- Separation processes, mixing and agitation equipments (2-3 hours).
- Principles of flow sheeting and process simulation (3-4 hours)
- Process intensification & chemical microreaction engineering (4-6 hours).
  ChemCad Demo (2-3h, to be conducted by the course TAs).

Course grading system:

Midterm Exam **(25%)**		**November 20, 2009**. Open book and notes. Room: KB 433.
	Topics	Whole course content covered until midterm date
	Type	Problem solving
Final Exam **(30%)**		**TBA by the registrar**. Open book and notes. Room: TBA
	Topics	Entire course content
	Type	Problem solving
Project **(45%)**	Topics	Build-up and design a process whose details will be announced on **October 8, 2009.**
	Type	Detailed literature survey, manual and computer-based calculations. Creative team (group) work to be demonstrated by progress reports and short presentations (see below). Groups will involve 4 students.

Progress report **(10%)**	Submission date: **Nov. 25, 2009, 12:00 sharp.**
Presentation 1 **(8%)**	**Dec. 4, 2009**. Max. 7 min/group for presentation.
Final report **(16%)**	Submission date: **Jan. 15, 2010, 12:00 sharp.**
Final report presentation **(11%)**	**Jan. 21, 2010**. Max. 9 min/group for presentation.

TOTAL (100%)

Other information:

- Project submission is a definitive must for passing this course. No matter of the midterm and final exam grades, the student/group will get a direct F in case he/she/group does not submit the final project. No excuses will be accepted for a missing final project report.
- The use of original copy of the textbook is a must. Original copies can be (1) purchased from the bookstore, (2) borrowed from the library or from previous classes. Partial or complete photocopies of the textbook are strictly prohibited, such copies will not be allowed for use in open-book exams.
- Licensed and latest versions of ChemCad software will be available during the course. The use of illegal copies of ChemCad will lead to a direct F, no matter what the grades are.
- Presentation 1 will be conducted by two members of the group, who will be selected on random basis just before the presentation. Grades will be assigned on group and personal bases. Group grades will be assigned also to the non-presenting members, whereas personal grades, aimed to measure the individual contribution, will be assigned to each student. Final presentation will be conducted by the members who did not make the presentation before. Grading policy will be the same as in the first one.
- **Reports:** Late submission policy (unless otherwise specified)
  - Target: Submission date before 12:00 sharp.
  - Same day, submission btw 12:01 – 13:59: 10 pts. OFF (out of 100)
  - Same day, submission btw 14:00 – 17:30: 15 pts. OFF (out of 100)
  - Same day Submission after 17:30 and following days: Reports will not be accepted!
- **Attendance policy:**
  - A minimum of 65% attendance is required. If the attendance is less than 65%, the letter grade will be reduced by one level, for example from BA to BB, from CC to DC and from DD to F (no E!). No excuses will be accepted.
- **Average grading periods:**
  - Exams: 2 weeks
  - Reports: 2-3 weeks
  - Presentations: 1 week
- **Other:**
  - Please be in the class on time! Do not disturb the class if you see the doors closed.
  - Cell phones MUST be switched off during the lectures and in the exams. Any opposing attempts will be penalized (lectures – will be asked to leave the class; exams – will be treated as an attempt to cheating)