

COURSE DESCRIPTION  
ECH 4644 Process Design

**Instructors:** Spyros A. Svoronos (section 6221)  
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Office: 264 ChE Student Center  
Office Hours: TBA  
- In addition, I have an open door policy.

**Homework Grader:** Tushar D Mahajan

**Catalog Description:**

Preliminary design of convention chemical processes, including process specifications, siting and layout, equipment sizing, utility and manpower needs, safety and hazard analysis, environmental considerations and economic evaluation. Planning techniques for detailed engineering, construction and startup

**Prerequisites:**

Synthesis and Specification of Economic Production (ECH 4604)  
Chemical Kinetics and Reactor Design (ECH 4504)  
Materials of Chemical Engineering (ECH 4824)  
Separation and Mass transfer Operations (ECH4403)

**Textbook:**

*Product & Process Design Principles – Synthesis, Analysis and Evaluation.* By Seider, Seader, and Lewin, any edition

**Computer:** Laptop computer running Windows 7, 8, or 10 and Excel is **required**

**Class Schedule:**

W 12:50-1:40 NEB 202

Th 4:05-6:00 PM FIGym 280

One weekly team project review meeting in which the teams make Powerpoint presentations.

**Optional weekly software lectures time to be set after polling students**

**Course Objectives:**

- To instill an ability to analyze comprehensive situations and masses of data and facts in order to define key problems and variables.
- Learn systematic methodologies for designing components, units and processes that meet performance specifications.
- Learn how to search the literature for possible solutions to various aspects of the problems.
- Develop techniques for checking individual work for accuracy and learn to work together as part of a team to review and help each other avoid mistakes.
- Become power users of available computer aided engineering tools.

**Topics Covered:**

- Overview of the design process
- Assessing the problem
- Surveying literature
- Database creation & property estimation
- Safety & environmental impact analysis
- Professional ethics
- Preliminary process synthesis
- Selection of base case - Concept screening & scoring matrices
- Heuristics for process synthesis
- Reactor design & reactor network synthesis
- Synthesis of separation trains
- Separation of azeotropes
- Heat and power integration
- Economic evaluation of designs
- Thermodynamic property estimation using UniSim or HYSYS
- Steady state simulation of reactors using UniSim or HYSYS
- Steady state simulation of separation processes using UniSim or HYSYS
- Steady state simulation of entire plants (including integration) using UniSim or HYSYS
- Pump sizing & selection

**Contribution to Professional Component:**

This course contributes to the engineering topics (3 credits).

**Relationship to Program Objectives:**

This course contributes to program objectives 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11.

- (1) Students develop the ability to apply knowledge of mathematics, science and engineering in context of a professional process design project. Students must seek out the information (knowledge) needed for developing the design solution in appropriate references or other repositories of knowledge.
- (2) Students are required to project needs into engineering requirements, synthesize process design concepts and prepare preliminary designs – thus identifying, formulating and solving engineering problems. Students are expected to define the nature of the problems as well as their solutions.

- (3) A major emphasis of the design course is on the integration of previously learned facts and principles through the framework of comprehensive, open-ended student projects with particular attention being given to the application of engineering economics and engineering principles, and techniques.
- (4) A prime objective of the course is to teach students a systematic methodology for designing components, units and processes that meet performance specifications. Students develop an ability to apply knowledge from prerequisite courses to the solution of problems and sizing of equipment.
- (5) The ability to analyze and interpret data gathered from existing operations is developed through problem identification and process improvement opportunity analysis assignments in preparation for conceptual design assignments.
- (6) The success of the capstone process design course is leveraged through a structured development process, guided by project management techniques and supported by modern engineering tools (UniSim, HYSYS, ASPEN) used in engineering practice.
- (7) Oral and written communications are practiced through weekly team project review meetings with the course instructor and industrial mentors. Each phase of the projects are written up and reviewed (biweekly). These interim reports are revised and become part of the final preliminary design report. Formal team presentations of the projects are made at the end of the project.
- (8) Each student is a part of a four or five member design team that meets weekly with the design instructor (and, as available, invited guest professionals). Performance is tracked through periodic peer evaluations.
- (9) Professional responsibility is reinforced throughout the course with project management and deliverables that each student must meet. Ethical and professional responsibility including process safety considerations and verification of results play a key role in evaluating the success of the project. During each weekly review meeting each student reaches an agreement with their team on the tasks to be completed and target schedules for deliverables. The performance of student team members during the preceding week in meeting these commitments are evaluated each weekly review.
- (10) The process designs prepared by students must consider a range of issues about the process including Environment, Health, and Safety. The impacts of the process operations, product quality, resource consumption, waste generation, and emissions are evaluated. Market issues and product quality along with local and global social impacts are considered as part of feasibility studies made during the needs analysis phase of the project.
- (11) An ability to engage in lifelong learning is fostered through the project activities. Students are expected to research beyond the class and course materials for possible ideas and solutions to the problems, which arise in the development of valid design solutions.

### Course Assessment:

Homework	20 % (individual)
UniSim exam	20 % (individual)
Class & workshop participation	5 % (individual)
Final oral presentation	5 % (individual)
Project grade	50 % (the individual team members' grade is adjusted according to peer evaluations*)
Project progress reports (approximately one per week)	25%
Final design report	25%

\*Individual grade = team grade \* 0.5 {min[1 + (average of student's evaluation excluding max and min)/(team average)], 2.2}

The students are sorted in the order of decreasing overall points. Grades are then decided as follows:

Division between A and A- : Largest gap between two students with  $90 \geq$  overall points  $> 85$   
Division between A- and B+ : Largest gap between two students with  $85 \geq$  overall points  $> 80$   
Division between B+ and B : Largest gap between two students with  $80 \geq$  overall points  $> 75$   
Division between B and B- : Largest gap between two students with  $75 \geq$  overall points  $> 70$   
Division between B- and C+ : Largest gap between two students with  $70 \geq$  overall points  $> 65$   
Division between C+ and C : Largest gap between two students with  $65 \geq$  overall points  $> 55$   
Division between C and C- : Large gap between two students with  $55 \geq$  overall points  $> 45$   
Division between C- and D+ : Largest gap between two students with  $45 \geq$  overall points  $> 30$   
Division between D+ and D : Largest gap between two students with  $30 \geq$  overall points  $> 10$   
Division between D and D- : Largest gap between two students with  $10 \geq$  overall points  $\geq 0$   
(never happens)

E: Given to students for honesty violations

### Other:

**Do not hesitate to ask questions** both in class and outside class.

## **ADDITIONAL INFORMATION**

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a safe and inclusive learning environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination.

It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. If you feel like your performance in class is being impacted by discrimination or harassment of any kind please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@ufl.edu](mailto:nishida@ufl.edu)

### ***Sexual Discrimination, Harassment, Assault, or Violence***

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

## ***Campus Resources:***

### ***Health and Wellness***

#### **U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### ***Academic Resources***

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

#### **Student Complaints Campus:**

[https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).