

4104 (4 hours) Process Component Design

Required Course for ChE Degree

Current Catalog Description: Open-ended problems in economic design of chemical process components. Economic aspects of engineering, including evaluating alternative courses of action, depreciation, replacement analysis, and process optimization. Lecture 3 hours per week, laboratory 3 hours per week. Prerequisites: Senior Standing, ChE 3084.

Recent Textbook: P. Buthod, R.E. Thompson, A.J. Wilson, "Process Component Design", The University of Tulsa, 1993

Recent References: Perry's ChE Handbook, 6th ed., McGraw-Hill; Walas, "Chemical Process Equipment - Selection and Design", Butterworths, 1988.

Set of Course Goals/Objectives: At the end of the course, students will be able to:

1. Apply engineering judgment, including safety and ethics, in the selection and design of process equipment, including piping systems, tanks and vessels, heat exchangers, trayed and packed columns.
2. Apply engineering economics to the design and sizing of process equipment, including estimation, escalation, and optimization of equipment cost.
3. Use modern computing tools to design process equipment.
4. Evaluate options for corrosion mitigation and selection of materials of construction.
5. Develop process flowsheets.

Prerequisites by Topic: (1) Stoichiometry; (2) Basic and advanced thermodynamics; (3) Fluid mechanics; (4) Heat transfer; (5) Mass transfer

Major Topics Covered in the Course: (1) Cost estimation; (2) Estimation of physical properties; (3) Materials selection; (4) Piping and instrumentation drawings (5) Pipe, fittings, and piping systems, pipe sizing (6) Tanks and vessels, separator and accumulator sizing (7) Pump design and selection; (8) Compressor design and selection; (9) Heat exchangers; (10) Shell-and-tube heat exchangers; (11) Fired heaters (12) Tray columns; (13) Packed columns: **and (14) Process flow sheets.**

Class/Laboratory Schedule: three 50-minute lectures and one three-hour lab session per week for 14 weeks.

Laboratory Projects: (1) Pipe, fittings, and piping systems; (2) Materials selection; (3) Tanks and vessels; (4) Pump design and selection; (5) Reviews for FE exam; (6) Safety review; (7) Compressor design; (8) Tray columns; (9) Shell-and-tube heat exchangers (10) Tests.

Oral and Written Communications: Design projects must include an appropriate written report. At least three such projects. Each design group also presents its findings orally.

Social, Ethical and Professional Issues: Social and ethical issues are discussed throughout the course whenever they impact process design. Usually they appear when safety, emissions, noise, regulations and codes are involved in design. Professional registration is discussed in detail. Students are urged to take the FE exam and three lab periods are used to prepare them for the ChE afternoon portion of the exam.

Theoretical Content: Each topic starts with a brief review of the underlying theory.

Analysis/Design: The course emphasizes design and analysis of process equipment.

Teamwork: Three design projects require that students work in teams of 2 or 3.

Laboratory/Data Interpretation: While students do not take any experimental data, they are frequently asked to analyze and interpret data on heat exchangers, compressors, and distillation columns. Sometimes the data are either missing or faulty.

Contemporary Issues Presented/Discussed: Current Federal regulations on industrial safety, health, emissions, and pollution control are discussed whenever relevant.

Computer Usage: (1) Computation of gas properties using HYSYS process simulation software; (2) Computation of shell-and-tube by HETEX, optimizing results of hand calculation assignment; (3) Design of fractionator by HYSYS, based on hand shortcut calculations, confirm hand-calculated tower sizing.

Field Experiences: Field trips to manufacturers of shell-and-tube heat exchangers.