



CHE654
Chemical Engineering Plant Design Projects



Chemical Engineering Practice School (ChEPS)
Semester 1, 2024

DATE: August 5, 2024
TO: All New Engineers
FROM: CHE654 Course Coordinator
RE: Plant Design Projects

Welcome to your new positions as design engineers with ChEPS. Each of you has been assigned to a Design Team. Each team will be assigned a project. In the next 3 months of this course, your responsibilities will be to produce a preliminary, but thorough, design of a full-scale chemical plant to manufacture an assigned product at the annual capacity requested. The company will be evaluating several alternatives of manufacture but you do not need to optimize your design at this point.

To help you adjust to your new responsibilities, this memo will outline the expectations and procedures you will be evaluated on over the next 4 months. This design aspect of the course is organized in such a way as to help you review the fundamentals of chemical engineering practice in the following areas:

- Technical writing
- Oral presentation
- Material/energy balances and recycle calculations
- Applied thermodynamics
- Kinetics and reactor design
- Distillation/separation unit design
- Utility system design
- Sizing and costing of equipment
- Profitability analysis

Design Projects:

There will be 6 design teams and 6 design projects. So no two teams will work on the same design project. Every member in each team is expected to contribute equally to the final solution of the project. This applies to the oral presentations and written reports as well. Please see the Design Project Handout for a list of all projects and members in your team.

Project Advisors:

There are no lecturers for this component of CHE654. Instead, a total of 7 English advisors from ChEPS staff have been appointed with whom you could consult during the course of your work when you have problems, including both technical and English problems. This year, we have appointed Asst. Prof. Dr. Hong-ming Ku as the technical advisor who will give you advice on technical problems, and Dr. Nonsee Nimitsirawat as the general advisor who will help you with any general problems. Please refer to the Design Project Handout for the names of the advisors

Oral Presentations:

Oral presentation is an essential component of the CHE654 course. Engineers in the real world are often asked to communicate their technical know-how to management through formal presentations. The objective is to train you in the skill of presentation which must be conducted in English.

There will be four oral presentations including the formal final presentation. A tentative schedule for the presentations is shown in the table below. In each presentation, *every* member of a team must present one part of the project. Each team will make the presentation for about 20 minutes with 10 minutes for questions. Please keep in mind that if you go over the time limit by a wide margin, points will be taken off from your presentation grade. The advisors will sit through all the presentations and write down their feedback and comments on the performance of each speaker.

You should plan to use Microsoft PowerPoint and ChEPS LCD projector and a computer laptop to make your presentations.

Reports:

Three reports are required for this class: a proposal, a progress report, and a final report. A proposal must be submitted to an advisor at least one day before the first presentation. Your proposal should include: a company name, background of the problem, a process description, and a detailed work plan. Your advisor will correct the English in the reports and will discuss with you the format of your presentations. Before your second progress presentation, a progress report must be submitted to your advisor at least one day before the actual presentation. This report should contain the most up-to-date results and discussion and a time line. Finally, a final report is to be submitted about a week after the day of the Final Presentation (see the table below for the actual due date).

The major components, which should appear in the report, are as follows:

- Process Flow Diagram (PFD) and Material Balances
- Process Description
- Energy Balance and Utility Requirements
- Equipment List and Unit Descriptions
- Specification Sheets
- Equipment Cost and Capital Investment Summary
- Operating Cost Summary
- Profitability Analysis

You can apply what you learned during your undergraduate courses, such as unit operation design, equipment sizing and costing, or engineering economics, to prepare those components mentioned above. Most of the calculation may be carried out using hand calculations, Excel, or a simulation tool such as Aspen Plus, especially when simulating complex columns. You should consult with your technical advisor to determine whether a simulation tool is necessary for your process.

Tentative Schedule:

| Date | Team | Subject | Start Time | Location |
|--------------------------|------------------|---|-------------------|-----------------------|
| September 5, 2024 | All Teams | Proposal Presentation | 13:30 | Student Office |
| October 3, 2024 | All Teams | Progress Presentation | 13:30 | Student Office |
| October 31, 2024 | All Teams | Final Presentation | 13:30 | Student Office |
| November 15, 2024 | All Teams | Final report due – submitted to Dr. Hong-ming Ku via Email | | |

Grading:

The design project component of CHE654 is worth 25% of the course with the following grade distribution:

| Item | Marking (25%) |
|--------------------|----------------------|
| Technical Accuracy | 10 |
| Engineering Report | 5 |
| Oral Presentation | 10 |

While you will not be graded in each progress presentation and report, the final grading will be made on the technical accuracy of the project, the performance at the Final Presentation, and the English and organization of the final report. Although each member within the same team will be assessed individually on his/her oral presentation, everyone in the same team will receive the same final grade (taking the average of all speakers in the same team). So it is important that every member contributes to the success of the project. In addition, those with better presentation skills should help the weaker ones in order to receive a good grade for the project.

General Milestones for Presentations and Progress Work

- ❑ Week 1 – Problem Understanding
 - ❖ Problem definition
 - ❖ Establishing goals
 - ❖ Description of process
 - ❖ Work plan and strategy

- ❑ Week 3 – Flowsheet Synthesis
 - ❖ Gathering information
 - ❖ Representing alternatives
 - ❖ Developing criteria for assessing preliminary designs
 - ❖ Generating and searching among alternatives

- ❑ Week 5 – Mass and Energy Balances I
 - ❖ Reactor design
 - ❖ Reaction chemistry
 - ❖ Reaction temperature and pressure
 - ❖ Thermodynamics
 - ❖ Reaction kinetics
 - ❖ Approximate design for all reactors

- ❑ Week 7 – Mass and Energy Balances II
 - ❖ Separation processes
 - Property list
 - Describe types of equipment
 - Report target compositions for streams entering and leaving units
 - ❖ Complete heat exchanger network and utilities
 - ❖ Complete overall mass and energy balances

- ❑ Week 9 – Equipment Sizing and Costing
 - ❖ Equipment specifications
 - ❖ Complete equipment data sheets
 - ❖ Cost estimates
 - Equipment cost
 - Manufacturing cost
 - General expense
 - ❖ Sensitivity analysis

- ❑ Weeks 11 and 12 – Economic Evaluation and Final Presentation
 - ❖ Return on investment
 - ❖ Cash flow analysis
 - ❖ Complete final report