

# **EXECUTING THE CBE 459 DESIGN PROJECT**

**2016-2017 Academic Year**

When planning to undertake your senior design projects, the following items need to be addressed. Please read these shortly after receiving your design project assignment and keep them in mind throughout the course.

## **1) OVERVIEW**

The projects are developed for the class and the students by faculty and industrial consultants. Also, once again, students were encouraged to propose projects. The goal has been to have interesting and economically favorable projects. Note that when the economics are found to be unfavorable, which often occurs in industry, the results are useful in guiding a company's ongoing strategy.

## **2) SOURCES OF INFORMATION**

Your project author is your first source of information and data. However, often, all of the data your team will need is not readily available and you will be given guidance as to where to look or what assumptions are reasonable when some important data are unavailable.

Your faculty advisor and industrial consultants (when other than your project author) will do their best to help in your search for data or in formulating assumptions. For each project, some faculty and consultants will be more knowledgeable. Others may have more limited knowledge of the technologies, but will try to help in the overall project development.

## **3) LOOSELEAF NOTEBOOKS**

It is recommended that you keep all of your CBE 400 printed materials in a looseleaf binder for easy access.

It is also recommended that you prepare a looseleaf binder to contain materials relating to your design, including:

- a. Important references
- b. Design calculations
- c. Computer programs and results

Bring your binder to your design group meetings.

#### 4) DESIGN GROUP MEETINGS

Each design group will meet with its project author and faculty advisor in November to raise questions and obtain suggestions regarding the formulation of a solution strategy. It is your responsibility to find a time that works for your group, your faculty advisor, and project author. In addition, please invite Prof. Bruce Vrana to the meeting, and if he is available, he will call in. The purpose of this meeting is to review your research to date, answer any questions you have about the project and plan the next steps. Then, on each of three Monday evenings (**Nov. 21, Dec. 5, 12**), three or four of the 10 design groups will describe their plans to the entire class.

All design group meetings will be held in the Weiss Pavilion (under the north stands of Franklin Field) – Conference Rooms I, II, or III of the Penn Libraries Education Commons. Each room is equipped with a large-screen LCD that permits video conferencing. For each meeting, your group will meet with an industrial consultant(s) and your faculty adviser (see the attached project and consultant schedules). Periodically, Prof. Bruce Vrana will attend your meeting. When a participant is located remotely, printed or typed documents will be shared using PDF files. Please bring your files on a thumb (flash) drive.

#### 5) FIRST DESIGN GROUP MEETING IN SPRING

For your first design group meeting in the spring, on January 17, be prepared to present your *objective-time chart* in writing, as described on page 8 of SLSWGN. Also, show your initial work on an *innovation map* for your product design (see pp13-14). In addition, show the initial results of your market and competitive analyses and indicate customer requirements (pp10-12).

Then, when a process is being designed, discuss your findings, thus far, concerning:

- a. A survey of the methods used in manufacturing the product, giving the raw materials, the principal chemical reactions, byproducts, and intermediates.
- b. A discussion of the choice of the production level and plant location.
- c. Create a block diagram showing the principal steps for the process anticipated to be the most promising (Figure 2.16 – p42). When possible, prepare promising process flow diagrams (Figure 2.17 – pp42-44)
- d. Reaction kinetics and thermophysical property data.
- e. Economics, toxicity, and safety data (pp20-21).

Where you are uncertain or have questions, seek the advice of your faculty advisor and industrial consultants.

These materials should be updated and presented every Tuesday, with one copy provided for your faculty adviser and the industrial consultant(s) who will be meeting with you. Also, please leave a copy with Prof. Vrana, whether or not he attends your meeting. Again, for those located remotely, prepare PDF files to be displayed on the LCD screens. Please

check the consultant schedule each week, and if two industrial consultants are expected for your meeting, bring copies for both.

## 6) **PROGRESS MILESTONES**

You will receive a schedule of the weekly design group meetings on Tuesday afternoons in the spring. On this schedule, *milestones* will indicate items to be prepared for specific meetings. In cases where the milestones don't apply to your project, modifications should be formulated by your group and agreed upon with your faculty adviser.

Your preliminary designs should be completed by the end of January. For a process, plan to submit a preliminary material balance and a computer-drawn block flow diagram by the first week of February. For a product, focus on the customer preferences, the technical specifications, the product concept, and a competitive (patent) analysis (Section 1.2 - SLSWGN).

Most of the process synthesis work should be completed by the last week of February. Plan to submit the material and energy balances for the most promising flowsheet(s), that is, base-case designs, together with a computer-drawn process flow diagram. See *Flow Diagrams* in Section 2.5 (pp41-44 - SLSWGN).

Much of the detailed design of your new product and/or the process units for your manufacturing plant should be completed by the last week in March. Plan to submit the detailed design for your product and/or one key process unit.

The intent here is to pace each group in completing its project and final design report without undue stress and time limitations toward the due dates.

## 7) **LIBRARIES**

Learn to use the SEAS Library Collection (no longer in the Towne Building) and the Chemistry Library effectively. To help, our librarians, Douglas McGee and Judith Currano, have prepared a discussion of the special features of the Towne and Chemistry Libraries, use of the important indices, computerized databases, and facilities for interlibrary loans. They will make presentations in a CBE 400 class in October. Also, you may find the *Design Literature* in Section 3.1 (SLSWGN) helpful.

## 8) **WEEKLY PROGRESS**

As your design evolves, individual team members should assume responsibility for aspects of the work. It is important that your group meet from time-to-time during the week to examine each other's work and coordinate the next steps.

At Tuesday meetings during the spring semester, each student in the group should be prepared to discuss aspects of the work for which he or she is responsible. Use the group meetings to discuss results and seek advice. Participation will influence your grade.

These meetings will be attended by your faculty advisor and an industrial consultant (or perhaps two). Prof. Vrana will attend your group meeting for the full hour every second or third week. Your weekly progress report should be prepared to keep your faculty advisor (and Prof. Vrana) abreast of your progress. These reports should describe your efforts completed during the prior week, provide process flowsheets, raise questions and concerns, among other items. Copies should be presented to your faculty advisor and your industrial consultant(s) in attendance at your meeting. Also, if Prof. Vrana doesn't attend your meeting, please find him at the Educ. Commons and hand him a printed copy.

Between Tuesday design meetings, you can seek help from your adviser, other faculty with specific expertise, the industrial consultants, local industry, etc. Prof. Vrana will be available for meetings on Tuesday (before 1:30 or at 5:30 p.m.) and most Thursdays. On weeks when Prof. Vrana is not available on Thursday, he will suggest another day. If you are not available at those times, please suggest a couple of times that will work for you and he will try to find a mutually agreeable time. Please contact him directly via e-mail to schedule a one-hour meeting on a first-come basis. You can also drop in on Tuesday any time without an appointment, although you may need to wait if there is another group meeting. Our industrial consultants all have busy schedules. Please contact them only after exhausting other avenues for help. When contacting persons in industry, be sure they understand that your questions concern your **senior design project**. Note that Prof. Vrana is expert in the design of industrial processes. He will try to provide help in all areas of your design projects, but cannot be fully aware of all technologies. When necessary, he will try to refer you to persons better able to provide assistance.

For those groups that use ASPEN ENG. SUITE products, Prof. Fabiano can be very helpful. Also, he can help you with the detailed design of specific equipment items, and provide advice on the application of the SUPERPRO DESIGNER batch process simulator.

In addition to meetings at Penn, Prof. Vrana encourages e-mail correspondence. He is almost always available with little delay. Remember, however, that he has a full time job at DuPont in Wilmington, Delaware.

## 9) **15-MINUTE ORAL PROGRESS REPORTS**

On Tuesday, February 28, during your normal group meeting hour, your design group will make a 15-minute oral progress report (room to be announced) to your design group faculty adviser, and Profs. Vrana, Fabiano, and Seider, and Dr. Holleran. Industrial consultants and other project authors will also be invited.

## 10) **SOFTWARE AVAILABILITY**

Feel free to use Aspen Tech's Aspen Engineering Suite (including ASPEN PLUS, ASPEN PLUS DYNAMICS, ASPEN BATCH PROCESS DEVELOPER (formerly BATCH PLUS), and ASPEN PROCESS ECONOMIC ANALYZER (formerly Aspen IPE), SUPERPRO DESIGNER, the Downey Economics Spreadsheet (Profitability Analysis 4.0.xls), VISIO Technical Plus, MATLAB, GAMS, ProPred, and ProCAMD. These

programs can be accessed from the PC's in the Towne computer labs. Use of the computer is optional throughout the course, but strongly recommended.

## 11) WRITTEN AND ORAL DESIGN REPORTS

Your written design report is due on Tuesday, April 11. It should follow the format in Chapter 23 (*Written Reports and Oral Presentations* – SLSWGN). The report will be reviewed by your adviser and returned to you with comments before Friday, April 14. You will make revisions and submit your revised written report on Tuesday, April 18. Note that a lecture has been scheduled on Tuesday, February 14 from 6:00-7:00 p.m., to provide advice in the preparation of your design report. We will go over Chapter 23 and clarify any questions you may have. All students should plan to attend. Also, the design reports will be bound for storage in the SEAS Library Collection and a PDF file will be circulated.

Oral design presentations will be on Tuesday, April 25. Each group will be allotted 40 min (30 min presentation, 10 min questions). We will have an **All-day Technical Meeting** involving students, faculty, and consultants. A luncheon will be held. The **Senior Class Picture** will be taken just prior to the luncheon.

## 12) TEAMMATE EVALUATION

You will complete two survey questionnaires during the semester in which each design team member will be asked to assess the percentage effort on the project by all team members including himself/herself. Each group member will be required to provide an evaluation of other team member's performance and participation quality. This will be required at the halfway point of the semester and again after the presentations are completed – and may have an impact on individual grades. It is not expected that all group members will contribute exactly the same percentage of the work, but reasonable percentages are expected.

## 13) COURSE GRADES

Your faculty advisor will read your draft report and suggest changes. Then, Prof. Vrana will read your report (and all design reports written by the design groups in CBE 400-459) and will provide detailed comments for your final report. The final written and oral reports, and participation and presentation at design group meetings will determine your final grade. Grades for your oral design presentation will be suggested by those in attendance. Then, your faculty advisor and Prof. Vrana will determine your course grade.

## 14) MOLSTAD PRIZE

The three winning groups of the Melvin C. Molstad Prize, for the most outstanding designs, will be honored during Commencement Exercises.

This year's projects are very promising and, hopefully, will lead to novel and profitable designs. Good Luck!