EXECUTING THE CBE 459 DESIGN PROJECT

2019-2020 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, students and industrial consultants. 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 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, Prof. Vrana and industrial consultants 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 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) **FALL DESIGN GROUP MEETINGS**

Each design group will meet with its project author and faculty advisor in late October or early 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. 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.

In addition to this meeting with your problem author and faculty advisor, your team should meet as needed in order to establish a tentative schedule for the project (which should be updated as needed), establish goals, plan tasks and prepare for the fall presentation. Your team will need to decide how best to organize and self-manage your project.

On each of three Monday evenings (Nov. 18, 25, Dec. 9), four of the 11 design groups (plus the ISD Walmart Food Waste group) will describe their plans to the entire class with a 15-minute presentation. No technical calculations are expected at this point. You should show that you have begun thinking about the project, who your customers might be, any thoughts about the market you are entering, perhaps comment on some of the upcoming design challenges, things that make your project interesting/unique, etc. The presentation should include, at a minimum:

- Description of your project and why it is interesting
- How you are planning to organize your work
- Tentative schedule
- What are the public health, safety, environmental or societal impacts associated with your project
- What new knowledge you need to acquire and apply to successfully complete your project
- Path forward

5) **SPRING DESIGN GROUP MEETINGS**

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, and a networked computer. For each meeting, your group will meet with one or more industrial consultants and your faculty advisor (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 or have them readily available by logging in.

For your first design group meeting in the spring, on January 21, 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, Prof. Vrana 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 give or e-mail a copy to 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 bring copies for everyone expected to attend. An extra copy would be a good idea, to accommodate any unforeseen changes in the consultant schedule.

The weekly meeting is your opportunity to update your faculty advisor, Prof. Vrana and the industrial consultants of your current status and then ask any questions that you have. It is your hour to seek advice from experienced engineers – use it well. If the group before you is running over time, you should diplomatically encourage them to wrap up.

6) PROGRESS MILESTONES

You have received 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 third week of meetings. For a process, plan to submit a preliminary material balance and a computer-drawn block flow diagram by that week. 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 8th consultant meeting. Plan to submit the detailed design for your product and/or one key process unit. All equipment should be designed the week after that, and economics completed by the final meeting with industrial
consultants.

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. You will regret falling behind schedule.

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 Curran, have prepared a discussion of the special features of the SEAS 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 the fall. 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 they are responsible. Use the group meetings to discuss results and seek advice. Participation will influence your grade. These meetings will be attended by your faculty adviser and one or more industrial consultants. Prof. Vrana will attend your group meeting for the full hour every third week. Your weekly progress report should be prepared to keep your faculty adviser and Prof. Vrana abreast of your progress. These reports should describe your efforts completed during the prior week, provide process flowsheets, and raise questions and concerns, among other items. Copies should be presented to your faculty adviser 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 project author, the industrial consultants, other industry contacts as recommended, etc. Our industrial consultants all have busy schedules. Please contact them only after exhausting other avenues for help. When contacting anyone 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 refer you to someone better able to help.

9) OFFICE HOURS

Prof. Vrana will be available for meetings on Tuesday (generally 10:30 to noon, or at 5:30 p.m.) and another day every week. If possible, please let him know of your desire to meet
at 5:30 on Tuesday by noon. In January, he will survey each group to find the best times for office hours, and set a schedule which will change from week to week. He will send out a link to his Google calendar so you can schedule one or two 30-minute time slots as needed. If you are not available during that week’s office hours but need to talk with him, please suggest a couple of times that will work for you and he will try to find a mutually agreeable time for a phone call. You can also drop in during office hours without an appointment, although you may need to wait if there is another group meeting. If no group has signed up for office hours by 6:00 a.m. that day, he reserves the right to cancel office hours and not come to campus, so please reserve a time by the evening before.

In addition to meetings at Penn, Prof. Vrana encourages e-mail. He is almost always available with little delay, and keeps an eye on Penn e-mail throughout the day and evening. Many questions can be handled by e-mail, so do not hesitate to ask technical or non-technical questions. If something is holding you up, please ask about it rather than waiting. Remember, however, that he has a full-time job at DuPont in Wilmington, Delaware, so daytime responses may be delayed at times, depending on the type of question asked and the time required to respond.

10) 15-MINUTE ORAL PROGRESS REPORTS

On Tuesday, March 3, 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. You are expected to stay for the entire hour, listen to presentations by the other groups, and offer feedback as appropriate.

11) 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, formerly Aspen Icarus), SUPERPRO DESIGNER, the equipment costing spreadsheet, 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.

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.

12) WRITTEN AND ORAL DESIGN REPORTS

Your written design report is due on Tuesday, April 14. It should follow the format in Chapter 23 (Written Reports and Oral Presentations – SLSWGN) and the Monday evening lecture on the design report early in the spring semester. The report will be reviewed by
your adviser and returned to you with comments before Friday, April 14. It is your responsibility to discuss (or negotiate) these dates with your adviser to ensure you get feedback on the timeline you need. You will make revisions and submit your revised written report by 5:00 p.m. on Tuesday, April 21, in both paper and PDF form. Please plan ahead and get your report to the Towne Printing Office on Monday, April 20. Note that a lecture has been scheduled on Monday, January 27 from 5:00-6:00 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 electronically published as PDF files in Scholarly Commons for posterity (see http://repository.upenn.edu/cbe_sdr/).

Oral design presentations will be on Tuesday, April 28. 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. You are expected to be present and participate for the entire day, except for other classes, in order to support and celebrate the accomplishments of your classmates.

13) 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 members’ 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.

14) COURSE GRADES

Your faculty advisor will read your draft report and suggest changes. Then, Prof. Vrana will read all the reports written by the CBE design groups and will provide detailed comments on 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 adviser and Prof. Vrana will determine your course grade.

15) 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!