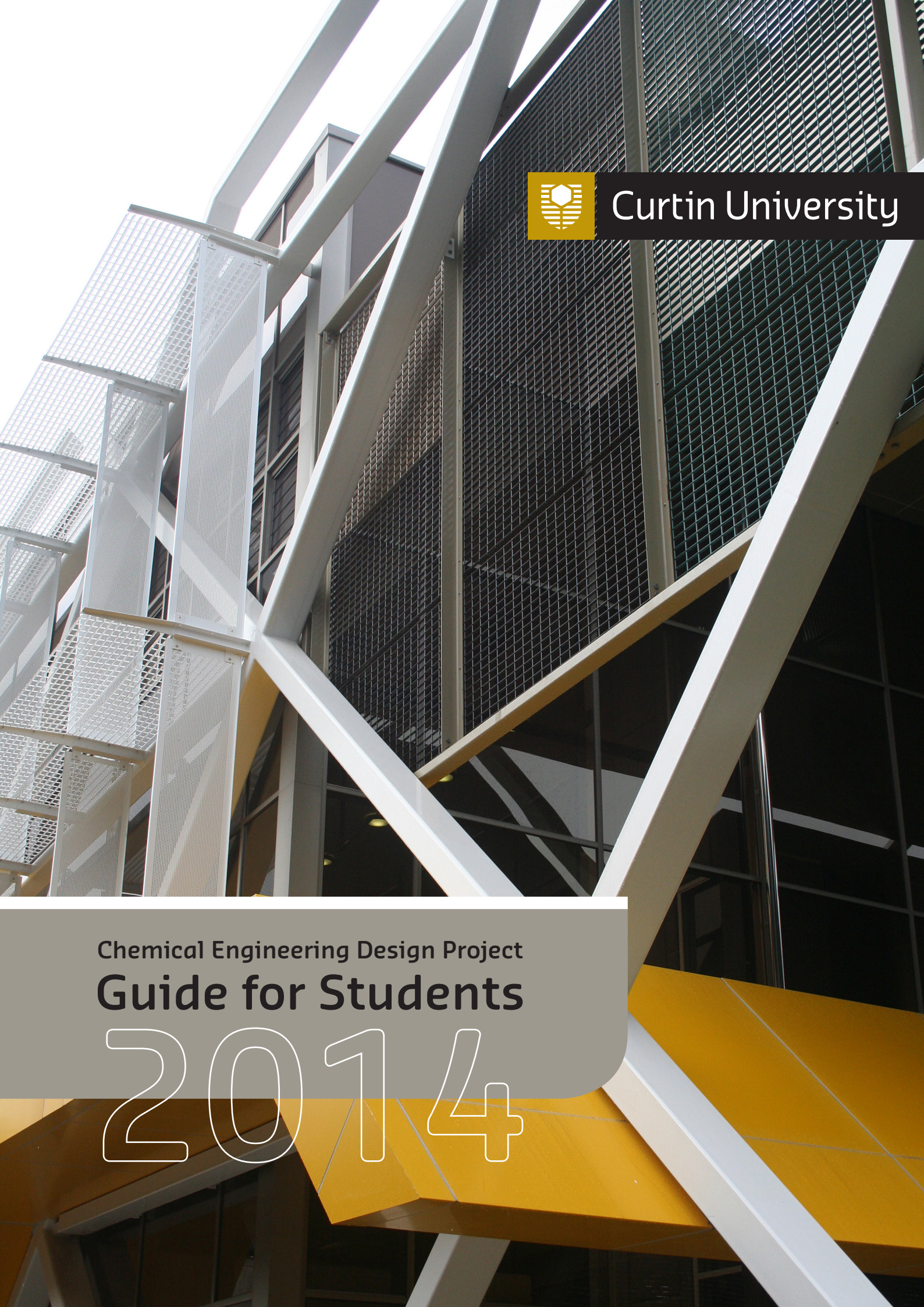


Curtin University

Chemical Engineering Design Project

Guide for Students

2014

Contents

1 Purpose and significance of the Design Project

Design is arguably *the* defining activity of the professional engineer.

Design for mass production is one of the things that makes engineering different from science. Chemical engineers design both products and processes. In this unit, you'll perform design work on a large-scale process plant. The aim is to design a plant that is technically feasible, safe, environmentally acceptable and as economical as possible within the given project constraints. The Design Project is the 'capstone unit' of the chemical engineering course, meaning that is meant to draw upon and consolidate knowledge gained in the previous years of the course. It is meant to challenge you to apply chemical engineering fundamentals and your growing engineering judgement to a large and complex project.

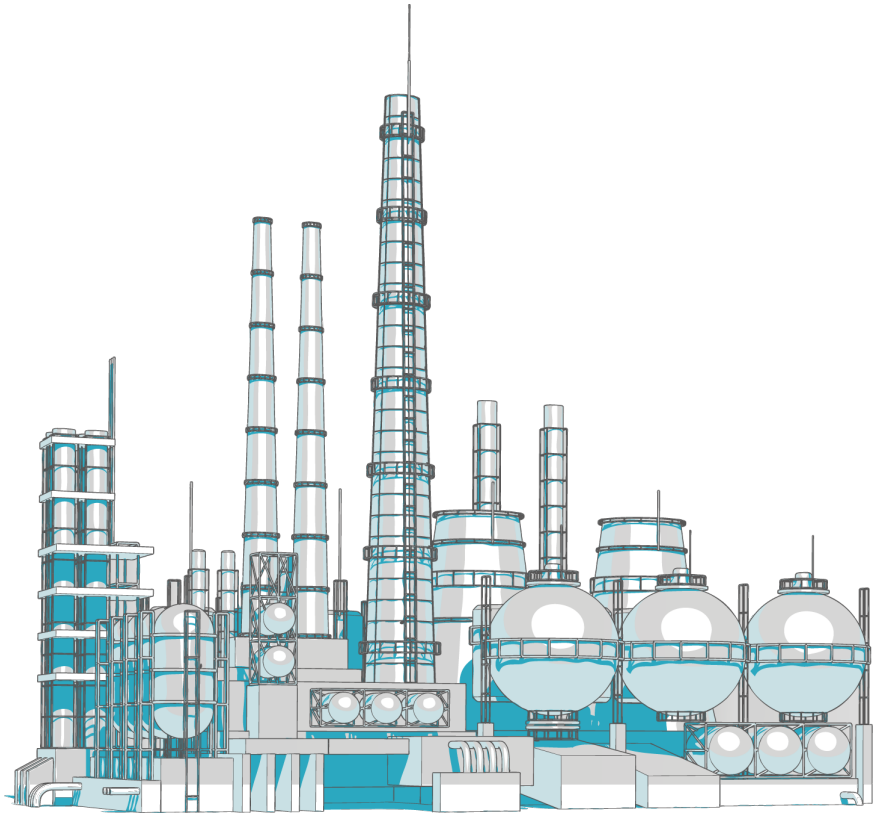
It can help you to:

- revise and bring together skills developed in different units through the course,
- build confidence,
- enter a particular industry,
- strengthen your teamwork and time management skills to a level that other units usually do not, and
- generate evidence of quality of work for potential employers.

Each of the design projects on offer were devised and will be partly supervised by *practising engineers from major engineering companies*. They will answer technical questions, share their practical experience and provide feedback on your work. Each group of students will also have an academic advisor to answer some technical questions, clarify the assessments, provide feedback on your work, and help you keep on track with the unit.

The unit learning outcomes for the Design Project are as follows:

- Locate and evaluate information needed for chemical engineering design;
- Conduct a process feasibility study based on a project brief;
- Perform detailed design work on selected equipment items, including chemical, mechanical and operational aspects;
- Apply problem-solving skills, demonstrate engineering judgement and engage in reflective practice;
- Apply teamwork and communication skills in a process engineering team environment.



2 General Information

- Design Project 499 is a core 50-credit point unit in the undergraduate Chemical Engineering degrees and makes up 25% of the final year's mark. Process Design Project 599 is a core 50-credit unit in the Postgraduate Diploma in Chemical Engineering and the Master of Chemical Engineering degrees. These undergraduate and postgraduate units are co-taught.

- Students work in more-or-less self-selected groups of four or five. Postgraduates and undergraduates may work together.

- There will be several projects available at Bentley this year, mostly in the oil and gas or minerals industries. Usually four to six groups will do the same project, or small variations of it. You will be asked to rank the projects from most to least preferred. We will attempt to give you one of your more preferred projects, but cannot guarantee it. Project details will be provided before the start of the semester. As a guide, here are some of the process plants that have been designed in previous years:
    - Domestic gas production plant, LNG plant, a variety of gas processing facilities, oil refinery, biodiesel production plant, natural gas to ammonia plant, underground coal gasification plant;
    - Plants to upgrade ores or produce metals: alumina, copper, gold, lithium carbonate, nickel matte, titanium sponge, yellowcake;
    - Air liquefaction plant, seawater desalination plant, winery.

- The projects have been devised by local engineers from major engineering companies. They will meet with groups at the start of the project, will provide specialist advice through the semester, and will be invited to attend the mid-semester presentations.

- Each team will also have an academic advisor who will meet with his or her groups each week to monitor progress, clarify the assessment requirements, help with organisation, provide technical advice and mark the various assessments. While you can give your project and group preferences, we'll allocate the academic advisor for each group. You'll be informed about your group members, and your allocated project and academic advisor before the start of semester. In general, each project will have two academic advisors, so one of them can assist groups if the other is away.

- There are some special considerations related to selecting the team partners and projects, as set out in the next section.

- The project has both team and individual parts: in the first half of the semester the focus is on group work to establish a technically and economically viable process flowsheet, and then in the second half, each student will individually design two pieces of equipment in detail.

- The assessments consist of several technical memos, a team presentation and the final report, which compiles the team and individual work.

- It is important not to miss the first week of semester when the start-up meetings are held with the industry and academic advisors. The unit is run according to a reasonably demanding schedule, with the first assessment being due in Week 3.

3 Special considerations related to group and project allocation

If you are in one of the categories below, then special considerations apply to the project your team will be given.

i. **Oil and gas stream students:** will be given an oil or gas design project, if possible.

ii. **Extractive metallurgy double degree students:** will be given a minerals design project, if possible.

iii. **A student who is a current or confirmed future employee of one of the companies supporting the Design Project:** the student involved should discuss their project selection with their employer, and then advise the unit coordinator. The team will be given, if possible, that company's project if that is what the company wishes.

iv. **Any other special circumstances potentially related to project allocation:** please let the unit coordinator know.

When you are thinking about potential team members, please take this into account and discuss it with them because your situation may affect them also.

4 Actions you need to take before the start of Semester 2

i. **Please double check your study plan.** You may not be enrolled for the unit despite receiving this information. If you intend to take the Design Project in Semester 2 this year then please enrol as soon as possible. If you don't intend to take the unit this year, please email me to let me know. In fact, if you change your enrolment status for the unit in any way, please inform me.

ii. **Talk with your classmates and form a group of four or five people.** We have found that six people is too many, three is too few and five is probably the best number. If you are a group of less than five, then I may need to add extra people to your group. We reserve the right to split up, re-form and add people to groups if necessary even after the beginning of semester. If you can't or don't want to choose your own group for any reason, or if you have only two or three people in your group, then I will find you other people to work with.

iii. **Discuss with your group members the types of projects you would like to do.** If a group member will not be contactable during the semester break, then he or she will need to allow the other group members to decide on the group's project preferences in their absence.

iv. **As a group, monitor your email several times per week.** This is so you can respond to my future email providing descriptions of the projects and calling for your response about group members and project preferences. After I send you this information, groups will have about one week to reply. It is not first come, first served. You just need to reply by the due date. If you don't reply by the required date, then I will allocate you to any available group and project.

5 Teaching and learning arrangements

To support your group's work on the project, the following teaching and learning arrangements are in place:

- In the first 6–7 weeks, there are technical lectures on topics such as process selection, developing mass and energy balances, process control, environmental assessment, process safety, economic evaluation and detailed equipment design. The timing of the lectures is synchronised with the assessments.
- There are also supporting lectures on plagiarism, report writing and giving presentations in the context of the Design Project.
- Start-up presentations by industry engineers in Week 1.
- For some projects, training will be offered in new software packages, usually in Week 1 or 2.
- Academic advisor meetings each week.
- Contact with the industry advisors through the semester according to their preferred communication method.

Academic advisors

In the first week of semester, the project teams should approach their academic advisor and arrange a regular, one-hour meeting time each week. All team members should attend these meetings.
The other academic advisor(s) for the project is available for meetings if your main advisor is away. This is the default pattern, but individual academics can make different arrangements.

Industry advisors

The industry advisors are practicing engineers working for local production or consulting companies. The companies that support our design projects change from year to year, but in recent years they have included:

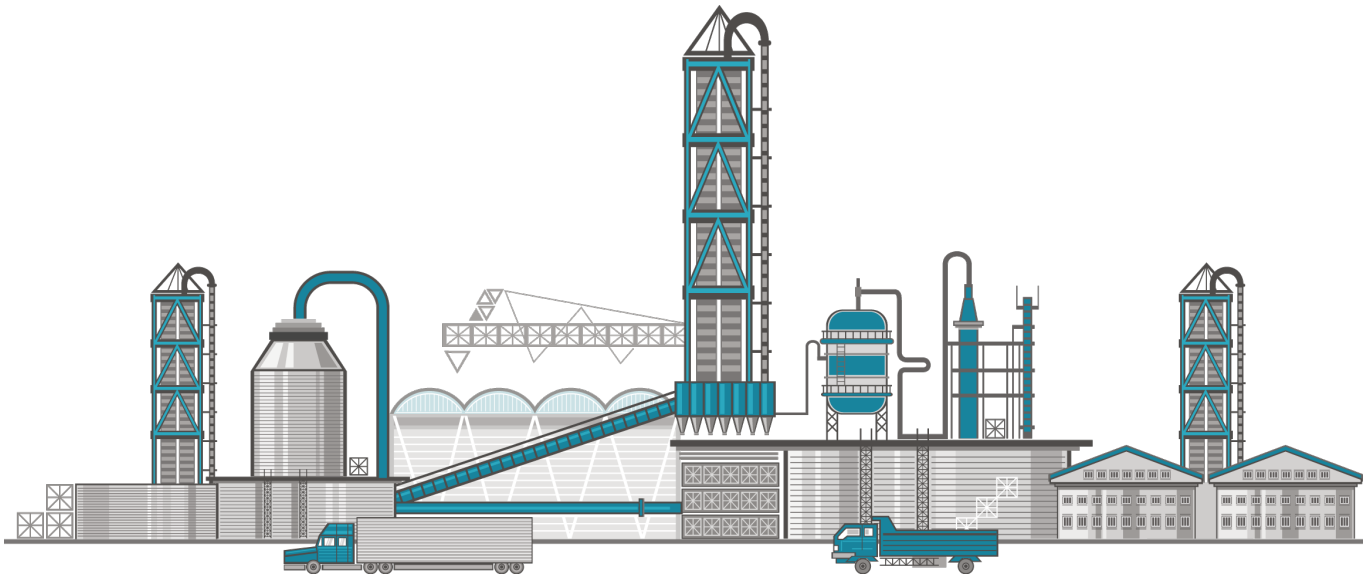
- **Aker Solutions**
- **BHP-Billiton**
- **Chevron**
- **Clough**
- **GHD**
- **Hatch**
- **Rio Tinto**
- **Tetra Tech Australia**
- **Woodside**

Prior to the semester, the industry advisors have proposed and refined the design projects. There is a start-up meeting on campus with industry in the first week of semester. This meeting is used to explain the scope and key issues of the project, outline the availability of data and establish the communications protocol for their groups during the semester. Some industry advisors prefer weekly or fortnightly meetings with the students, usually at their offices in the CBD, while others prefer to use email contact only. Their role during the semester is to provide practical and specialist technical advice on the project, and give you feedback on your work as it progresses.

While they have made a commitment to support the Design Project, please be mindful that the industry advisors have many other demands on their time. *Please respect any protocols they request regarding meetings, lead times for questions, phone calls and especially emails*.

Who do you see if you have problems?

Problem:	Contact:
Administrative problems; Blackboard access; extension requests; ...	Unit coordinator
Group-related problems; keeping on track with assessments; marking; ...	Your team's academic advisor (he/she has both technical and pastoral care roles)
Lecture materials	The lecturer in charge of the particular topic
Technical matters	• Your academic advisor • Other Curtin academics • Your industry advisor
What should go in each memo?	Please refer to Blackboard and then your team's academic advisor
What equipment is acceptable for major and minor design studies?	Please refer to Blackboard and then your team's academic advisor
The industry and academic advisors disagree on a technical matter ...	Please let the academic advisor know about this, and we'll resolve it with the industry advisor



6 Design Project assessments

More information will be given during the semester on the assessments, but an outline is given below. The memos each have a relatively small weighting given the amount of work involved – their main purpose is to help keep your group on track, and to provide feedback.

Memo 1

- Due: Teaching week 3
- Weighting: 5% of unit mark
- Written and assessed as a group, with the same mark given to each person
- The focus of Memo 1 is **process technology selection**, but other factors to consider are the project background, market, plant site selection, storage and transportation requirements and the group's work schedule for the semester.

Memo 2

- Due: Teaching week 5
- Weighting: 5% of unit mark
- Written and assessed as a group, with the same mark given to each person
- The focus of Memo 2 is solving the **flowsheet mass and energy balances**, but other tasks include drawing the Process Flow Diagram, specifying utilities, performing preliminary equipment and pipe sizing, optimisation, doing the plant layout, and assessing the environmental impact and process hazards.

Memo 3

- Due: Teaching week 7
- Weighting: 5% of unit mark
- Written and assessed as a group, with the same mark given to each person
- The focus of Memo 3 is **economic evaluation** of the project, but other work should include outlining the plant-wide control philosophy, explaining key issues in commissioning, start-up and shutdown, and deciding who will design what equipment in the individual design studies.

Memo 4

- Due: Teaching week 9
- Weighting: 5% of unit mark
- Written and assessed individually
- Memo 4 is a short progress report on your **individual design studies**, giving evidence of work that has been performed, outlining what is still to be done and flagging any problems.

Presentation

- Conducted around mid-semester, after submission of Memo 3
- Weighting: 15% of unit mark
- Presented and assessed as a group
- The presentation should report on the group's work on Memos 1–3 and consist of 10 minutes of presentation with 5 minutes for questions. The departmental staff, industry advisors and all Design Project students will be invited to attend and ask questions. All team members are expected to participate in some manner, and a team mark will be given. Both supervisor and peer marking will be used, so that student teams will mark and give feedback to each other. A small amount of credit will be given for marking other groups.

Final report

The final report is due in Teaching Week 12. It consists of three volumes – two printed and one electronic.

Volume 1

- Weighting: 20% of unit mark
- Written and marked as a team, but peer assessment will be used to convert the group mark to an individual mark that is intended to reflect each person's contribution to Volume 1. That is, team members will rate each other's contribution and that will affect the mark that each person receives.
- Volume 1 is essentially an extended and revised version of Memos 1–3. It should be a maximum of 50 pages long.

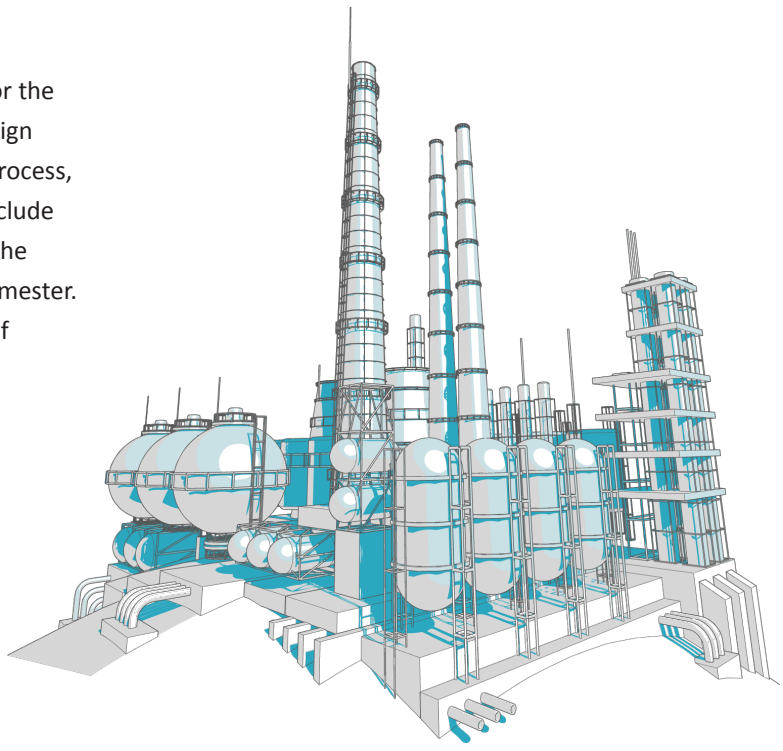
Volume 2

- Weighting: 45% of unit mark
- Consists of two chapters – a major design study and a minor design study – from each team member compiled together.
- Each chapter is written and assessed individually.
- Each person can include a maximum of 40 pages for the major design study and 20 pages for the minor design study. The individual design studies should cover process, operational and mechanical design aspects, and include an element of reflective practice. More details on the expected scope of work will be given during the semester.
- In addition, the group can include up to 10 pages of common material at the start of Volume 2.

Volume 3

- Is electronic – a CD or DVD – and has to be supplied along with Volumes 1 and 2.
- It should contain a full copy of all memos, the presentation and final report volumes, as well as all supplementary files used in the design work: scanned manual calculations, spreadsheets, drawings, simulation files and similar.
- It does not receive a separate mark, but is used when assessing Volumes 1 and 2.

This pattern of assessments means that 30% of the mark for the unit is based on undifferentiated group work, while 70% is for individual work.



7 Prizes

There are prizes for the best final report for each project, and the best overall project of the year. The best project may also be entered in the national design project competition. However, if no reports for a project have sufficient merit, a prize will not be given.

8 Final Tips

- Remember to bring technical information and evidence of your work to your meetings with advisors (photocopies, sketches, printouts, hand calculations, ...) so you can have concrete discussions and get concrete answers.
- A good approach for advisor meetings is to present what you've done and ask for feedback.
- If you're not sure how to do something, then set out the alternatives as best you can and begin work on one of them.
- You will never find all the data you want. Don't let one piece of data, however vital it seems, hold up your entire project. Make a (reasonable, conservative) assumption, state it, proceed from there and use a sensitivity analysis to gauge its effect.
- Transparency is important: be sure to keep the group members informed about how your work is progressing, be prepared to present evidence of it and be open if you are having problems.
- Aim to complete all the technical work and 99% of the report writing by Tuesday of the last week. Give yourselves two clear days for proofreading, printing and binding.
- Make regular, multiple backups of all your documents, spreadsheets and simulation files. What would happen if your USB drive crashed, or your laptop got a virus?

The Design Project is a great learning experience that draws together what you have learnt through your course, and applies it to a realistic, complex project proposed by practicing engineers from local industry. I think you'll find it challenging, but also very rewarding.

For more information, please email:

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