

Instructors:

Prof. Richard LAKERVELD, Room: CYT2003, Tel: 3469 2217, Email: r.lakerveld@ust.hk

Prof. Frank LAM, Room: 5580, Tel: 2358 7239, Email: kefrank@ust.hk

Prof. Becki Yi Kuang, Room: 5578, Tel: 3469 2617, Email: kekuang@ust.hk

Prof. Marshal YS LIU, Room: 4551, Tel: 2358 8409, Email: keysliu@ust.hk

Prof. Henry H N LAM, Room: 4561, Tel: 2358 7133, Email: kehlam@ust.hk

Delivery format: Experiential and blended learning

Scope: Conceptual design of chemical processes and products. Integration of prior knowledge in the execution of a structured design project, under the direct guidance of faculty. Project topics encompass both process and product design with different emphases. Design tasks include literature and market survey, ideation, feasibility and viability studies, prototyping and/or simulation, unit operation or component design, planning and project management, and societal and environmental impact assessment. Emphasis on the design process, hands-on experimentation, teamwork, and self-learning.

Learning objectives: On successful completion of this course, students are expected to be able to:

1. Perform conceptual design of a chemical process and/or product in a team setting.
2. Assess the societal impact, feasibility, viability, and desirability of a chemical process/product.
3. Communicate and cooperate effectively in a project team.
4. Acquire practical skills and knowledge required of chemical process/product design through self-learning.

Content

- Project management
- Conceptual process and product design
- Data Analysis and Design of Experiments
- Safety, Health & Environmental Awareness
- Design project

Assessment

The final grade will be determined as follows:

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| • Online work: | 10% |
| ○ Quizzes (Weeks 1-4) | |
| ○ Logbook | |
| • Participation and attendance: | 30% |
| ○ In-class (Weeks 1-5) | |
| ○ Lab/prototyping work | |
| ○ Project related exercises, quizzes, etc. | |
| • Mid-Term Project presentation: | 20% |
| ○ Planning, progress, application of general modules | |
| • Project report: | 35% |
| ○ Final Written Project Documentation | |
| ○ Q&A session in final exam period | |
| • Teamwork | 5% |
| ○ Peer evaluation | |

The assessment of the course will involve five main components. The online work will be rewarded for 10% and mainly contains performance in the quizzes related to the general modules and maintaining the logbook. The logbook will be an online document to which the TAs and course instructors will have access. We will randomly access this document for assessment. It is important as a team to keep the logbook in good shape. This is not only important for assessment. Maintaining an overview of tasks and individual responsibilities is essential for effective teamwork. We will provide a template and guidelines how to use it. However, it is the team's responsibility to make effective use of it, which we will monitor for assessment.

This course requires active participation, which will be rewarded with 30% of the final grade. Participation during all elements of the course will be assessed, including, but not limited to; attendance, in-class discussion, ad-hoc presentations, the quality of submitted tutorial documents, asking question (and answering questions for your classmates), lab work, prototyping work, exercises and/or quizzes related to the project topic, communication with your project advisor, etc.

Being able to present a project proposal to a group of stakeholders is an essential skill that you will be able to practice in this course and that will be rewarded with 20% of your final grade. The presentation will be conducted in Week 5, which needs to contain items such as your project background, planning, anticipated results, etc. This presentation will also be an important opportunity for you to get feedback on your project from your peers and advisors.

The execution and outcome of your design project must be documented in a final report. Reporting is another such skill that is essential for successful execution of design projects. Being able to report your work effectively in written documentation is by no means just required for this course. It is an essential skill in your professional career given the notion that modern engineers work in multi-disciplinary and dynamic teams, addressing many different stakeholders. A panel of advisors will read and assess your final report. Furthermore, they will ask questions about your report in a Q&A session that will be scheduled in the Spring term final examination period. This Q&A session is an opportunity for you to clarify your work, which will be considered when setting your final grade.

Finally, a small part of your final grade will be determined from peer evaluation. This allows us to reward you if your teammates appreciate your individual contributions to the project. There will be no tolerance for free riding, which normally results in an F grade for the entire course.

Course format

The course will be offered through an experiential and blended learning format. Your activities at home will be to watch short videos and complete an online quiz on Canvas or possibly to conduct small exercises related to your project. By doing so, you will be ready to discuss the content when you come to class. These on-campus discussions with the instructors and your fellow classmates will help to deepen your understanding and learn from each other. Your on-campus activities will gradually shift toward project design activities when the course progresses. Design activities include prototyping, laboratory experiments, process simulations, calculations, data analysis, discussion with your project supervisor, etc. Each week will have a 4-hour face-to-face session and one tutorial hour focused on your design project. In the first 4 weeks, we will discuss general topics and skills related to integrated chemical process and product design that are important for all students, irrespective of the project choice. In Week 5, we will have the mid-term presentation. After week 5, your activities will be related to your chosen design project. A tentative timetable is provided below. Please check Canvas and the individual modules regularly for any updates and more detailed information.

Tentative general timetable

Dates	Online activities¹ (Canvas) (Before Thursday)	In-class activities (On Thursday 9:00 – 12:50)	Tutorial² (Thursday 1800–1850)
Week 1 1/2/2024 9:00-12:50 5619 (Lift 31/32) (Richard)	1) Watch videos Module 1: <ul style="list-style-type: none"> Course Introduction Project Introduction Project videos Course Benefits Challenges Project basics Project management basics Project planning step by step Your project 2) Complete project preference survey (before Wednesday 31/1/2024 14:00) 3) Complete Quiz Module 1 (before 31/1 23:59)	<ul style="list-style-type: none"> Course introduction and project team formation (35 minutes) Ideation on project background and preliminary approach with project team (75 minutes) Break (15 minutes) Project management case studies. (100 minutes) Wrap-up (5 minutes) 	Project preparation
Week 2 8/2/2024 9:00-12:50 4402 (Lift 17/18) (Richard)	1) Watch videos Module 2: <ul style="list-style-type: none"> Conceptual Product Design Overview House of Quality Example Hand Lotion Conceptual Process Design Overview Production of Benzene Example 2) Complete quiz Module 2	<ul style="list-style-type: none"> Q&A on Module 2 videos (10 minutes) Product design case study (80 minutes) Break (15 minutes) Process design case study (Aspen Plus) (120 minutes) Wrap-up (5 minutes) 	Project preparation
Week 3 15/2/2024 9:00-12:50 4402 (Lift 17/18) (Henry)	1) Watch videos Module 3 <ul style="list-style-type: none"> Data Analysis and Design of Experiments I Data Analysis and Design of Experiments II Optional: statistical modelling, parameter estimation, regression, model validation 2) Complete quiz Module 3	<ul style="list-style-type: none"> Q&A on Module 3 videos Case studies on data analysis and Design of Experiments 	Project preparation
Week 4 22/2/2024 9:00-12:50 5619 (Lift 31/32) (Frank, Marshal)	1) Watch videos Module 4: <ul style="list-style-type: none"> Hazard Identification Risk Assessment Process Safety Management Framework for Measuring Environmental Impacts of Products and Systems Assessment Steps and Environmental Impacts Tools and Practical Tips 2) Complete quiz Module 4	<ul style="list-style-type: none"> Q&A on Module 4 videos (10 minutes) Tutorial 1: Risks and Hazards (80 minutes) Break (15 minutes) Tutorial 2: LCA (120 minutes) Wrap-up (5 minutes) 	Project preparation
Week 5 29/2/2024 9:00-12:50 5619 (Lift 31/32)	Preparing mid-term presentations	Mid-term presentations (Instructions will be announced)	Project preparation
Week 6-13 7/3/2024 – 9/5/2024 ³ 9:00-12:50	Project-specific online activities (e.g., exercises, watching videos on project relevant theory, quizzes, etc. – to be defined by project advisor)	Project work (Location: experiential learning labs, teaching lab, computer barn)	Project work (advisor meeting etc)
Exam period	Discuss final report (Q&A with panel members)	N/A	

¹ To be completed before the F2F session of that week (make sure to receive Canvas information)

² Tutorials will be every Thursday 18:00-18:50 with all students working on the same project. The room depends on your project (5508, 5560, CYTG003, or 4402)

³ No course activities on 28/3 and 4/4 (mid-term break)

Textbooks

- W. D. Seider, D. R. Lewin, J. D. Seader, S. W., R. Gani, K. M. Ng (2016). Product and Process Design Principles: Synthesis, Analysis and Evaluation (eBook), 4th edition, ISBN: 9781119475262. [This textbook is recommended for reference and available as e-book for purchase from the bookstore]