COURSE MEMO

Course: **Preliminary Plant Design** **(7,5HEC)** **KBT156**
Academic year: 2021/2022 Study period 1
Msc. Program: Innovative and Sustainable Chemical Engineering

Examiner and Course tutor: **Gunnar Eriksson**
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AIM

The aim of the course is to introduce a systems approach in design of a chemical process plant.

After completion of this course, the student should be able to:

- apply a systems approach to chemical engineering processes
- use computer tools to optimize the process
- decide the best process alternative from an economic, environmental and sustainable point of view

CONTENT

While in the general courses in chemical engineering each operation is studied separately, in this course the process and the plant are at the center. The main part of this course involves a project where the design of a chemical plant with all its components is performed, using modern computational tools. The systems approach is emphasized, and aspects of operation, control, safety, environment, sustainability, optimization and economy are included.

The lectures in this course treat topics that form the basis for a commercial plant design project. The emphasis is on a preliminary design and cost estimation of a process plant. The course is given in cooperation between Chemical Engineering (CE) and Energy Technology (ET).

Prerequisites

The course is aimed at chemical engineering students at the M.Sc. level and good knowledge in the fields of reaction engineering, separation processes and energy analysis is assumed. During the project work process integration methods and tools will be used, and course participants are expected to have basic knowledge in this field.

ORGANISATION

The course will be given as lectures and a project assignment, performed in small groups of 3 persons. The lectures will partly support the project work, but also give a wider view on topics that has to be considered in plant design. The project assignment will be given as a more general task, but each group will also get a group assignment, to be presented at the concluding seminar.

LITERATURE

Towler, G, Sinnott R:"Chemical Engineering Design", 2nd edition, Butterworth-Heinemann 2013. Can be purchased at Store.
There will also be extra material handed out at the lectures.

EXAMINATION

A written examination will be given after the lecture series. There will be 30 p, mostly as descriptive questions, but also some calculation problems. The only allowed aids will be an optional calculator with emptied memory, data tables and dictionaries (printed, not copied). Please contact the examiner beforehand if you are unsure if your aid is allowed or not.

As the project assignment constitutes a large part of the course, there will be a grading of this, depending on the work put into it. A grading will be done based on both the oral presentation and the written report, with a maximum of 30 p in total (divided into 7 p for the oral and 23 p for the written presentation). In order to be able to take the report fully into consideration in the grading, the report, including a written presentation of the group assignment, has to be handed in **before Oct 29 17:00**. Failure to meet this deadline may give grounds for lower points for the report.

The final grading of the course is based on both the written examination grading and the project grading, based on a straight average of the points.

STAFF

Lecturers:	Gunnar Eriksson	Tel: 772 5704	E-mail: gunnar.eriksson@chalmers.se
	Derek Creaser	Tel: 772 3023	E-mail: creaser@chalmers.se
	Simon Harvey	Tel: 772 8531	E-mail: simon.harvey@chalmers.se
	Mats Lindgren	(IPS)	
	Sven Andersson	(Babcock & Wilcox Völund)	
Exercise tutors:	Rojin Feizie Ilmasani		
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COURSE OUTLINE

Lectures

Due to the current Covid-19 situation, all teaching may have to be given digitally in Zoom. However, if the restrictions will allow it, and if it is possible to conduct them safely, most of the lectures will be given at campus. The links will be provided in due time before each lecture, and if the situation changes, updated information will be found on Canvas.

	Topic	Date	Lecturer	Room
1	Introduction Flowsheeting, Material balances Short cut distillation	Mon 30/8 13.15-15	Gunnar Eriksson, CE	ML1
2	Process Safety	Thu 2/9 8-9.45	Mats Lindgren, IPS	KS32
3	Reactor design in practice	Mon 6/9 13.15-15	Derek Creaser, CE	ML1
4	Repetition of the basics of heat integration*	Fri 10/9 15.15-17	Simon Harvey, ET	ML1
5	The Role of Heat Integration in Process Synthesis and Optimisation	Mon 13/9 13.15-15	Simon Harvey, ET	ML1
6	Heat and power utility systems in process industry	Thu 16/9 8-9.45	Simon Harvey, ET	KS32
7	Economy	Mon 20/9 13.15-15	Gunnar Eriksson, CE	ML1
8	Process control	Mon 27/9 13.15-15	Derek Creaser, CE	Zoom
9	Plant layout & Scale up	Mon 4/10 13.15-15	Gunnar Eriksson, CE, Sven Andersson	ML1

Comments:
*) Lecture 4 is intended for students who have not participated in the course Industrial Energy Systems (KVM013)

Exercises

The main part of the exercises is dedicated to the project assignment , that will be conducted in groups of 3 persons. The exercises will be given either in digital form (with remote access to the software needed), or at campus. There will be supervisors present, to give the opportunity to go through the different items in the assignment under supervision (there are in total 20 scheduled, mostly 4 hour exercises). More information on the links needed will be provided during the course in due time.

The project starts with an overall planning to set up the flowchart for the process, followed by general material and heat balance calculations. Then the process equipment, including reactor and separation units, will be designed, with more thorough analysis in the case of some separation equipment, the reactor and heat exchangers. The energy and utility systems will also be analyzed, and finally the operational and investment costs will be calculated.
The presentation of the assignment will be both as a written report, and orally at a seminar. At the seminar each group will present a group assignment, treating some aspect of the process more deeply.

Suggested schedule for the project assignment in PPD 2020

	Item	**Date**	**Main supervisors**	**Room**
1	HYSYS / Process simulation*	Thu 2/9 10-11.45	CE	Zoom
2	Material balances	Thu 2/9 13.15-17	CE	Zoom
3	Condenser, Absorption and Extraction	Mon 6/9 8-11.45	CE	Zoom
4	Distillation columns	Wed 8/9 8-11.45	CE	Zoom
5	Reactor & Process closure	Thu 9/9 13.15-17	CE	KD2
6	Energy system analysis	Mon 13/9 8-11.45	ET	Zoom
7	Self study time	Wed 15/9 8-11.45	(CE,ET)	Zoom
8	Process Modification	Thu 16/9 13.15-17	ET	KD2
9	Heat exchanger network: design and cost estimation	Mon 20/9 8-11.45	ET	Zoom
10	Chemistry of hot utility system	Thu 23/9 10-11.45	ET	Zoom
11	Design of hot utility system	Thu 23/9 13.15-17	ET	KD2
12	Production and Capital cost	Fri 24/9 15.15-17	CE	Zoom
13	Costs cont. Introduction of group assignments	Mon 27/9 8-11.45	CE	Zoom
14	Summary / Analysis	Thu 30/9 10-11.45	CE	Zoom
15	Summary / Analysis, Group assignments	Fri 1/10 15.15-17	CE,ET	Zoom
16	Group assignments	Mon 4/10 8-11.45	CE,ET	Zoom
17	Group assignments	Wed 6/10 13.15-17	CE,ET	KD2
18	Group assignments	Thu 7/10 13.15-17	*CE,ET*	KD2
19	Group assignments	Mon 11/10 8-11.45	*CE,ET*	Zoom
20	Group assignments	Thu 14/10 13.15-17	*CE,ET*	KD2
21	Seminar	Thu 21/10 13.15-17	*CE,ET*	KD2