

COURSE MEMO

Course: Preliminary Plant Design (7,5HEC) KBT156

Academic year: 2020/2021 Study period 1

Msc. Program: Innovative and Sustainable Chemical Engineering

Examiner and Course tutor:

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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. 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 Cremona.

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 30 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
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	Mats Lindgren	(IPS)	
	Sven Andersson	(Babcock & Wilcox Völund)	

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COURSE OUTLINE

Lectures

Due to Covid-19, all lectures will be given digitally in Zoom. The links will be provided in due time before each lecture. More information on this will be given later.

	Topic	Date	Lecturer	Room
1	Introduction Flowsheeting, Material balances Short cut distillation	Mon 31/8 13.15-15	Gunnar Eriksson, CE	Zoom
2	Process Safety	Thu 3/9 8-9.45	Mats Lindgren, IPS	Zoom
3	Reactor design in practice	Mon 7/9 13.15-15	Derek Creaser, CE	Zoom
4	Choice of separation methods	Thu 10/9 8-9.45	Tuve Mattsson, CE	Zoom
5	Repetition of the basics of heat integration*	Fri 11/9 15.15-17	Stavros Papadokonstantakis, ET	Zoom
6	The Role of Heat Integration in Process Synthesis and Optimisation	Mon 14/9 13.15-15	Stavros Papadokonstantakis, ET	Zoom
7	Heat and power utility systems in process industry	Thu 17/9 8-9.45	Stavros Papadokonstantakis, ET	Zoom
8	Economy	Mon 21/9 13.15-15	Gunnar Eriksson, CE	Zoom
9	Advanced Process Integration in Process Synthesis and Optimisation	Thu 24/9 8-9.45	Stavros Papadokonstantakis, ET	Zoom
10	Plant layout & Scale up	Mon 28/9 13.15-15	Gunnar Eriksson, CE, Sven Andersson	Zoom
11	Process control	Thu 1/10 8-9.45	Derek Creaser, CE	Zoom

Comments:

*) Lecture 5 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. The exercises will also be digital, with remote access to the software needed. There will be supervisors present at these Zoom meetings, 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 3/9 10-11.45	CE	Zoom
2	Material balances	Thu 3/9 13.15-17	CE	Zoom
3	Condenser, Absorption and Extraction	Mon 7/9 8-11.45	CE	Zoom
4	Distillation columns	Wed 9/9 8-11.45	CE	Zoom
5	Reactor & Process closure	Thu 10/9 13.15-17	CE	Zoom
6	Energy system analysis	Mon 14/9 8-11.45	ET	Zoom
7	Self study time	Wed 16/9 8-11.45	(CE,ET)	Zoom
8	Process Modification	Thu 17/9 13.15-17	ET	Zoom
9	Heat exchanger network: design and cost estimation	Mon 21/9 8-11.45	ET	Zoom
10	Chemistry of hot utility system	Thu 24/9 10-11.45	ET	Zoom
11	Design of hot utility system	Thu 24/9 13.15-17	ET	Zoom
12	Production and Capital cost	Fri 25/9 15.15-17	CE	Zoom
13	Costs cont. Introduction of group assignments	Mon 28/9 8-11.45	CE	Zoom
14	Summary / Analysis	Thu 1/10 10-11.45	CE	Zoom
15	Summary / Analysis, Group assignments	Fri 2/10 15.15-17	CE,ET	Zoom
16	Group assignments	Mon 5/10 8-11.45	CE,ET	Zoom
17	Group assignments	Wed 7/10 13.15-17	CE,ET	Zoom
18	Group assignments	Thu 8/10 13.15-17	CE,ET	Zoom
19	Group assignments	Mon 12/10 8-11.45	CE,ET	Zoom
20	Group assignments	Thu 15/10 13.15-17	CE,ET	Zoom
21	Seminar	Thu 22/10 13.15-17	CE,ET	Zoom

Comments:

*) Exercise 1 is primarily intended for students who have not used HYSYS before, e.g. in the course Advanced Separation Technology (KAA102), but all are welcome.