



COURSE: **CHEMICAL PLANTS FOR THE ENERGY INDUSTRY**

ACADEMIC YEAR: 2019/20

TYPE OF EDUCATIONAL ACTIVITY: Characterising

TEACHER: Mario Iamarino

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mobile (optional): *n.a.*

Language: Italian

ECTS: 9

n. of hours: 81

Campus: Potenza

Semester: II

distributed as follows:

6 ECTS theory

3 ECTS exercise

distributed as follows:

48 h theory

33 h exercise

School: Engineering

Programme: Mechanical

Engineering (Master's degree)

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

Knowledge and understanding

Main objective is the acquisition of notions and tools to understand chemical processes and plants recurring in the energy industry. To this goal, a first overview of fundamental concepts in chemical engineering will be given (chemical thermodynamics, kinetics and mass transfer phenomena in reacting systems, ideal chemical reactors, catalysts and multi-phase reacting systems). This will be followed by applications, namely combustion science and technology (chemical and thermodynamic aspects, pollutant formation, laminar and turbulent flames, autoignition, deflagration and detonation), distillation columns and chemical processes for hydrogen production and CO₂ capture. To complement the theory, a quantitative approach will be pursued in dedicated sessions, through the implementation of mass and energy balances, the dimensioning and design of simple units, the optimization and integration of more complex schemes, the dynamic simulation of chemical processes by means of commercial software.

Applying knowledge and understanding

Capacity of abstraction will be stimulated in order for the student to be as much as possible autonomous when applying the proposed tools and method, even to cases and contexts different, to a reasonable extent, from those presented in the classes. To this goal, the exercise sessions will help verifying the capacity to apply the acquired knowledge. In such occasions, students will afford quantitative and design problems relevant to chemical processes and plants, in a more and more autonomous way. Students will be also stimulated to solve exercises in autonomy outside the class hours, and to discuss the results afterwards with teacher and other students.

Making judgement

At the end of the course, the student is supposed to be able to evaluate and compare in autonomy the different plant and process solutions considered, to highlight their pros and cons, to judge their suitability to different industrial contexts and practice and to identify acceptable operating conditions for such units. In this way, the student is encouraged to elaborate autonomously the concepts provided during the lessons, and to use the acquired knowledge as a basis to reach further conclusions and judgements.

Communication skills

During each lesson, the student is encouraged to interact with the teacher and to discuss with him about the concepts at hand. This will strengthen his ability to use the correct technical language commonly used in the



chemical industry sector, both at national and international level, and will improve his communication skills. To this goal, extracts from highly specialized books written in English and international scientific publications will be also used. The ultimate goal is to make the student aware of the technical jargon and confident to communicate technical topics, in a clear and unambiguous way, to a both specialized and non-specialized audience.

Learning skills

The student is encouraged to investigate further and in full autonomy any topics of major interest, including the consultation of additional specialized books, specialized internet sites, publications, etc.

PRE-REQUIREMENTS

Students are required to have basic knowledge of chemistry and applied physics concepts concerning chemical equilibria, stoichiometry, multi-phase systems, thermodynamics principles, heat exchange.

CONTENT

Chemical engineering fundamentals (16 h)

Thermodynamic principles. Chemical kinetics. Multi-phase equilibria and equilibria in reacting systems. Mass transport phenomena in reacting systems. Mass and energy balances in reacting systems. Ideal chemical reactors and multi-reactor systems. Catalysts and gas-solid systems. Kinetics and mass transfer control.

Industrial applications (32 h)

Principal unit operations in the process industry, with focus on the energy industry. Distillation columns. Chemical processes for hydrogen production. Technologies for carbon capture. Thermodynamics and kinetics of combustion reactions. Premixed and non-premixed flames. Autoignition. Pollutants formation and main abatement technologies.

Exercise sessions (33 h)

Exercise sessions will be distributed along the entire course, for topics that require a quantitative or design approach. Selected processes will be simulated using commercial software.

TEACHING METHODS

Course duration is 81 hours (48 hours theory and 33 hours exercise sessions).

EVALUATION METHODS

Written + Oral exam

The written part consists of numerical exercises on topics which require a quantitative or design approach, consistently with what was done during the exercise sessions. It takes 3 hours.

The oral part will take place a few days later and only students who have passed the written part will be admitted.

The final outcome of the exam will depend on both the written and oral part.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Material provided during classes

Himmelblau – Basic principles of Chemical Engineering, ed. Prentice Hall

Smith, van Ness, Abbott – Introduction to Chemical Engineering Thermodynamics, ed. McGraw-Hill

Levenspiel – Chemical Reaction Engineering, ed. Wiley



INTERACTION WITH STUDENTS

Useful information and material will be distributed to the students during the classes.

The lecturer is available to meet students in his office each Wednesday between 13:00 and 15:00 (5th floor, Engineering building, room 22) and can be reached via email anytime.

EXAMINATION SESSIONS (TENTATIVE)¹

24/6/20, 22/7/20, 9/9/20, 18/11/20, 3/3/2021, 5/5/2021

SEMINARS BY EXTERNAL EXPERTS YES NO

FURTHER INFORMATION

¹ Subject to possible changes: check the web site of the Teacher or the Department/School for updates.