ETY608 – Design of Chemical Industries and Processes

COURSE OUTLINE

(1) GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">SCHOOL OF ENGINEERING</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">UNDERGRADUATE</td></tr>
<tr><td>COURSE CODE</td><td>ETY608</td><td>SEMESTER</td><td>6</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Design of Chemical Industries and Processes</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures and laboratories</td><td>6</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organization of teaching and the teaching methods used are described in detail at (d).</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialized general knowledge, skills development</td><td colspan="3">General background</td></tr>
<tr><td>PREREQUISITE COURSES:</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">NO</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3">http://medlab.cs.uoi.gr/lessons/process_design/</td></tr>
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(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Knowledge: Design of Chemical Industries and Processes is one of the most important core courses in Chemical Engineering Departments all over the world. Design is the product of basic knowledge composition of Chemical Engineering, which ultimately leads to solutions that are complete and that are technically and economically acceptable. In our department, the course has been adapted to the knowledge and needs of the Materials Science Engineer and includes the principles, phases and design procedures with examples and specific solutions. These include topics related to flow charts, mathematical standards and models, technical and economic optimization, and economic and technical approaches. Upon completion of this course, the student will be able to translate what he/she learns in the laboratory into technically and economically efficient solutions that ultimately translate into industrial production.

The course includes the following sections:

- General design principles.
- System selection and configuration.

- Principles of completion.
- Installation safety.
- Calculation of critical parameters (performance, cost).
- Development of integrated solutions.
- Economic and technical approaches.

Teaching is conducted through the presentation of theoretical sections, workshops, and realistic engineering problems in practice.

Skills: After successfully completing the course and the implementation of the workshops, the student will have the following skills:

- Use of industry and process design methods
- Use of computer design tools
- Project Management
- Dimensioning of chemical plants
- Implementation of technical and economic studies.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
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Others…
…….

- Autonomous work
- Teamwork
- Project design and management
- Search, analyze and synthesize data and information, using the necessary technologies
- Work in an interdisciplinary environment

(3) SYLLABUS

- Mass and Energy Balances
- Design Options-Evaluation
- Chemical Reactors-Selection and evaluation
- Separation-Processes-Selection and evaluation
- Reaction-separation-Recycling streams
- Removal streams-Calculations
- Process safety and security
- Feasibility Study-Selection of production methodology, installation site and equipment.
- Facility options-Completed solutions
- Distillation options-Completed solutions
- Chemical reactor options-Completed solutions
- Finalization of a production unit

Laboratory content:

- Introduction to the chemical industry simulation software and DWSIM processes.
- Implementation of a flow-gas separation diagram in liquid-steam and pressure enhancement.
- Implementation of fluid flow diagram and quantitative separation.
- Implementation of a flow diagram for gas recycling in an industrial unit.
- Implement a flow chart for fluid cooling and quantity separation.
- Implementation of a flow diagram for the production of ethyl chloride.

Through the above laboratory exercises, students will become familiar (in practice) with the following units that are widely available in the chemical industry and processes:

- Separator vessel
- Mixer

• Splitter • Valve • Recycle • Cooler • Conversion reactor

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Advanced software for the design of chemical industries and processes (DWSIM – Open source chemical process simulator)
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	LANGUAGE OF EVALUATION: Greek METHOD OF EVALUATION: i. 2-hour written midterm exam (50%) that includes 5 problems that students should answer. ii. Written final exam lasting 2 hours (50%) which includes 5 problems that students should answer.

Activity	***Semester workload***
Lectures	52
laboratories	26
Homework	52
Unsupervised student work, preparation for final exams	20
Course total	150

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

- D. Marinos-Kouris, Z. Maroulis, Design of Chemical Industries, Papasotiriou 1993.
- M.S. Peters, K.D. Timmerhaus, R.E. West, Plant Design and Economics for Chemical Engineers, McGraw-Hill Education; 5 edition (December 9, 2002).
- G. Towler, R. K. Sinnott, Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, Butterworth-Heinemann; 2nd edition, 2012
- R.Turton, R.Bailie, W.B. Whiting and J. Shaeiwitz, Analysis, Synthesis and Design of Chemical Processes, 4th Edition, Prentice Hall International Series 2012.
- J. Douglas, Conceptual Design of Chemical Processes, McGraw-Hill, 1988.
- R. Smith, Chemical Process Design and Integration, Wiley, 2005.
- L.T. Biegler, I. Grossman, A. Westerberg, Systematic Methods of Chemical Process Design, Prentice Hall, 2004.
- W.D. Seider, J.D. Seader, J.D., D.R. Lewin, S. Widagdo, Product and Process Design Principles, Wiley, 2010.

Related scientific journals:

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