COURSE OUTLINE

## (1) OVERVIEW

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|---|---|---|---|
| SCHOOL | MARITIME & INDUSTRY | | |
| DEPARTMENT | INDUSTRIAL MANAGEMENT & TECHNOLOGY | | |
| LEVEL OF STUDIES | UNDERGRADUATE | | |
| COURSE CODE | ΤΕΠΑΡ05 | SEMESTER | 2 |
| COURSE TITLE | INDUSTRIAL PROCESEES | | |

| DISCRETE TEACHING ACTIVITIES<br>*In cases where ECTS credits are awarded to distinct components of the course (e.g., Lectures, Laboratory Exercises, etc.), please indicate them separately. If the credits are awarded as a whole for the entire course, please state the weekly teaching hours and the total number of credits* | WEEKLY TEACHING HOURS | ECTS |
|---|---|---|
| Lectures & Laboratory | 4+2 | 5.5 |
| | | |
| | | |
| *Please add additional rows if needed. A detailed description of the teaching organization and instructional methods is provided in Section (4).* | | |

| | |
|---|---|
| COURSE TYPE<br>*core (C), core elective (CE), elective (E) - background, specialization, skill development* | C - Specialization |
| PREREQUISITE COURSES: | None. |
| LANGUAGE OF TEACHING AND EXAMINATIONS: | Greek (English for ERASMUS students) |
| THIS COURSE IS AVAILABLE TO ERASMUS STUDENTS | Yes |
| COURSE WEBPAGE (URL) | |

## (2) LEARNING OUTCOMES

**Learning Outcomes**

*The learning outcomes of the course are described, specifying the particular knowledge, skills, and competencies at the appropriate level that students will acquire upon successful completion of the course.*

*Please refer to Appendix A*

- *Description of the Level of Learning Outcomes for each study cycle according to the Qualifications Framework of the European Higher Education Area.*
- *Descriptive Indicators of Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B.*
- *Concise Guide for Writing Learning Outcomes*

The course focuses on the analytical and systematic understanding of the operation of complex production systems, aiming to strengthen students' ability to analyze, evaluate, and optimize industrial processes using techno-economic and environmental criteria. Specifically, students will become familiar with:

- Analyzing the dynamics and stability of complex industrial systems and processes
- Using computational tools to assess variable operating conditions and predict critical points
- Estimating the optimal capacity and efficiency of industrial units
- Evaluating scale-up scenarios from laboratory to pilot and then to industrial scale
- Investigating combined processes involving various technologies and subsystems (e.g., recycling, energy recovery, raw material substitution)
- Analyzing the relationship between process conditions and product quality
- Studying the integration of green technologies and energy-saving solutions
- Understanding the interconnection of production, energy, and environment through case studies

The course incorporates laboratory and computational applications, utilizing digital tools for simulation and decision support in industrial operations.

Upon successful completion of the course, students will be able to:

- Apply computational tools to complex and dynamic production scenarios.
- Use simulation software for the analysis and optimization of production units.
- Design and assess alternative resource and energy flow management strategies.

- Identify and propose improvements to production subsystems, based on technical and economic criteria.
- Approach the production process as a system under constraints, including energy, environmental impact, capacity, and quality.

**General Competences**

*Taking into account the general competences that a graduate should have acquired (as listed in the Diploma Supplement and outlined below), which of these competences does the course aim to develop?*

| | |
|---|---|
| *Searching, analyzing, and synthesizing data and information, using the necessary technologies* | *Project design and management* |
| *Adaptation to new situations* | *Respect for diversity and multiculturalism* |
| *Decision making* | *Respect for the natural environment* |
| *Autonomous work* | *Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues* |
| *Teamwork* | *Exercising critical and self-critical thinking* |
| *Working in an international environment* | *Promotion of free, creative, and inductive thinking* |
| *Working in an interdisciplinary environment* | *…* |
| *Generation of new research ideas* | *Other competences: …* |

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adaptation to new situations
- Decision making
- Autonomous work
- Teamwork
- Respect for diversity and multiculturalism
- Respect for the natural environment
- Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
- Exercising critical and self-critical thinking

## (3) COURSE CONTENT

The course consists of two components: the theoretical component (lectures) and the laboratory component.

- Basic chemical processes, their synthesis into flow diagrams of the production process of representative industrial units, and their simulation.
- Scale-up of industrial processes from laboratory to medium and large industrial scale.
- Economies of scale and external economies in cases of combining industrial processes.
- Material and energy balances under steady and unsteady state conditions.
- Biochemical processes for environmental protection. Subsystems for material savings through recycling.
- Energy-saving systems and substitution of conventional energy forms with renewable energy sources.
- Dynamic process systems for the production process, stability, sensitivity, risk, combination and control of industrial processes, new technologies, optimization of process systems using technical and economic criteria.
- Impact of production conditions on the quality of intermediate and final products.
- Simulation & optimization of an integrated environmental protection system (river/lake). Methods for determining the optimal plant capacity.
- Computational simulation of batch reactors.
- Computational simulation of continuous-flow stirred-tank reactors (CFSTR).
- Computational simulation of plug flow reactors (PFR).
- Review exercises

Students are trained in the simulation and optimization of processes using physical simulators, at the Laboratory of Simulation of Industrial Processes. Participation in the laboratory is carried out on a rotating schedule. The laboratory schedule is posted on the course website and on eClass at the beginning of the semester. The laboratory schedule is listed below:

| Week | Laboratory Sessions |
|---|---|
| 1, 5, 9 | Study of Continuous Stirred Tank Reactor (CFSTR). Techno-economic Optimization of Homogeneous Reactor Systems |
| 2, 6, 10 | Optimization of Adsorption Column |

| | |
|---|---|
| 3, 7, 11 | Optimization of Batch Reactor for Biomass Utilization |
| 4, 8, 12 | Study of Plug Flow Reactor (PFR). Application in Wastewater Treatment |
| 13 | Rescheduling of missed laboratory sessions |

Furthermore, articles, audiovisual lecture material, web links to useful resources, exercises, and software are uploaded in electronic format on the eClass platform.

## (4) TEACHING and LEARNING METHODS - ASSESSMENT

| | |
|---|---|
| TEACHING MODE<br>*Face-to-face, in-class lecturing, distance teaching and distance learning etc.* | • Face-to-face in a classroom or the Lab<br>• Distance teaching & learning (if required) |
| USE OF INFORMATION AND COMMUNICATION TECHNOLOGY<br>*Use of ICT in Teaching, Laboratory Education, Communication with students* | **Teaching**: Lectures using modern audiovisual equipment, learning support through the eClass electronic platform, synchronous distance teaching via MS Teams.<br>**Laboratory**: use of open-source software for data processing, along with specialized software developed specifically for the needs of the Laboratory<br>**Communication with students**: face-to-face during office hours, email, eClass platform, MS Teams tools |
| Organization of Teaching<br>*A detailed description of the teaching methods and approach is provided.*<br>*Lectures, seminars, laboratory exercises, fieldwork, study and analysis of literature, tutorials, internships (placements), clinical practice, artistic workshops, interactive teaching, educational visits, project work, writing assignments, artistic creation, etc.*<br>*The student's study hours for each learning activity, as well as the hours of independent study, are specified in accordance with the principles of ECTS* | see table below |
| STUDENT ASSESSMENT<br>*Description of the assessment process*<br>*Language of assessment, assessment methods, formative or summative evaluation, multiple-choice tests, short-answer questions, essay questions, problem-solving, written assignments, reports, oral examinations, public presentations, laboratory work, clinical patient examination, artistic interpretation, other(s)*<br>*Explicitly state assessment criteria and information on whether and where these criteria are accessible to students are included.* | **Language of Assessment**: Greek (English for ERASMUS students)<br>**Assessment Mode**: Face-to-face and/or distance learning (if required)<br>**Assessment Methods**: The final grade for the course is determined as follows:<br>• 60% based on the written examination during the spring semester exam period, and in case of failure, during the September resits.<br>• 40% based on participation in the Laboratory and the completion of the project.<br>Students from previous academic years are graded 100% based on the written exam grade.<br>The written exam includes problem-solving exercises and it is conducted as an open-book exam.<br>**Students with Learning Difficulties**: Students with certified learning difficulties in reading and writing (as recognized by the competent authority) are assessed according to the procedures established by the Department.<br>**Disclosure of Assessment Criteria**: The assessment criteria are communicated during the first class and are clearly stated on the course website and the eClass platform. The exam syllabus is announced on eClass following the final lecture of the semester. The exam answers are posted on eClass after the examinations take place. Students have the right to review their graded exams and receive explanations regarding their grades. In cases of further requests, the procedures outlined in the current Study Regulations apply. |

| Activity | Semester Workload |
|---|---|
| Lectures | 52 |
| Laboratory sessions | 8 |
| Lab Reports | 30 |
| Self-study of lecture and Laboratory material | 45 |
| Consultation Support | 0.5 |
| Exams (written) | 2 |
| Course Total | **137.5** |

## (5) SUGGESTED BIBLIOGRAPHY

*- Books:*

- Sidiras, D. (2023). Industrial Chemical Processes, DaVinci Publications, ISBN -13: 9789609732543 [143547386] – in Greek

*- Journals:*

*- Other educational material:*

- Lecture Notes and Supporting Material provided by the Instructor
- Laboratory Workbook