COURSE OUTLINE

(1) OVERVIEW

SCHOOL	MARITIME & INDUSTRY		
DEPARTMENT	INDUSTRIAL MANAGEMENT & TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ΤΕΠΑΡ02-1	SEMESTER	4
COURSE TITLE	TECHNOLOGIES & INNOVATION IN CHEMICAL PRODUCTION		

DISCRETE TEACHING ACTIVITIES *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, Project	4	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 *core (C), core elective (CE), elective (E) - background, specialization, skill development*	E - 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 aims to explore modern technologies and forms of innovation that significantly influence the structure, efficiency, and sustainability of industrial chemical production processes. It focuses on the transformation of traditional manufacturing through the adoption of advanced technological solutions (e.g., biotechnological applications, green chemistry), as well as the integration of innovation into the production of high value-added products (e.g., pharmaceuticals, petrochemicals, polymers, biopolymers, etc.). The course covers:

- New technologies for material production and conversion (e.g., catalytic processes, low-energy processes, bioprocesses).
- Recycling and reuse technologies for raw materials and by-products within circular production models.
- Adaptation of production systems to sustainability requirements and regulatory compliance, with an emphasis on green and low-footprint processes.

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

- Analyze the role of technological choices in designing sustainable and efficient production processes in the chemical industry.
- Understand the mechanisms of transition from traditional to innovative production systems.
- Design production flows that incorporate cutting-edge technologies (e.g., bioprocesses, green processes) aiming at the creation of high value-added products.
- Apply computational tools and models for the analysis and optimization of chemical production process parameters.
- Evaluate technological transformation scenarios using simulations and techno-economic modeling, taking into

account technical, environmental, and economic criteria.

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
- Project design and management
- 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
- Promotion of free, creative, and inductive thinking

(3) COURSE CONTENT

The course covers the following topics:

Week	Topics
1	Coal technology. Petroleum technology. Innovative technologies. Catalysts.
2	Petrochemical technology. Polymer technology. Case study: Innovative technologies in polymer technology.
3	Refineries. Fuel production. Case study: Innovative technologies for co-production and utilization of products and by-products. Special applications of hydrocracking and petroleum desulfurization.
4	Innovative technologies and special applications of petroleum desulfurization.
5	Textile industry: raw materials, production methods, product quality. Paint industry: raw materials, production methods, product quality. Case study: Impact of raw materials on the quality of the final product. Innovative technologies.
6	Explosives production: production methods. Innovative production methods.
7	Pharmaceutical industry. Case study: Formulation of medicinal products with combinations of active ingredients and complex dosage forms – the problem of mixing. Production of active substances. Case studies: analgesics, antibiotics, antivirals. Innovative technologies.
8	Industry of dyes, fragrances, and preservatives. Computational topics: Production of chloroform, aniline, and benzaldehyde. Innovative dye production technologies.
9	Fats, oils, and soap industry: traditional and modern technology. Saponification: product separation and glycerin content in the final product. Innovative technologies for vertically integrated industrial production of soaps and detergents.
10	Hydrogenation of fatty substances and margarine production. Co-production and utilization of products and by-products. Case study: Cost minimization of co-production in an industrial unit producing hydrogenated fats and soaps. Innovative technologies.
11	Horizontal integration: wine, vinegar, and aldehyde production. Sugar industry. Case study: Quantitative composition of waste and by-products in sugar production. Innovative technologies.

12	Production of wines and alcoholic beverages. Quality of spirits, acidity, and control of volatile compounds. Computational topics: Effect of raw materials on wine quality. Innovative design techniques in the food industry.
13	Review topics

The course includes lectures and the completion of a project. 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 *Face-to-face, in-class lecturing, distance teaching and distance learning etc.*	• Face-to-face in a classroom • Distance teaching & learning (if required)
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *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. **Communication with students**: face-to-face during office hours, email, eClass platform, MS Teams tools
Organization of Teaching *A detailed description of the teaching methods and approach is provided.* *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.* *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*	

Activity	Semester Workload
Lectures	52
Project	26
Self-study of lecture material	57
Consultation Support	0.5
Exams (written)	2
Course Total	137.5

STUDENT ASSESSMENT *Description of the assessment process* *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)* *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) **Assessment Mode**: Face-to-face and/or distance learning (if required) **Assessment Methods**: The final grade of the course is determined as follows: • 60% by the written exams during the spring semester examination period and, in case of failure, during the September resits • 40% from the project During the September resits, students are graded 100% based on the written examination. The written exam includes problem-solving exercises and it is conducted with open books. **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. **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.

(5) SUGGESTED BIBLIOGRAPHY

- Books:

- Pegiadou-Koemtzopoulou, S., Tsatsaroni, E., Eleftheriadis, I. (2009). Industrial Organic Chemistry, Gartaganis Publications, ISBN: 9789609828888 [1945] – in Greek

- Karvounis, S. (2017). Technology Systems Analysis and Industrial Processing Sectors, Varvarigou Publications, ISBN: 9789607996640 [68398900] – in Greek

- Journals:

- Biomass and Bioenergy
- Industrial Crops and Products
- International Journal of Oil, Gas and Coal Technology
- Journal of Cleaner Production
- Journal of Drug Development

- Other educational material:

- Lecture Notes and Supporting Material provided by the Instructor