COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Sciences		
DEPARTMENT	Department of Chemistry		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	EN29	**SEMESTER**	7 or 8
COURSE TITLE	Petroleum and Natural Gas Chemistry and Technology		

TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
-	3	3
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.	-	-

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Specific Area
PREREQUISITES:	No
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	No
COURSE URL:	https://chem.duth.gr/en/courses/chemical-process-modelling-and-simulation

(2) LEARNING OUTCOMES

Learning Outcomes
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

After the successful completion of the course, participants will be able to:

- Demonstrate advanced knowledge in the field of hydrocarbon chemistry and technology.
- Possess advanced cognitive and practical skills for solving complex and unpredictable problems in the oil and gas industry.
- Apply complex techniques and methodologies for decision-making in highly demanding industrial environments.

Knowledge

- Understand the operation of crude oil distillation units (atmospheric and vacuum), hydro-treatment units for intermediate straight-run fractions, stabilisation and reforming units, fluid catalytic cracking (FCC) units, and units for producing high-octane gasoline components (isomerisation, alkylation, and polymerisation units), blending units for final product formulation, as well as auxiliary refinery units.
- Understand the reactions and reaction mechanisms governing the operation of the above-mentioned units.

Skills

- Control the composition, quality, properties, and specifications of crude oil and natural gas from extraction through processing.
- Evaluate and classify crude oils and natural gases according to their properties.
- Operate and handle specialized laboratory equipment.
- Interpret data and information from physical properties and chemical analyses of intermediate and final process samples.
- Determine and assess the combustion quality characteristics of natural gas.
- Distinguish gas networks, operating conditions, and the transmission and distribution systems of natural gas.

Abilities

- Supervise and manage the operation of primary and secondary crude oil and natural gas processing units.
- Manage units that directly or indirectly utilize crude oil and/or natural gas.
- Make decisions in complex problems related to natural gas transmission and distribution.
- Select appropriate instruments, analytical techniques, or combinations of methods for sample analysis, taking into account cost and measurement effectiveness.

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,
ICT Use
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project design and management
Equity and Inclusion
Respect for the natural environment
Sustainability
Demonstration of social, professional and moral responsibility and sensitivity to gender issues
Critical thinking
Promoting free, creative and inductive reasoning

The general skills that participants will have acquired upon successful completion of the module are:

- Search, analysis and synthesis of data and information, ICT use
- Adaptation to new situations
- Decision making
- Autonomous work
- Teamwork
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Project design and management
- Respect for the natural environment
- Sustainability
- Critical thinking
- Promoting free, creative and inductive reasoning

(3) COURSE CONTENT

THEORY

- Reserves and Availability of Non-Renewable Energy Sources. Global Production and Consumption. Petroleum Resources Management System (PRMS).
- Petroleum Chemistry. Composition, Classification, and Evaluation of Crude Oil.
- Properties of Crude Oil: Density, relative density, API gravity, distillation characteristics, viscosity, flash point, fire point, carbon residue, surface and interfacial tension, refractive index, aniline point.
- Crude Oil Distillation Processes: Atmospheric and vacuum distillation.
- Hydro-treatment and Hydro-refining Processes. Reaction mechanisms and reactions.
- Cracking Processes: Thermal cracking, catalytic cracking (TCC, Houdry flow, flexicracking, FCC), hydrocracking. Reaction mechanisms and reactions.
- Reforming Processes: Semi-regenerative (UOP, Rheniforming, Magnaforming), cyclic (Powerforming, Ultraforming), and continuous regeneration processes. Reactions and reaction mechanisms.
- Alkylation Processes (sulfuric acid, hydrofluoric acid, and complex catalysts) and Isomerisation Processes (n-C4 and C5/C6 hydrocarbons). Reaction mechanisms and reactions.
- Natural Gas Chemistry and Gaseous Fuels (from biological, thermal, and chemical processes). Composition, classification, and evaluation of natural gas and gaseous fuels.
- Properties of Natural Gas: Density, relative density, concentration, specific volume, critical points, viscosity, specific heat capacity, compressibility factor, thermal conductivity, Prandtl number, vapour pressure, surface tension of liquefied natural gas, entropy, heating value, Wobbe index. Comparison of natural gas with other gaseous fuels.
- Combustion of Natural Gas: Stoichiometric combustion parameters (required air quantity, flue gas composition, determination of excess air coefficient), Ostwald combustion triangle.
- Types, characteristics, and operating conditions of natural gas transmission and distribution networks.

(4) LEARNING & TEACHING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD
Face to face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)
Use of ICT in Teaching, in Laboratory Education, in Communication with students</td><td>Use ICT in teaching and in communication with students:
Digital slides
Scientific simulators
Videos
MS Teams / eclass, webmail</td></tr>
<tr><td>TEACHING ORGANIZATION
The ways and methods of teaching are described in detail.
Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning,</td><td>
<table>
<tr><th>Activity</th><th>Workload/semester</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Interactive learning</td><td>30</td></tr>
<tr><td>Bibliographic research and analysis</td><td>21</td></tr>
<tr><td>Total</td><td>90</td></tr>
</table>
</td></tr>
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Study visits, Study / creation, project, creation, project. Etc. *The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.*	
STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others* *Please indicate all relevant information about the course assessment and how students are informed*	Student assessment is conducted through a written examination. The final written examination includes multiple-choice questions, short-answer questions, critical thinking questions, matching exercises, true/false questions, and problem-solving tasks carried out both in written form and in silico. The language of assessment is Greek. The evaluation criteria are communicated from the beginning of the course and are accessible to students via eclass.

(5) SUGGESTED BIBLIOGRAPHY

- Recommended bibliography:

1. Χημεία και Τεχνολογία Πετρελαίου, Ν. Α. Νικολάου, 2η Έκδοση, 2009, ISBN: 978-960-931336-0.
2. Τεχνολογία Φυσικού Αερίου, Δ. Γ. Παπανίκας, 2η Έκδοση, 2007, ISBN: 978-960-88598-1-4.
3. The Chemistry and Technology of Petroleum, J. G. Speight, 5th Edition, 2014, ISBN: 9781439873892.

- Relevant scientific journals:

1. Petroleum Science and Technology, Taylor and Francis Group.
2. Petroleum Chemistry, Springer.
3. Journal of Natural Gas Chemistry, Elsevier.