MODULE OUTLINE

1. GENERAL INFORMATION

SCHOOL	School of Science and Technology			
PROGRAM COURSE	Environmental Catalysis for Pollution Abatement and Clean Energy Production MSc			
LEVEL OF STUDY	Post-graduate			
MODULE CODE	KPPB81	**YEAR OF STUDY**	2nd	
MODULE TITLE	Clean Energy Production			
INDEPENDENT TEACHING ACTIVITIES *in case credits are awarded for separate components/parts of the course, e.g. in lectures, laboratory exercises, etc. If credits are awarded for the entire course, give the weekly teaching hours and the total credits*			**HOURS**	**CREDIS**
Hours per week: 17-18 hours x 32 weeks			520	20 ECTS
MODULE TYPE Compulsory, Optional, Optional mandatory	Compulsory			
PREREQUISITE MODULES:	-			
LANGUAGE OF INSTRUCTION AND EXAMS	GREEK			
THE MODULE IS OFFERED TO ERASMUS STUDENTS	No (due to annual duration of the module)			
MODULE WEBSITE (URL)	https://www.eap.gr/en/environmental-catalysis-for-pollution-and-clean-energy-production/topics/#k81 Each module has its own space in the Learning Management System of EAP, with controlled access (use of code) for students and teaching staff. https://study.eap.gr/course/view.php?id=395			

2. LEARNING OUTCOMES

Learning Outcomes

- *The course learning outcomes, specific knowledge, skills and competences of an appropriate (certain) level, which students will acquire upon successful completion of the course, are described in detail. It is necessary to consult:*

After completing this module, the student should be able to:

- Describe the basics of the operation of a petroleum refinery and state the main products.
- Describe the chemistry, operational conditions and required characteristics of catalysts used in the main catalytic processes of a petroleum refinery (reforming, isomerization, catalytic pyrolysis and hydrotreatment).
- Discuss the importance of biofuels for the sustainable growth.
- Describe the production processes of the main biofuels (bioethanol, biodiesel, renewable diesel, biogas, liquid synthetic fuels from gasification of lignocellulosic biomass, liquid biofuels from liquefaction / pyrolysis of lignocellulosic biomass, biofuels from microalgae,

and biohydrogen) and discuss their role in the environmental protection.
- Propose suitable catalysts for biofuels production processes.
- Explain the necessity of introducing hydrogen to the energy mix and state the relevant problems which are currently opposing the hydrogen economy.
- Describe the chemistry, operational conditions and catalyst requirements for the catalytic processes used for the production of hydrogen from hydrocarbons (steam or CO_2 reforming, catalytic partial oxidation and autothermal reforming).
- Describe processes for the production of hydrogen which are based on the electrolytic, thermochemical or photocatalytic decomposition of water.

General Competences

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and information by the use of appropriate technologies,
Adapting to new situations
Decision-making
Individual/Independent work
Group/Team work
Working in an international environment
Working in an interdisciplinary environment
Introduction of innovative research
Project planning and management
Respect for diversity and multiculturalism
Environmental awareness
Social, professional and ethical responsibility and sensitivity to gender issues
Critical thinking
Development of free, creative and inductive thinking
……
(Other…….citizenship, spiritual freedom, social awareness, altruism etc.) …….

After completing this module, students must have acquired the following general skills:
- Search for, analysis and synthesis of data and information by the use of appropriate technologies,
- Adapting to new situations
- Decision-making
- Individual/Independent work
- Project planning and management
- Critical thinking
- Development of free, creative and inductive thinking

3. MODULE CONTENT

The main objective of the module is to educate students on issues concerning advanced processes related to the clean energy production. More precisely this module aims to familiarize students with the main refinery processes and especially with those targeting to the production of environmental friendly conventional fuels (hydrodesulphurization), the production of biofuels (bioethanol, biodiesel, renewable diesel, and biogas) and the production, storage and use of hydrogen (Fuel Cells) for the production of electric energy.

Module subjects:
1. Production of clean petroleum fuels
2. Methods for the exploitation of biomass for biofuels production
3. Production, storage, transportation and use of hydrogen as alternative fuel

4. TEACHING METHODS ASSESSMENT

<table>
<tr><td>MODES OF DELIVERY
Face-to-face, in-class lecturing, distance teaching and distance learning etc.</td><td>Distance education with five Group Counseling Meetings (GCMs) during the academic year on weekends.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY
Use of ICT in teaching, Laboratory Education, Communication with students</td><td>In the GCMs and/or operations they are used:
-remote meeting tools (cisco webex),
-presentation software (powerpoint),
-software specialized in the subjects under training.
In addition, students use office automation tools, web browsers and e-readers for digital books.

In communication with students:
- support of the learning process through the EAP online platform http://courses.eap.gr (course information, educational material postings, announcements, messages, exam results, user groups, discussion forums, etc.).
- Electronic mail (e-mail)</td></tr>
<tr><td>MODULE DESIGN
Description of teaching techniques, practices and methods: Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, Internship, Art Workshop, Interactive teaching, Educational visits, projects, Essay writing, Artistic creativity, etc

The study hours for each learning activity as well as the hours of selfdirected study are given following the principles of the ECTS.</td><td><table><tr><th>Activity</th><th>Annual Workload</th></tr><tr><td>5 GCMs (x 4 hours)</td><td>20</td></tr><tr><td>5 Assignments (x 24 hours)</td><td>120</td></tr><tr><td>Digital educational activity</td><td>24</td></tr><tr><td>Examination</td><td>4</td></tr><tr><td>Individual study</td><td>392</td></tr><tr><td>Total module workload (hours)</td><td>560</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION/ASSESSMENT METHODS
Detailed description of the evaluation procedures.

Language of evaluation, assessment methods, formative or summative (conclusive), multiple choice tests, short- answer</td><td>- Students are assigned to submit five (5) written assignments during the academic year. The average grade of the five (5) written assignments, weighted at 30%, is taken into consideration for the calculation of the final grade. The grade of written assignments is activated only with a score equal to or above the pass level (≥5) in the final exam.
- The grade of the final exam shall be weighted at 70 % for the calculation of the final grade.
- Students have the right to participate in the final</td></tr>
</table>

questions, open-ended questions, problem solving, written work, essay/report, oral exam, presentation, laboratory work, other……etc. *Specifically defined evaluation criteria are stated, as well as if and where they are accessible by the students*	exam if (a) at least 50% of the potentially excellent grade has been obtained when adding the total of the five (5) assignments and (b) at least three (3) of the five (5) written assignments have been submitted. Language of evaluation: Greek All the evaluation criteria are posted, both in the general regulation of HOU at: https://www.eap.gr/en/study-regulations/ and the web published study guide at: https://www.eap.gr/education/odigos-spoudwn-eap/

5. SUGGESTED BIBLIOGRAPHY

- Suggested bibliography:

1. Catalytic Production of Environmentally Friendly Fuels, I. Vasalos, X. Verykios, A. Lappas, A. Lemonidou, HOU, Patras, 2005.
2. Production of Hydrogen from Hydrocarbons, C. Matralis, HOU, Patras, 2015.
3. Methods for the Valorization of Biomass for the Production of Biofuels, C. Kordulis, HOU, Patras, 2013.

-Related scientific Journals:

Applied Catalysis B: Environmental
Catalysis Today
Chemical Engineering Journal
International Journal of Hydrogen Energy
Catalysis Reviews: Science and Engineering
Journal of Catalysis
Biotechnology for Biofuels
Bioresource Technology
Energy & Fuels
Renewable and Sustainable Energy Reviews
Renewable Energy
Fuel Processing Technology