MODULE OUTLINE

1. GENERAL INFORMATION

SCHOOL	School of Science and Technology			
PROGRAM COURSE	Environmental Catalysis for Pollution Abatement and Clean Energy Production			
LEVEL OF STUDY	Post-graduate			
MODULE CODE	KPPB70	**YEAR OF STUDY**	1st	
MODULE TITLE	Catalysis			
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**	**CREDITS**	
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/#k70 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=361			

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:*
Upon successful completion of KPPB70, students will be able to: • Present in detail the basic concepts of homogenous, enzymatic, and heterogenous catalysis (e.g. activity, selectivity, and stability of catalysts, measures of activity and selectivity, active sites, the catalytic cycle, deactivation and regeneration of catalysts, the general mechanism of catalytic action). • Taxonomize catalysts and catalytic reactions into crucial reaction categories and present in detail the various aspects of catalytic function per catalyst category (e.g. protonic catalysis in solutions and catalytic surfaces, homogenous catalysis with

organometallic complexes, enzyme catalysis, the catalytic activity of metals, oxides, and sulphides).

- Present the basic concepts and methods of the science of surfaces and how it is implemented in heterogenous catalysis.
- Discuss the contributions of catalysis to the chemical industry, the destruction of pollutants, the improvement of traditional fuels and the development of environmentally friendly fuels and processes.
- Identify the post suitable catalyst for a given catalytic reaction.
- Combine various catalytic materials to perform a composite catalytic procedure.

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
- Working in an international environment
- Working in an interdisciplinary environment
- Introduction of innovative research
- Project planning and management

3. MODULE CONTENT

The module presents the general characteristics of Catalysis and introduces students to the world of catalysts and catalytic reactions and the study of the catalytic phenomenon through important categories of catalysts that act either dissolved in a solvent (homogenous catalysis), in a biochemical environment (enzymatic catalysis), or as solid surfaces (heterogenous catalysis). Furthermore, the module aims to present the basic concepts of the science of surfaces that are closely related to Catalysis.

Module Subjects:
1. Homogenous Catalysis

2. Enzymic Catalysis 3. Heterogenous Catalysis 4. Surface Science Analytical Module Content: 1. Introduction 2. Catalysis in solutions of acids and bases 3. Catalysis in solutions of transition element complexes 4. Enzymatic catalysis 5. Heterogeneous acid-base catalysis: Zeolites 6. Catalysis on the surface of transition metals: Hydrogenation, dehydrogenation and hydrogenolysis of hydrocarbons 7. Catalysis on the surface of transition metals: Hydrogenation of CO and catalytic synthesis of NH_3 8. Catalysis on the surface of transition metals: Catalytic oxidations 9. Catalysis on the surface of transition metal oxides: Redox reactions 10. Catalysis on sulfide surfaces of transition metals: Hydrotreatment reactions 11. Introduction to surface science 12. Basic Concepts of vacuum Technology 13. Surface analysis 14. Surface structure 15. Electronic properties of surfaces 16. Surface atomic motion 17. Thin films on solid surfaces

4. TEACHING METHODS--ASSESSMENT

MODES OF DELIVERY *Face-to-face, in-class lecturing, distance teaching and distance learning etc.*	Distance education with five Group Counseling Meetings (GCMs) during the academic year on weekends.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *Use of ICT in teaching, Laboratory Education, Communication with students*	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)
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.*	

Activity	***Annual Workload***
5 GCMs (x 4 hours)	20
5 Assignments (x 24 hours)	120
Digital educational activity	24
Examination	4
Individual study	392
Total module workload (hours)	**560**

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 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*	- 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 exams shall be weighted at 70 % for the calculation of the final grade. - Students have the right to participate in the final exams 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. Catalysis, A. Lycourghiotis, C. Kordoulis, HOU, Patras 2003.
2. Surface Science, S. Kennou, HOU, Patras 2003.
3. Modern interactive catalysis, A. Lycourghiotis, HOU, Patras 2016. Digital material of multiple choice exercises within the study platform (study.eap.gr).

-Related scientific journals:

Applied Catalysis B: Environmental
Catalysis Today
Chemical Engineering Journal
Molecular Catalysis
Catalysis Reviews: Science and Engineering
Journal of Catalysis
Applied Catalysis A: General
ACS Catalysis
Catalysis Science and Technology
Catalysts
Catalysis Communications