# COURSE OUTLINE

## 1. GENERAL

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| **SCHOOL** | ENGINEERING | | |
| **DEPARTMENT** | PRODUCT AND SYSTEMS DESIGN ENGINEERING | | |
| **LEVEL OF STUDIES** | UNDERGRADUATE | | |
| **COURSE CODE** | **5001** | **SEMESTER** | **7$^{O}$** |
| **COURSE TITLE** | DESIGN OF ADVANCED MATERIALS FOR ENERGY AND ENVIRONMENTAL APPLICATIONS (AMEE) | | |
| **INDEPENDENT TEACHING ACTIVITIES** *if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits* | | **WEEKLY TEACHING HOURS** | **CREDITS** |
| Lectures and Laboratory | | 3 +3 | 6 |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | | |
| **COURSE TYPE** *general background, special background, specialised general knowledge, skills development* | SCIENTIFIC AREA<br>Free Choice to Compulsory Specialization "Systems Design" (EEK3) | | |
| **PREREQUISITE COURSES:** | MATERIALS SCIENCE AND TECHNOLOGY | | |
| **LANGUAGE OF TEACHING AND EXAMINATIONS:** | GREEK | | |
| **COURSE DELIVERED TO ERASMUS STUDENTS** | YES | | |
| **MODULE WEB PAGE(URL)** | https://eclass.uowm.gr/ | | |

## 2. LEARNING OUTCOMES

**Learning Outcomes**

The course "Design of Advanced Materials for Energy and Environmental Applications" is an approach to the synthesis, characterization, and evaluation of materials for energy and environmental applications, such as solar thermochemical processes, catalytic processes, $CO_2$ capture from the atmosphere, processing of solid organic waste for energy production. Students study the synthesis, characterization, and evaluation of advanced materials for energy and environmental applications.

**On successful completion of this module the learner will be able to:**

1. Understand the concepts and categories of Composite and Advanced Materials for Energy and Environmental Applications.
2. Understand the relationship between the properties and the structure of these materials.
3. Select the appropriate materials by their properties.
4. Study a variety of properties of composites and advanced materials.
5. Analyze and combine the concepts of the course to develop the application of these materials.
6. Acquire the necessary technical problem-solving skills for various important Energy and Environmental Applications.

**General Skills**

**Upon successful completion of the program students will:**

- have the theoretical background concerning the Selection of Composite and Advanced Materials studying their structure and properties in special applications.

- the ability to apply a wide range of scientific and technical knowledge concerning the structure and properties of composite and advanced materials, study their processing for design and development Advanced Materials for Energy and Environmental Applications.

## 3. COURSE CONTENTS

The course is taught as a Free Elective Course of the students of the Department of Product and Systems Design Engineering of the University of Western Macedonia and its subject is the synthesis, characterization, and evaluation of advanced materials for Energy and Environmental applications. The content of the course is as follows:

- Introduction - Current state of Energy & Environment at European and Global level - Climate change
– Sustainable development and circular economy
– Concept of catalysis
– Catalysis species and reactors
- Environmental catalysis - Applications - Protection of the environment (anti-pollution)
- Catalytic processes for the capture/destruction of substances – Management of industrial by-products – Production of clean energy
- Sources of industrial by-products harmful to the environment
– Recycling-reuse-utilization of by-products by industrial units
– Categories of by-products – Conversion of by-products and use
- Technologies and technical methods for the conversion of by-products and their reuse
- Clean energy technologies and management/reduction of air pollutants
- Systems of catalytic advanced materials for the reduction of air pollutants and particles
- Technologies for carbon capture and utilization
- Synthetic Fuels – Types and methods of production of synthetic fuels
- Alternative fuels – Solar fuels – Hydrogen as an alternative fuel
- Production of clean energy - Environment, Sustainability, and renewable energy sources
– Alternative methods of solar energy utilization and uses
- Energy storage – Felt (sensible), latent & thermochemical energy storage
- Categories of advanced material systems used for energy storage
- Advanced materials with application to environmental catalysis
- Synthesis technologies
– Formatting techniques
- Categories of materials and uses
- Preparation of materials with specific properties adapted to the application
– Methods of characterization and evaluation of materials
- Repetition of the curriculum – Questions
– Coverage of questions - highlighting of most important points

## 4. TEACHING METHODS - ASSESSMENT

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| **MODE OF DELIVERY**<br>*Face to face, Distance learning, etc.* | 1. THEORY<br>In class, face to face<br>2. LABORATORY<br>In laboratory facilities, face to face |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY** | • Use of appropriate software<br>• Use of projection system<br>• Support of teaching process via the electronic platform e-class. |

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| **TEACHING METHODS** | ***Activity*** | ***Semester workload*** |
| | Lectures (teaching hours) | 40 |
| | Semester project | 20 |
| | Laboratory Exercises | 40 |
| | Independent student's own-time course, preparation for the final exam | 50 |
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| | Total Course | **150** |
| **ASSESSMENT METHODS** | 1. THEORY<br>The final written exam include:<br>i. Short-answer questions<br>ii. Multiple choice questions<br>iii. Problem solving<br>**2.** LABORATORY<br>Written exam at the end of the semester based on exercises during the courses in laboratory. | |

## 5. ATTACHED

- *Suggested Bibliography:*
  - Chemical reaction mechanics and reactor design, Fogler Scott H., K. Filippopoulos, G. Marnelos (dir.), 2018, 5th Edition, A. TZIOLAS PUBLICATIONS & SONS S.A.
  - Energy and Environment, Authors: Tsatiris Michael N., Testator, (Publisher): G. DARDANOS - K. DARDANOS O.E., Edition: 1st ed./2002.
  - Heterogeneous Catalytic Reactions and Reactors, Verykios X., Publisher: SPYRIDON KOSTARAKIS, 1st Edition, 2004.
- *Relevant scientific journals.*