Master Programme

SUSTAINABLE ENGINEERING & CLIMATE CHANGE

Program Guide
Academic Year 2023-24

SCHOOL OF CHEMICAL AND ENVIRONMENTAL ENGINEERING
TECHNICAL UNIVERSITY OF CRETE

Preface

The ambition of the School of Chemical and Environmental Engineering is to train highly qualified engineers, with skills and background to serve the modern scientific research and cutting-edge production processes in the fields of Environmental and Chemical Engineering:

- Design and development of chemical and biochemical processes.
- Restructuring and readjustment of production and processing industrial facilities.
- Design, construction and operation of treatment plants for liquid waste, gaseous emissions, municipal, toxic and hazardous waste.
- Atmospheric pollution management, surface and groundwater pollution, systems for measuring air and water pollution, soil and groundwater remediation.
- Design and implementation of management programmes for the natural and structured environment (measurement, monitoring, evaluation).
- Hydraulic works studies, hydrogeology and groundwater studies and studies of water resources management.
- Development and improvement of added-value chemicals and wide-range products or products for special applications.
- Materials/nanomaterials technology with environmental, biochemical medical and energy applications.
- Sustainable exploitation of natural resources and enhanced utilization of fossil fuels/biofuels.
- Production, conversion, energy saving, and development of energy cycles of minimal or zero carbon footprint.
- Elaboration or control of management programmes for natural or man-made environmental impacts, technical projects or other activities.

We are looking forward to welcoming you to our School!!

I. CONTENTS

II. TECHNICAL UNIVERSITY OF CRETE (TUC)

The Technical University of Crete (TUC) was founded in Chania in 1977 and admitted its first students in 1984. Since its foundation, the Technical University of Crete is at the forefront in the development of modern engineering skills and specializations, as well as in the research for advanced technologies and their connection with the industrial and productive units of the country. The Technical University of Crete consists of five engineering Schools all of which offer postgraduate programs of studies. The Schools are listed below in chronological order of operation:

- School of Production Engineering & Management
- School of Mineral Resources Engineering
- School of Electronic and Computer Engineering
- School of Chemical & Environmental Engineering
- School of Architecture

The campus is built on a panoramic location at Akrotiri, 7 km northeast of the city of Chania, and occupies an area of 300 hectares.

The University Library is housed in two buildings (E1 and Δ1).

The University Hall of Residences accommodates students in single and double rooms. The University restaurant serves the University community at low cost. The Ministry of Education provides free accommodation and catering to undergraduate and graduate students with low income. For more information, interested students should contact the Department of Student Affairs.

III. SCHOOL OF CHEMICAL & ENVIRONMENTAL ENGINEERING

I.1 General Information

The Department of Environmental Engineering was established[1] at the Technical University of Crete and admitted its first students in Academic Year 1997-1998. The School of Environmental Engineering[2], which incorporated the former Department, was established in May 2013.

In June 2021 the School of Environmental Engineering was renamed "School of Chemical and Environmental Engineering"[3]

I.2 School Objectives

The mission of the School of Chemical and Environmental Engineering goes beyond the boundaries of classical Chemical Engineering and Environmental Engineering, composing an interdisciplinary, innovative cradle of cutting-edge education and postgraduate research in Greece, aiming to:

- Provide high quality education at undergraduate and postgraduate level and a strong scientific background, know-how and skills to its graduates in two basic and distinct areas: (a) in the science of Modern Chemical Engineering, and (b) in Environmental Engineering.

[1] P.D. 232/1995, O.G. 134/22-6-1995/vol. A'
[2] O.G. 119/28-5-2013/vol. A'
[3] O.G. 2348/03-06-2021/vol. B'

- Prepare well-trained Chemical Engineers and Environmental Engineers, who will be able to evaluate, design and implement decisions, and constantly evolve into a wide range of activities to compete in current and future challenges within a rapidly technological and scientifically developing society.
- Promote research and innovation via the knowledge transfer to cutting-edge areas, the evolution of the science of chemical engineering and environmental engineering and the expansion of their fields of application.
- Seek and acknowledge excellence, through encouraging, enhancing and rewarding the achievements of members of the academic community in teaching and research.
- Enhance openness through the promotion of collaborations and actions to publicize the achievements of the School at local, national and international level.

I.3 Mission of the School of Chemical and Environmental Engineering

The mission of the School is to train engineer scientists with high qualifications, skills and background to serve modern scientific research and productive processes in the fields of:

- design and development of chemical and biochemical processes for the installation, operation and control of modern, economical and environmentally friendly industrial infrastructure,
- measuring, monitoring, evaluating, rehabilitating/improving the natural and structured environment and tackling the problems arising from human activity, with the aim of sustainable development,
- development and improvement of added-value chemicals and of wide-range or specialized application products,
- restructuring/readjustment of production and processing industrial facilities and the primary agricultural sector through adaptation and application of new know-how,
- materials technology/nanomaterials with environmental and energy applications,
- efficient and environmentally friendly exploitation of natural resources, secondary treatment and utilization (refining, remodeling, synthesis, etc.) of fossil fuels / biofuels,
- generation, conversion, energy saving, and development of energy cycles of minimal or zero carbon footprint, hydrogen energy, thus contributing through the educational and research process to the long-term vision of a resilient European zero carbon footprint by 2050 (Green Deal),
- research and innovation that will address critical national and global environmental issues and contribute to the United Nations action to promote emerging Nature-Based Solutions, Green Infrastructure and the broader ecological engineering sector in the context of a sustainable and circular economy,
- recycling, waste and biomass treatment (biorefinery) for the production of high added- value products (e.g. bioplastics), energy materials (e.g. biodiesel, biogas, hydrogen) with the prospect of a sustainable future.

Objectives of the Postgraduate Program

The goal of the Postgraduate Program entitled: "Sustainable Engineering and Climate Change", of the School of Chemical Engineering and Environmental Engineering is to train scientists and professionals with high qualifications, skills, and background to serve the modern scientific research and production process in cutting-edge issues related to climate change and environmental management, and to design sustainable energy systems and environmentally sustainable cities of the future.

The MSc. consists of two specializations:

1. MSc Specialization Area A: Sustainable Water and Wastewater Management awarding a Diploma of Postgraduate Studies from the School of Chemical and Environmental Engineering.

2. MSc Specialization Area B: Sustainable Energy awarding the Diploma of Postgraduate Studies of the School of Chemical and Environmental Engineering.

In both directions, the curriculum addresses a wide range of scientific and technological subjects in Engineering, Mathematics, Statistics, Natural Sciences, Chemistry, Biology, Materials Science, Computer Science and their applications.

The courses aim to further develop this knowledge by bringing postgraduate students in touch with new subjects that are at the forefront of academic interest and business operations in the field of Environment and Engineering, such as Statistical Data Analysis, Modelling and Simulation, Fluid Dynamics, Materials Technologies in the Environment, Prevention, Risk Assessment and Protection from Environmental Risks, Renewable Energy, Climate Change, Smart and Sustainable Cities, European Policies, Artificial Intelligence and Decision Support Systems in Environmental Engineering, Legal Issues related to the Environment, etc.

The specific objectives of the Postgraduate Program are:

- The provision of high-quality education to graduates of higher education in our country, as well as equivalent institutions abroad, aiming at understanding and deepening the basic principles and methods in Environmental Sciences and Technological Applications.

- To strengthen research in this field by integrating the graduates of the programme into the national and international research community.

- The scientific/technological training and specialisation of graduates with a focus on their employment in environmental risk management development and service companies.

- The provision of preparation for postgraduate studies at doctoral level.

- The development of innovation in the scientific areas: sustainable water and wastewater management and sustainable energy.

- The development of long-term international partnerships at scientific and business level.

- The promotion of Greece abroad as a country of production and export of technology, know-how and high added value products.

I.4 Administration

The Management Bodies of the MSc are:

- The Departmental Assembly.
- The Steering Committee
- The Director of the MSc.

The MSc is coordinated by the Steering Committee of the Postgraduate Programme of the School of Chemical and Environmental Engineering of the Technical University of Crete.

Decisions are taken by the Departmental Assembly after recommendations of the Steering Committee of the MSc. The Departmental Assembly appoints the members of the Committee, allocates the teaching responsibilities among the instructors of the MSc, establishes selection or examination committees for postgraduate students or doctoral candidates, and determines the successful completion of the programme in order to award the MSc. The Steering Committee is responsible for the appointment of the supervisor and the appointment of the three-member examination committee for the preparation of the Master's Thesis (M.Sc.) in order to award the Diploma of Postgraduate Studies (M.Sc.) and generally carries out all other responsibilities foreseen by the legislation in force.

The Director of the MSc, according to article 31, paragraph 8 of Law 4485/2017, is a member of the Board and is appointed together with his/her Deputy, by decision of the Department Assembly for a two-year term. The Director is a Full or Associate professor. The Director chairs the Steering Committee and is of the same or related area of knowledge of the MSc. The Director makes recommendations to the appropriate bodies of the Institution and the Department on any matter concerning the effective operation of the programme. The Director is responsible for the budget and reporting of the Programme, which he/she submits to the Departmental Assembly for approval, the monitoring of the implementation of the budget and the issuing of payments for the relevant expenditure.

Departmental Assembly (DA)

The Departmental Assembly is composed of all School faculty members, one (1) member of the Laboratory Teaching staff, one (1) member of the Specialized Technical Laboratory Staff, three (3) undergraduate students and one (1) student representing both postgraduate students and PhD candidates.

The DA is the ultimate decision maker for all issues concerning postgraduate studies. The assembly is responsible for appointing the three members of the Advisory Committee for MSc students, awarding degrees and any other issues defined by the current legislation.

Dean

Professor **Dionysia Kolokotsa** is the Dean of the School of Chemical and Environmental Engineering. Professor **Ioannis Yentekakis** serves as Deputy Dean.

Deanery of the School

The Dean of the School, Professor **Dionysia Kolokotsa**, chairs the Deanery of the School, which consists of the following members.

The Faculty members:

- Professor **Ioannis Yentekakis** (serves as Deputy)
- Professor **Petros Gikas**
- Associate Professor **Danae Venieri**
- Associate Professor **Apostolos Voulgarakis**
- Associate Professor **Paraskevi Panagiotopoulou**

Upon their appointment by the respective associations:

- Representing the Laboratory Teaching Staff: **Irene Koutsogiannaki**
- Representing the Specialized Technical Laboratory Staff: **Ariadni Pantidou** (**Efprepios Baradakis**)
- a representative of undergraduate students (not designated)
- a representative of postgraduate students and PhD candidates (not designated).

Director of Postgraduate Studies

Associate Professor Apostolos Voulgarakis is the Director of Postgraduate Studies and chairs the Coordination Committee. Professor George Karatzas serves as Deputy Director.

Steering Committee

The members of the steering committee are:

- A.Voulgarakis, Associate Professor (Director of Postgraduate Studies)
- D. Kolokotsa, Professor (Dean)
- G. Karatzas, Professor (Deputy Director)
- M. Lazaridis, Professor
- P. Gikas, Professor
- T. Tsoutsos, Professor

Evaluation Committee

The members of the Evaluation Committee for applications to the Master's Programme, are:

- A.Voulgarakis, Associate Professor (Director of Postgraduate Studies)
- G. Karatzas, Professor (Deputy Director)
- N. Nikolaidis, Professor
- C. Chrysikopoulos, Professor

Secretary

Mrs. Lina Manaroli is Secretary, employee, (Diploma and MSc. in Architecture) graduate of Aristotle University of Thessaliniki.

School's Committees

By decision of the DA of the School the following committees are appointed (2023-2024):

1. Undergraduate Studies Committee
   - I. Yentekakis, Professor
   - A. Giannis, Assistant Professor
   - A. Manousakis, Associate Professor
   - N. Paranychianakis, Associate Professor
   - T. Tsoutsos, Professor
   - P. Panagiotopoulou, Associate Professor
   - D. Gournis, Professor
   - (One student representing the Undergraduate Students' Association)
2. Postgraduate Studies Steering Committee
   - A. Voulgarakis, Associate Professor (Coordinator – Head of Postgraduate Studies)
   - D. Kolokotsa, Professor (Dean)
   - M. Lazaridis, Professor
   - P. Gikas, Professor
   - G. Karatzas, Professor
   - T. Tsoutsos, Professor
3. Committee for the Evaluation of Applications for Postgraduate and Doctoral Studies
   - A. Voulgarakis, Associate Professor (Coordinator – Head of Postgraduate Studies)
   - N. Nikolaidis, Professor
   - G. Karatzas, Professor (deputy)
4. Advising Committee for Undergraduate Students
   - 1st yr A. Stefanakis, (Assist. Prof.) and Yentekakis, (Prof.
   - 2nd yr D. Kolokotsa, Professor (Dean) and N. Diangelakis, (Assist. Prof.)
   - 3rd yr G. Karatzas, (Prof.) and P. Gikas, (Prof.)
   - 4th/5th yr. N Nikolaidis, (Prof.) and T. Tsoutsos (Prof.)
5. Internship
   - N. Diangelakis, Assistant Professor
   - E. Maria, Professor
6. ERASMUS+
   - S. Rozakis, Professor
   - T. Daras, Associate Professor
7. TUC Library Committee

- N. Xekoukoulotakis, Assistant Professor
- S. Rozakis, Professor (deputy)

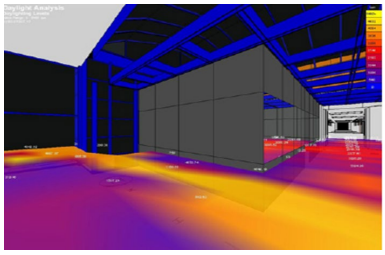
8. Energy Committee
   - T. Tsoutsos, Professor
   - D. Kolokotsa, Professor
   - E. Baradakis, STLS
9. Health and Safety Committee
   - I. Yentekakis, Professor
   - E. Koukouraki, LTS
   - R. Sarika, LTS
   - I. Gounaki, LTS
10. Fire Safety Committee
   - A. Giannis, Assistant Professor
   - A. Pantidou, STLS
   - K. Antelli, LTS
   - I. Kanakis, LTS
   - A. Spyridaki, LTS
11. Financial Records
   - I. Gounaki, LTS
12. Quality Assurance IT System and Students' Evaluation monitoring
   - A. Koutroulis, Associate Professor
   - T. Glytsos, LTS
   - G. Botzolaki, LTS
   - A. Malandrakis, LTS
   - D. Venieri, Associate Professor
   - N. Xekoukoulotakis, Assistant Professor
   - N. Paranychianakis, Associate Professor
   - A. Giannis, Assistant Professor
   - D. Gournis, Professor
13. Web site Content Management
   - N. Vakakis, LTS
   - A. Spiridaki, LTS
   - K. Tyrovola, LTS
   - L. Manaroli, Secretary
14. Undergraduate and Postgraduate Studies Guide
   - I. Koutsogiannaki, LTS
   - A. Koutroulis, LTS
   - L. Manaroli, Secretary
15. TUC Special Research Funds Unit (School representative)
   - T. Tsoutsos, Professor (member)
   - P. Gikas, Professor (alternate member)
16. Outreach Committee
   - T. Tsoutsos, Professor
   - P. Gikas, Professor
   - S. Rozakis, Professor
   - A. Stefanakis, Assistant Professor
   - A. Pantidou, LTS

17. TUC Quality Assurance Unit
    - I. Tsompanakis, Professor
    - D. Venieri, Associate Professor
18. TUC Center for Continuing Education and Lifelong Learning Committee
    - T. Tsoutsos, Professor
    - D. Kolokotsa, Professor (Dean)
19. School Facilities Committee
    - P. Gikas, Professor
    - E. Psillakis, Professor
    - N. Paranychianakis, Professor
    - A. Pantidou, LTS
    - P. Anteli, LTS
    - E. Koukouraki, LTS

I.5 Divisions

The School is organized into four Divisions, each including a number of laboratories.

ENVIRONMENTAL & ENERGY MANAGEMENT, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (DIVISION I)



Division I is engaged in the field of sciences / areas of specialization: Climate Change - Mitigation and Adaptation; Sustainable Energy; Energy Savings and Renewable Energy Sources; General, Organic, Environmental and Aqueous Chemistry; Instrumental Chemical Analysis; Chemistry of the Atmosphere; Geology; Physics; Greenhouse gases and Climate Change; Forest Fires and Climate Change; Air Pollution; Public Health; Environmental Legislation, etc.

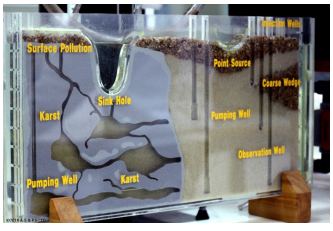
PROCESS DEVELOPMENT, ANALYSIS AND DESIGN (DIVISION II):

Division II is engaged in the field of sciences / areas of specialization: Chemical, biochemical and Environmental Process Design and Analysis; Thermodynamics; Calculus, Mathematics and Statistics; Numerical Analysis and Programming; Environmental Engineering; Unit Operations; Process Control; Physical Chemistry; Transport Phenomena; Fluid Mechanics; Byproducts process manufacturing; Natural Gas, Biogas and Hydrogen Technology; Fuel and Lubricant Technology; Microbiology and Biological Processes; Food Technology; Ecological Engineering and Technology, etc.

MATERIAL SCIENCE, NANO-TECHNOLOGY AND BIOTECHNOLOGY APPLICATIONS (DIVISION III):

Division III is engaged in the field of sciences / areas of specialization: Solid State Physics; Crystallography; Instrumental Chemical Analysis & Characterization of Materials; Surface Science; Heterogeneous Catalysis; Photocatalysis and Electrocatalysis; Corrosion of materials; Polymers and Macromolecules Science and Technology; Metallurgy; Materials Science and Technology; Nanomaterials and Nanotechnology; Biomaterials & Biopolymers; Ceramics & Porous Materials; Catalytic and Energy Storage Materials, Electrocatalytic Materials-Fuel Cells; Biomedical Technology and Materials etc.

ENVIRONMENTAL HYDRAULICS & COASTAL AND GEOENVIRONMENTAL ENGINEERING (DIVISION IV):



Division IV is engaged in the field of sciences / areas of specialization: Hydrology; Hydraulics; Hydraulic works, Surface-water and groundwater management; Environmental Rehabilitation (soil, groundwater and surface water); Nature based solutions and technologies; Agricultural Technology; Fluid Mechanics; Marine Environmental Hydraulics; Coastal Engineering, Port Works; Geodesy; Geographic Information Systems; Geotechnical and Geo-Environmental Seismic Engineering; Computational Dynamics, etc.

I.6 Faculty and Staff

The personnel of the School fall in the following categories:

Professors. There is a three-level academic rank system, from Assistant Professor to Associate Professor to Professor in ascending order. Additional needs for course instructors, researchers and laboratory instructors are often covered by scientists hired in accordance with the provisions of the current legislation.

Laboratory Teaching Staff (LTS). The LTS members perform specific laboratory and applied educational duties which primarily consist of conducting laboratory sessions and recitations for the courses taught.

Specialized Technical Laboratory Staff (STLS). The STLS members provide fundamental support to the School operation by offering specialized technical services in order to better serve the educational and research activities at the School.

Administration. Employees who are under the administration of the Technical University of Crete.

Faculty

Professors

Chrysikopoulos, Constantinos: Environmental Technology, B.Sc. in Chemical Engineering (1982), University of California, San Diego, USA, Engineer Degree in Civil Engineering (1986) (Geothermal Program), Stanford University, USA, M.Sc. in Chemical Engineering (1984), Stanford University, USA, Ph.D. Civil and Environmental Engineering (1991) [Ph.D. Minor: Petroleum Engineering], Stanford University, USA.

Gikas, Petros: Environmental Engineering, Diploma in Chemical Engineering (1990) National Technical University of Athens, Greece, Ph.D. in Chemical Engineering (1996) University of London, Imperial College, London, UK.

Gournis, Dimitrios: Nanomaterials and Nanotechnology. Dipl. in Chemistry (1998) University of Ioannina, Ph.D. (1992) Chemical Engineering, National Technical University of Athens, Greece.

Karatzas, George: Groundwater flow-mass transport and optimal remediation design, B.Sc. School of Forestry and Natural Environment (1982) Aristotle University of Thessaloniki, Greece, M.Sc. (1987) Rutgers University, USA, Ph.D. (1992) Rutgers University, USA.

Kolokotsa, Dionysia: Energy Resources Management, Degree in Physics (1991) University of Athens, Greece, M.Sc. in Meteorology (1994) University of Athens, Greece, M.Sc. Environmental Design and Engineering in Architecture (1995) University College London, UK, Ph.D. (2001) Technical University of Crete, Greece.

Lazaridis, Mihalis: Climate change air pollution and atmospheric research, B.Sc. (1988) Aristotle University of Thessaloniki, Greece, M.Sc. (1991) University of Helsinki, Finland, Ph.D. (1993) University of Helsinki, Finland.

Maria, Efpraxia (Aithra): Environmental Law, Law Degree (1984) University of Athens, Greece, M.Sc. in Public Law (1988) Aristotle University of Thessaloniki, Greece, Ph.D. in Public Law – Specialty Environmental Law – (1998) University of Athens, Greece.

Nikolaidis, Nikolaos: Hydrogeochemical engineering and soil remediation, B.Sc. Civil and Environmental Engineering (1982) University of Iowa, USA, M.Sc. (1984) University of Iowa, USA, Ph.D. (1987) University of Iowa, USA.

Paranychianakis, Nikolaos: Agricultural Engineering, Natural Treatment Systems, Effluent Reuse, and Irrigation Requirements B.A. in Natural Resources Management and Agricultural Engineering (1994) Agricultural University of Athens, Greece, Ph.D. in Natural Resources and Agricultural Engineering (2001) Agricultural University of Athens, Greece.

Psillakis, Elia: Aquatic Chemistry with emphasis on Environmental Applications, Maitrise de Chimie (1994) University of Montpellier II, France, Ph.D. (1997) University of Bristol, England.

Rozakis, Stelios: Operations Research in Agriculture and Energy, Bachelor in Economics, Athens University of Economics and Business (1986), D.E.S.S. Institut des Etudes Economiques et Sociales, Université de Paris I (1988), D.E.A. Sociology of Technology: Université Paris I – Sorbonne (1989), M.P.A. School of Public and Environmental Affairs, Indiana University, USA. (1991), Ph.D. Dept of Agricultural Economics and Rural Development, Agricultural University of Athens (2000).

Tsompanakis, Yiannis: Structural mechanics and earthquake engineering, Dipl. in Civil Engineering (1992) National Technical University of Athens, Greece, Ph.D. in Computational Mechanics (1999) School of Civil Engineering, National Technical University of Athens, Greece.

Tsoutsos, Theocharis: Renewable Energy Sources and Sustainable Energy Systems, Dipl. in Chemical Engineering (1984) National Technical University of Athens, Greece, B.A. Econ. (1990) National and Kapodistrian University of Athens, Greece, Ph.D. (1990) National Technical University of Athens, Greece.

Venieri, Danae: Environmental microbiology, Degree in Biology (1999) University of Patras, Greece, Ph.D. in Environmental Microbiology (2005) Medical School, University of Patras, Greece.

Yentekakis, Ioannis: Physical chemistry, (Heterogeneous Catalysis, Electrochemistry, Nanotechnology, Chemical Processes). Dipl. in Chemical Engineering (1982) University of Patras, Ph.D. in Chemical Engineering (1987) University of Patras, Greece.

Associate Professors

Daras, Tryfon: Probability & Statistics, Degree in Mathematics (1984) University of Patras, M.Sc. in Probability and Statistics (1990) Case Western Reserve University, USA, Ph.D. in Probability and Statistics (1995) Case Western Reserve University, USA.

Koutroulis, Aristeidis: Applied Hydraulics and Hydrology, Diploma in Mineral Resources Engineering (2002) Technical University of Crete, M.Sc. (2005) and Ph.D. (2010) in Environmental Engineering Technical University of Crete.

Manoussakis, Antonios: Banach space Theory, B.Sc. in Mathematics (1992) University of Athens, Greece, Ph.D. in Mathematics (1998) University of Athens, Greece.

Panagiotopoulou, Paraskevi: Gas-emissions Treatment Technology, Diploma in Chemical Engineering (2001) University of Patras, Greece, M.Sc. and Ph.D. (2006) Department of Chemical Engineering, University of Patras, Greece.

Voulgarakis, Apostolos: Climate change and atmospheric environment, BSc in Physics (2002), School of Natural Sciences, Aristotle University of Thessaloniki, Greece, MSc, (2004) School in Environmental Engineering, Technical University of Crete, Greece Ph.D in Atmospheric Science (2008) Department of Chemistry, University of Cambridge, UK.

Assistants Professors

Diangelakis Nikolaos: System Dynamics and Process Control, Chemical Engineer NTUA (2011), MSc (2012) and PhD (2017) in Process Systems Engineering, School of Chemical Engineering, Imperial College London.

Giannis, Apostolos: Municipal and Hazardous Solid Waste Management and Treatment. B.Sc. in Environmental Sciences (2001), Department of Environment, University of the Aegean, M.Sc., Department of Environmental Engineering (2003), Technical University of Crete, PhD, Department of Environmental Engineering (2008), Technical University of Crete.

Stefanakis, Alexandros: Diploma in Environmental Engineering (2005), Department of Environmental Engineering, Democritus University of Thrace, M.Sc. in Civil Engineering (2007), Department of Civil Engineering, Democritus University of Thrace, Ph.D. in Environmental Engineering (2011), Department of Environmental Engineering, Democritus University of Thrace, Greece

Tsouchlaraki, Androniki: Computational Analysis of Spatial Information - Geodesy - GPS/GIS, Dipl. Surv. Eng (1991) National Technical University of Athens, Greece, Ph.D. (1997) National Technical University of Athens, Greece.

Xekoukoulotakis, Nikolaos: Environmental Organic Chemistry-Micropollution Degree in Chemistry (1995) Aristotle University of Thessaloniki, Greece, Ph.D. in Organic Chemistry (2001) Aristotle University of Thessaloniki, Greece.

Emeritus Professors

Diamantopoulos, Evangelos: Environmental Management, Dipl. in Chemical Engineering (1978) Aristotle University of Thessalonik, Greece. M.Eng. (1982) and PhD (1985) McMaster University, Canada.

Gidarakos, Evangelos: Toxic and Hazardous Waste Treatment and Disposal, B.Sc. in Physics (1977) University of Hamburg, Germany, Ph.D. (1980) University of Hamburg, Germany.

Kalogerakis, Nicolas: Biochemical engineering and environmental biotechnology, Dipl. in Chemical Engineering (1977) National Technical University of Athens, M.Eng. (1979) McGill University, Montreal, Canada, Ph.D. (1983) University of Toronto, Canada.

Laboratory Teaching Staff (LTS)

Antelli, Kalliopi: Environmental Process Design, Diploma in Chemical Engineering (1999) National Technical University of Athens, M.Sc. "Quality Control & Environmental Management" (2001) Technical University of Crete.

Botzolaki, Georgia: Materials characterization and Catalysis, Degree in Chemistry (1999) Aristotle University of Thessaloniki, M.Sc. Department of Biology (2001) Long Island University, Brooklyn, New York, M.Sc. "Quality Control & Environmental Management" (2004) Technical University of Crete.

Dr. Glytsos, Theodoros: Atmospheric Pollution, Degree in Physics (1997) Aristotle University of Thessaloniki, M.Sc. "Environmental Physics" (2000) Aristotle University of Thessaloniki, Ph.D. in Environmental Engineering (2010) Technical University of Crete.

Gounaki, Iosifina: Environmental Microbiology, Degree in Biology (1983) Aristotle University of Thessaloniki, M.Sc. “Quality Control & Environmental Management” (2005) Technical University of Crete.

Kanakis, Ioannis: Physics, Degree in Physics (1991) National and Kapodistrian University of Athens, M.Sc. “History and Philosophy of Science and Technology” (2000) National Technical University of Athens.

Kastanaki, Eleni: Municipal and Hazardous Waste Management, Diploma in Chemical Engineering (1999) National Technical University of Athens, M.Sc. “Quality Control & Environmental Management” (2002) Technical University of Crete.

Koukouraki, Elissavet: Water and wastewater treatment, Degree in Chemistry (1992) University of Crete, M.Sc. “Quality Control & Environmental Management” (2002) Technical University of Crete.

Koutsogiannaki, Irene: Geology - Soil Mechanics, Degree in Geology (1999) Aristotle University of Thessaloniki, M.Sc. Mediterranean Agronomic Institute of Chania (2000), M.Sc. “Quality Control & Environmental Management” (2004) Technical University of Crete.

Dr. Malandrakis Anastasios : Pesticide Science, Diploma in Production and Management Engineering (1996), School of Production Engineering and Management, Technical University of Crete, M.Sc. (2003) School of Crop Production Science, Agricultural University of Athens, Diploma of Crop Production Agriculturalist (2004) School of Crop Production Science, Agricultural University of Athens, Ph.D (2009) School of Crop Production Science, Agricultural University of Athens.

Dr. Papadopoulos, Athanasios: B.Sc. in Physics with Environmental Science (1998) University of Sussex, M.Sc. in Oceanography (1999) University of Southampton, Ph.D. in Environmental Engineering (2009) Technical University of Crete.

Sarika, Roika: Biological processes in wastewater treatment, Diploma in Chemical Engineering (1985) National Technical University of Athens, M.Sc. “Quality Control & Environmental Management” (2004) Technical University of Crete.

Dr. Spyridaki, Athina: Air Quality Models, Degree in Physics (1996) Aristotle University of Thessaloniki, M.Sc. “Environmental Physics” (1999) Aristotle University of Thessaloniki, Ph.D. in Environmental Engineering (2005) Technical University of Crete.

Dr. Tyrovola, Konstantina: Water treatment techniques, Degree in Chemistry (1998) University of Crete, M.Sc. (2001) and Ph.D. (2007) in Environmental Engineering Technical University of Crete.

Vakakis, Nikolaos: Materials and Catalytic Procedures, Degree in Physics (1997) University of Crete, M.Sc. “Materials science and technology” (2001), National Technical University of Athens.

Specialized Technical Laboratory Staff (STLS)

Baradakis, Efprepios: Diploma in School of Mineral Resources Engineering (2000), Technical University of Crete, M.Sc. in School of Mineral Resources Engineering (2017), Technical University of Crete. STLS for the Renewable and Sustainable Energy Systems Laboratory.

Pantidou, Ariadni: Degree in Chemistry (1992) University of Crete, M.Sc. “Mechanistic Organic Chemistry” (1995) University of Crete. STLS for the Biochemical Engineering & Environmental Biotechnology Laboratory.

Administration

Poniridou, Georgia: School Secretary, permanent employee, B.A. in Management/Economics, Panteion University of Social and Political Sciences, Greece.

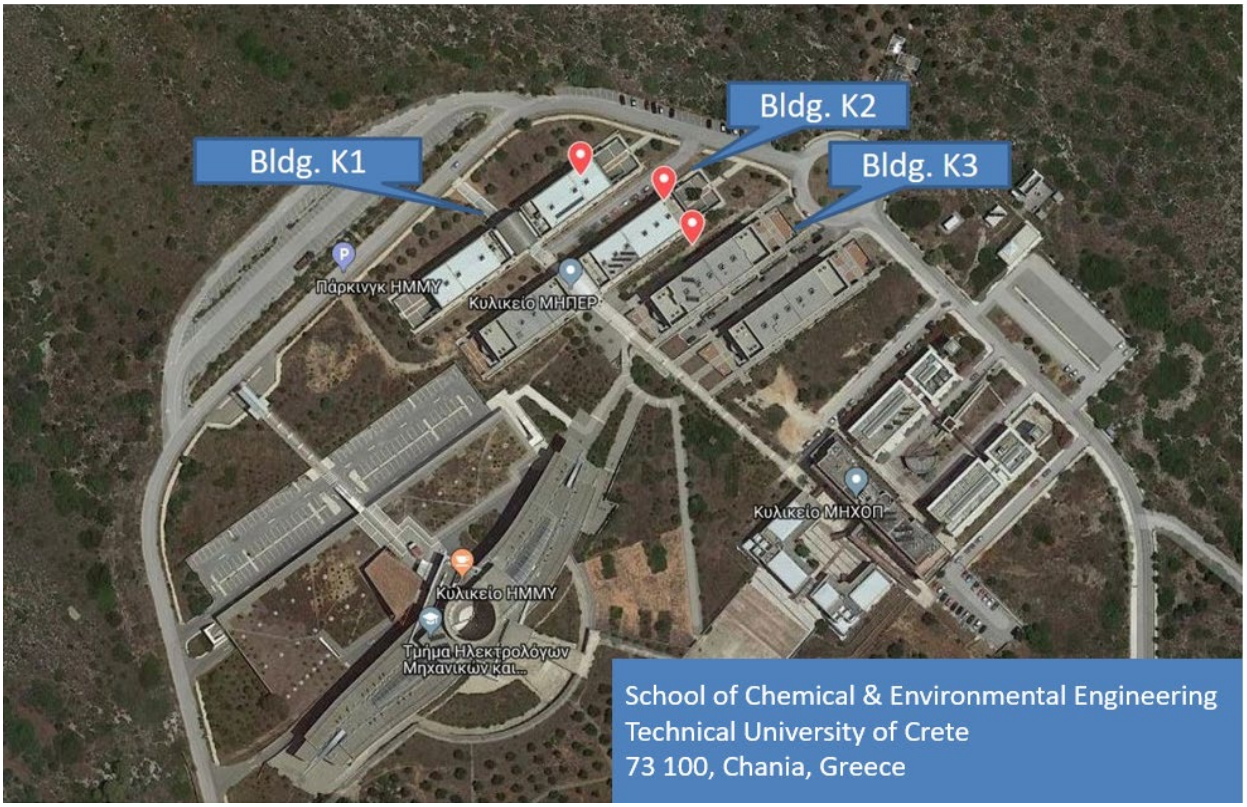
Pateraki, Dimitra: Permanent employee, coordinator of undergraduate and postgraduate studies (diplomas, registrations, certificates).

Manaroli, Lina: Under contract employee, Diploma in Architecture Engineering, Aristotle University of Thessaloniki, M.Sc. School of Architecture, Technical University of Crete (postgraduate studies).

I.7 Facilities

Building Facilities

The School of Environmental Engineering occupies three buildings on campus (K1, K2 and K3) with a total area of 3000 m^2. The first floor of building K2 houses the Secretariat. Laboratories are located on the ground floor of all buildings and in specially designed establishments on campus.



Laboratories

Education and research at the School of Chemical and Environmental Engineering is supported by the following laboratories:

Agricultural Engineering Laboratory

DIVISION IV - Head: Paranychianakis Nikolaos, Professor

Natural wastewater treatment systems, Wastewater reuse, Irrigation/Drainage, Soil Quality, Soil remediation, Carbon and Nitrogen Biogeochemical Processes, Process Simulation, Microbiome Study and Interaction with Abiotic Factors.

Aquatic Chemistry Laboratory

DIVISION I - Head: Psillakis Elia, Professor

Current research projects at the laboratory of Aquatic Chemistry focus on: (i) the development and application of novel analytical methodologies used for the detection emerging and persistent organic pollutants in a variety of environmental matrices (ii) studying the fate and monitoring the contamination levels of trace organic chemicals in natural or engineered environments and (iii) the development of novel on-site monitoring techniques used for the detection of anthropogenic pollutants.

Atmospheric Aerosols Laboratory

DIVISION I - Head: Mihalis Lazaridis, Professor

Study of the dynamics of atmospheric aerosols, heterogeneous reactions in the atmosphere, development and application of air quality models, nucleation processes, measurements of air pollutants and meteorological parameters, modeling and measurements of indoor air quality, dosimetry modeling and transport of pollutants inside the human body.

Atmospheric Environment and Climate Change Laboratory

DIVISION I - Head: Voulgarakis Apostolos, Associate Professor

Climate change and atmospheric environment, modeling of the atmosphere on global and regional scales, modeling of fires and their gas emissions on a large scale, relationship of fires with climate change and the atmospheric environment, use of models of the earth system in combination with machine learning in the field of climate change, correlation of gaseous pollution with public health, specialized indicators for the analysis of effects of anthropogenic pollutants.

Biochemical Engineering & Environmental Biotechnology Laboratory

DIVISION II - Head: Vlysidis Anestis, Associate Professor

Development, analysis, design, process control and optimization of biochemical processes. Biological treatment of solid, gas and liquid wastes. Application of mammalian and insect cultures to environmental protection. Design of Phytoremediation systems and wetlands for the remediation of contaminated water and/or soil. Design of subsurface biological barriers. Environmental microbiology, development of enzymatic processes for toxicological assessment, environmental biotechnology, Application of process design software to environmental processes.

Bioeconomy and Biosystems economics Laboratory

DIVISION II - Head: Stelios Rozakis, Professor

Within the economics and management scientific disciplines and the interdisciplinary domain of sustainability applied to agriculture, energy and bio-systems analysis, domains of activity comprise: Conceptual issues: understanding and monitoring bioeconomy; added value of bioeconomy to economic analysis and policy design. Welfare analysis: evaluate costs and benefits as well as externalities from biomass production, conversion and final product use; estimate impacts on welfare and allocation of losses and benefits from alternative bio-based vale chains; analysis on new value chains. Economic, social and environmental sustainability questions: farm resource use; waste management; land use change; greenhouse gas emissions; bioenergy; biorefineries; life cycle assessment; social implications. Managerial and micro-economic issues: investment appraisal of technology, business models for new bio-based products/processes; logistic supply chains; technology & knowledge transfer and property right questions. Policy analysis: Policy studies are needed throughout due to the high relevance of agricultural policies, the public goods features of the Bioeconomy, the innovation component and the fact that many bioeconomy products require in fact the creation of new markets.

Computational Dynamics & Energy Laboratory (CODEN)

DIVISION IV- Head: Tsompanakis Yiannis, Professor

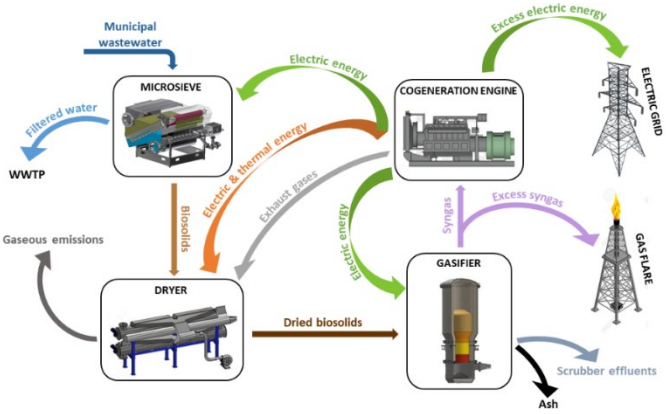
Computational Dynamics & Energy (CODEN) Research Group of TUC main expertise is the development and application of advanced simulation techniques and computational methods for structures and infrastructures (buildings, geostructures, lifelines, etc). Scientific interests of CODEN group include structural and geotechnical earthquake engineering, soil-structure interaction, structural optimization, probabilistic mechanics, structural integrity assessment & monitoring, mitigation of geohazards, life-cycle analysis & performance-based design, artificial intelligence methods in engineering, etc. CODEN group has many cooperations with other scientific groups in Greece and other countries and has participated in national and international projects. CODEN group has given particular emphasis on various engineering problems related to geohazards for structures and energy infrastructure, aiming to assist in the protection of the environment, population and energy infrastructures (transportation networks, pipelines, plants, tanks, etc) from natural and man-made disasters. Indicative related research and engineering practice fields: a) design of onshore and offshore gas pipelines against geohazards (active faults, landslides, soil liquefaction, etc), b) seismic design of liquid fuel tanks and storage terminals, c) onshore and offshore wind turbine design with emphasis on dynamic soil-structure interaction, d) seismic vulnerability of dams, waste landfills, tailings dams, etc.

Design of Environmental Processes Laboratory

DIVISION II - Head: Gikas Petros, Professor

The major research activities of the Design of Environmental Processes Laboratory (www.deplab.tuc.gr) is the scale-up of Environmental Engineering processes. The focus is on novel processes for wastewater treatment and water reclamation and reuse, as well as processes for the management and valorization of solid wastes and sludges. Special attention is given to bioprocesses of immobilized biomass, to nitrogen removal from wastewaters using the "anammox" process, to the effects of heavy metals on microbial

behavior and to disinfection processes. Integrated water resources management with emphasis on non-conventional water sources. Optimization of environmental process, cost analysis and environmental impact assessment. Research is carried out in laboratory, and at the field, with large scale pilot applications, with combination of experimental, informatics and design processes. The Research Unit has established collaboration with international



and Greek universities, research centers and private enterprises, which are active on environmental engineering.

Energy Management in the Built Environment Laboratory

DIVISION I - Head: Kolokotsa Dionysia, Professor

Energy efficiency in buildings and built environment. Indoor Environmental Quality and Energy Efficiency: Thermal Comfort, Visual Comfort, and Indoor Air Quality. Performance indicators. Green Buildings. Zero carbon emissions buildings. Urban environment and Climate Change. Urban heat island studies. Urban heat island mitigation techniques. Energy Management Systems. Monitoring and Control of indoor environmental conditions, design, and integration of smart systems in buildings and urban environments.

Environmental Catalysis Laboratory

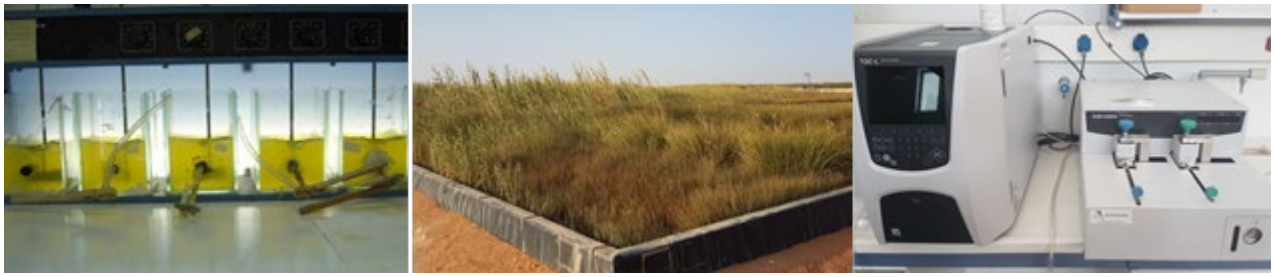
DIVISION III - Head: Panagiotopoulou Paraskevi, Associate Professor

Research activities of the laboratory of Environmental Catalysis are focused in the fields of Heterogeneous Catalysis and, especially, in materials synthesis and characterization, catalyst development and evaluation, and investigation of reaction kinetics and mechanisms, with emphasis given in environmental and energy-related applications. Catalyst characterization is being carried out employing measurements of the total and exposed metallic surface area (BET, selective chemisorptions of gases), temperature-programmed techniques under transient conditions (TPR, TPO and TPD) and spectroscopy techniques (FTIR, XRD etc.). Of particular interest is the investigation of the surface chemistry and structure of dispersed metallic systems and of reducible metal oxides and their mixtures. Primary goals are the identification of the key parameters that determine catalytic activity and selectivity, and the investigation of reaction mechanism.

Environmental Engineering and Management Laboratory

DIVISION II - Head: Stefanakis Alexandros, Assistant Professor

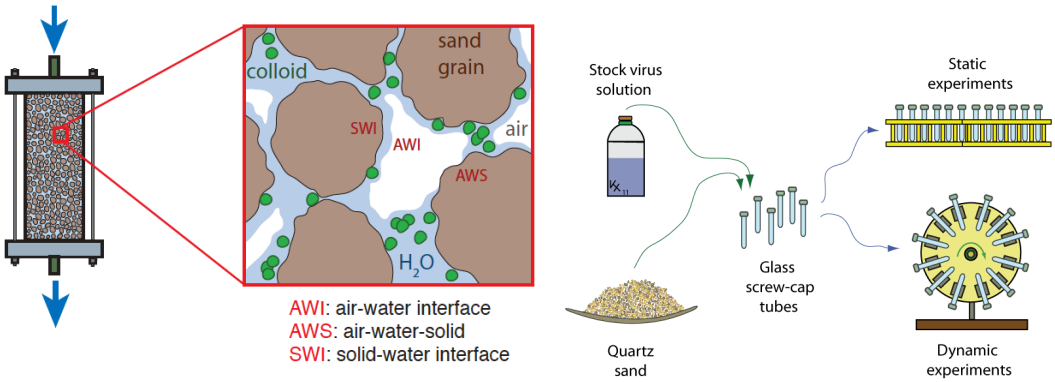
The Laboratory of Environmental Engineering and Management of the Technical University of Crete is involved (in terms of teaching and research activities) with the development and application of technologies for the appropriate management and treatment of water, wastewater and solid wastes. The Laboratory has several advanced analytical systems for the determination of organic pollutants and heavy metals in water and wastewater, as well as several lab-scale and pilot scale treatment units.



Environmental Engineering Laboratory (TUCeeL)

DIVISION II - Head: Chrysikopoulos Constantinos, Professor

Experimental as well as theoretical aspects of contaminant transport in porous media and environmental systems: (1) Fate and transport of viruses in subsurface formations, (2) Transport of polydisperse colloids in natural fractures, (3) Dissolution of multi-component nonaqueous phase liquids in porous media, (4) Mathematical modelling of reactive transport in subsurface formations, (5) Development of an environmentally friendly technology for groundwater remediation using acoustic waves, and (6) Solar energy applications in environmental systems.



Environmental Law and Governance Laboratory

DIVISION I - Head: Efpraxia (Aithra) Maria, Professor

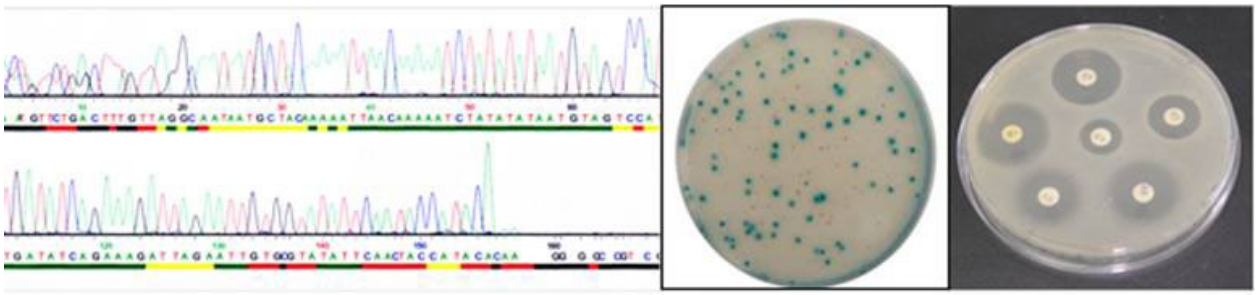
The laboratory is active in the following research areas: legal protection of forest ecosystems, legal protection of landscape, legal protection of biodiversity, agrobiodiversity, plant genetic resources, Genetic Material & Seed Banks, Botanical Gardens, garden and civil law legal issues of renewable energy projects, legal issues of energy efficiency, smart meters, energy saving in buildings, environmental governance, landscape governance, biodiversity governance, new technologies and monitoring of environmental use, ensuring environmental compliance.

Environmental Microbiology Laboratory

DIVISION II - Head: Venieri Danae, Professor

The Environmental Microbiology Laboratory is involved with the evaluation of microbiological quality of aquatic environment and the study of environmental microorganisms. We focus on the application of novel molecular techniques for the detection, isolation and further study of microorganisms. Research topics include microbial resistance against variable antibiotic agents, gene expression, resistance transport and evaluation of disinfection methods.

The main groups of microorganisms under study include bacteria, parasites, bacteriophages and enteric viruses, which either are used as qualitative and quantitative indicators of aquatic environment, or they have great impact on public health.



Environmental Organic Chemistry and Micro-pollution Laboratory

DIVISION III - Head: Xekoukoulotakis Nikolaos, Assistant Professor

Degradation of organic pollutants in aqueous phase (water and wastewater) using oxidizing chemical degradation methods such as UV radiation in the presence of H_2O_2 (UV/H_2O_2), Ozone (O_3), homogeneous and heterogeneous photocatalysis and electrochemical oxidation. Green Chemistry and Technology with emphasis on the development and implementation of environmentally friendly processes.

Geodesy and Geographic Information Systems Research Unit

DIVISION IV - Head: Tsouchlaraki Androniki, Assistant Professor

Geodesy – Topography and Environment, Geographical Information Systems and Spatial Analysis, Landscape analysis and visual impact assessment.

Geoenvironmental Engineering Laboratory

DIVISION IV – Head: Karatzas George, Professor

Environmental fluid mechanics, environmental geology and hydrogeology, flow in porous media, contamination of soils and ground water remediation techniques for contaminated

soils and ground waters, water intake structures, simulation of groundwater flow and mass transport, optimization methods for environmental systems, optimal groundwater management, saltwater intrusion, development, and applications of geo-environmental software packages.

Hydrogeochemical Engineering and Soil Remediation Laboratory

DIVISION IV – Head: Nikolaidis Nikolaos, Professor

Water quality management at the watershed scale, development of hydrogeochemical models, pollution prevention and sustainable development. Assessment and remediation of soils polluted by heavy metals as well as the impact of organic pollutants on the fate and transport of heavy metals in the environment. Development of new technologies and use of existing ones for the remediation of soils and aquatic ecosystems from inorganic pollutants

Mathematics Laboratory

DIVISION I – Head: Manousakis Antonis, Professor

Research is focused in the Geometry of Banach space (distortion problem, heterogeneous structures, indecomposable Banach spaces) and in Operators on Banach spaces.

Physical Chemistry & Chemical Processes Laboratory

DIVISION III – Head: Yentekakis Ioannis, Professor

The laboratory of Physical Chemistry and Chemical Process (www.pccplab.tuc.gr) has excellent scientific equipment, active and productive faculty members, young and older researchers, postgraduate students and international collaborations thus, ensuring high quality education and research work.

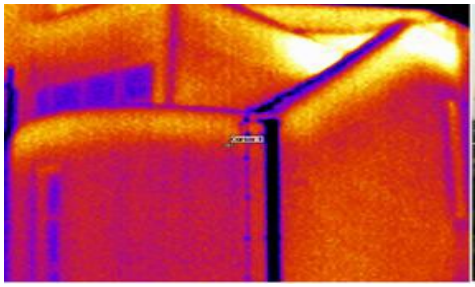
Research activities and scientific interests include: Synthesis of novel enhanced catalytic/ electrocatalytic properties nano-structured and composite materials. Structure, morphology, physicochemical characterization and catalytic performance evaluation of novel materials under selected reactions relevance to important technological applications. Behaviour of surfaces and interfaces. Promotion and its origin in heterogeneous catalysis and electrocatalysis. Fuel Cells science and technology. Hydrogen energy, biofuels, natural gas. Environmental catalysis and pollution control. Chemical and processes engineering

Renewable and Sustainable Energy Systems Laboratory

DIVISION I – Head: Theocharis Tsoutsos, Professor

The Unit of Renewable and Sustainable Energy Systems covers a wide range of Applied Research and Technological Development, Energy Planning and Sustainable Energy Management on the following groups of activities: Management Systems Renewable Energy and Energy Conservation (regional-local energy planning, sustainable management of natural resources, technology transfer, Life Cycle, Technical/Economic/Environmental evaluation), biofuels (use of agricultural and stockbreeding residues, production of liquid biofuels, biofuels for buildings heating, assessment of technical and financial resources available), Solar Air Conditioning (design active solar air conditioning systems, technical and financial evaluation), sustainable energy systems (Environmental Impact analysis using energy Systems, Renewable energy and Environment, Assessment of Renewable Sources

of Energy under uncertainty, development of sustainable energy systems, renewable energy industry analysis).




Stochastic models Laboratory

DIVISION II – Head: Daras Tryfon, Associate Professor

The main research activities is the study and formulation of mathematical models (deterministic and especially stochastic) to study the development of cancerous tumors. Emphasis is placed on the study of breast cancer.

Toxic and Hazardous Waste Management Laboratory

DIVISION I – Head: Giannis Apostolos, Assistant Professor

The main goal of the laboratory is the development of advanced scientific technologies, the promotion of scientific research, as well as the transfer of knowledge in the area of hazardous waste management. Physicochemical, biological and thermal treatment of hazardous waste, safe disposal at special landfills, waste recycling and hazardous waste management, as well as soil and groundwater remediation from hazardous wastes, are some of the basic fields on which the laboratory focuses.


Hydrologic and Hydraulic Engineering Laboratory

DIVISION IV – Head: Koutroulis Aristeidis, Associate Professor

The Hydrologic and Hydraulic Engineering Laboratory (hydromech.gr) is committed to advancing knowledge and research in the field of water resources and engineering. Our laboratory focuses on a diverse range of research activities encompassing hydro-climatology, hydraulics, and water systems aiming to address the complex challenges faced in managing and optimizing water resources. Key research areas include studying watershed dynamics at various spatial scales, assessing the impacts of floods and droughts and developing forecasting methods, providing weather and hydro-climate services, conducting hydraulic modelling, and analysing water resources in the face of changing climate and societal demands.

IV. Postgraduate Programme Regulations

I.8 Registration

The MSc "Sustainable Engineering and Climate Change" is open to a maximum of thirty (30) students per year.

The website of the CheEnvEng provides detailed information for new students and their registration.

A) Registration requirements

Holders of a diploma of higher education Greek institutions or equivalent institutions of foreign countries are admitted to the MSc.

The categories of graduates admitted to the MSc are:

- Graduates of all departments of Greek Higher Educational Institutions or equivalent educational institutions from abroad,

- Graduates of the Departments of Physics, Chemistry, Geology, Geography, Agriculture, Mathematics, Environmental Sciences, Computer Science, Medical and Biological Sciences of the Higher Educational Institutions (HEI), Hellenic Higher Military Educational Institutions or the equivalent educational institutions of foreign countries, as well as

- Graduates of the Greek Higher Technological Educational Institutions (TEI), of relevant field of study.

Also, Erasmus+ students, Special Education Staff Teachers and research staff of the following categories are admitted to the MSc:

- Laboratory Teaching Staff (LTS).

- Specialized Technical Laboratory Staff (STLS)

For those from foreign universities, a certificate of accreditation by Hellenic NARIC is required for admission to the Postgraduate Studies Programme.

I.9 Evaluation of applications and procedures

Admission

The admission of students follows the following procedure:

- Public expression of interest by the School of Chemical and Environmental Engineering of the Technical University of Crete for the admission of students to the Graduate Studies programme.

- Submission of an application form by the candidates through the online application system, accompanied by a set of supporting documents:

1. General information of the candidate and desired specialization (A or B).
2. Copies of acquired degrees/diplomas.
3. Certificate of accreditation by Hellenic NARIC (for degrees from foreign institutions). Further information will be provided after the evaluation results.
4. Official transcripts.
5. Copies of English Language Certificates (and of any other foreign language, where applicable).
6. Extended curriculum vitae.
7. List of awards, fellowships and publications.
8. Copies of scientific publications, if available.
9. A Personal statement in English of up to 1000 words setting out the reasons for participation in the postgraduate programme, previous experience and research interests.
10. At least two letters of recommendation which should be written by Faculty members, via the online application system (https://e-graduate.tuc.gr).

Criteria and evaluation

The selection committee for postgraduate students assesses the qualifications of the candidates. The main selection criteria are:

- the candidate's analytical score of the diploma,

- the candidate's performance in courses related to the field of the MSc, and

- the candidate's thesis (if any).

- proficiency in English.

Generally, the average score of the diploma must be at least seven (7). In addition, any research activity, professional experience and a proven knowledge of other foreign languages will be considered. In addition, the Steering Committee (SC) of the MSc may request a personal interview with the candidate. In exceptional cases, a treatise on a topic to be determined by the Departmental Assembly may be requested.

In the event that the candidate is admitted before being awarded a degree/diploma, the graduation must be completed within specific time limits and within the registration deadlines set by the Departmental Assembly.

I.10 Student Identity Card and Certificates

Students can apply for the Academic Identity Card (AIC) online throughout the academic year and at no cost, via the Ministry of Education's "Academic Identity" service [https://academicid.minedu.gov.gr/]. In order to apply, it is necessary for the student to have access to the online services of the Technical University of Crete. The AIC allows for a reduced (student) ticket to public transport as well as to various social events (cinemas, theatres, concerts, etc.)

After submitting the online application, the student receives the AID card from a distribution point of his/her choice. The AIC card is strictly personal. Discontinuation of the student status automatically means the termination of academic identity. In this case, the student must return the academic identity card to the Secretariat of the School. In case of loss, theft or destruction of his/her AID card, the student submits to the Secretariat or Student Services Center a statement authenticated by the police for its loss/theft, requesting the re-issuance of the academic identity card.

It is noted that following the approval of the reissue by the Secretariat, the process of acquiring academic identity is repeated. In case of re-issuance the student must pay a fee of € 3.10 upon receipt of the new academic identity card.

Certificates

The following certificates are issued by the Student Services Centre upon request:

- Certificate of Student Status
- Grade Transcript
- Certificate of Student Status for use with office of military services
- Diploma Certificate
- Certificate of Studies Completion
- Graduation Certificate

I.11 Student Status

Student status is acquired on registration to the School of Chemical and Environmental Engineering and terminated upon the award of the Diploma.

Students have the right to discontinue their studies for a maximum period of ten (10) semesters, consecutive or not, by submitting a written request to the School Secretariat. These semesters are not counted towards the maximum duration of study. Students who discontinue their studies loose temporarily their student status for the period of suspension. Student status is restored immediately upon return from suspension.

I.12 Services to Students

Academic Affairs
The Directorate of Academic Affairs is responsible for academic matters such as admission and registration of students to the university, issuing of student ID cards, student accommodation at the university Halls of Residence, meals at the university restaurant, transportation, scholarships and awards, health insurance, university textbooks and notes, students with disabilities, academic calendar etc.

Library and Information Centre
Students have free access to both the Library and the Digital Library Services which provide bibliographic databases for the search of articles, books, conference proceedings and others, electronic journals and books, dictionaries, encyclopedias. Students can also order articles through the Library.

Career Services Office
The main mission of the Career Services Office is to offer systematic information to TUC students and alumni on: postgraduate studies, successful career planning, employment opportunities in private or public enterprises as well as self-employment opportunities.

There are three main divisions in the Career Services Office. The first one provides information and counselling in education matters. The second division gathers factual information from the world of work, and supports students and alumni in their career development. The third division of entrepreneurship aims at making the entrepreneurial activity known to the students and alumni as an alternative option to their career path.

Psychological Support

The Counselling & Psychological Support Office was established in 2006 following a decision of the Rector's Council of the Technical University of Crete. The Office is supported by the Directorate of Academic Affairs and it is located at the building complex of the Mineral Resources Engineering Department – Building

Language Centre

The Language Centre of the Technical University of Crete supports enrolled students in English, German and Chinese language courses as well as those who generally want to improve their language skills in these languages. Greek language courses are also offered to Erasmus students. The goal is to make students aware of their learning process, to encourage self-assessment and the independent use of language learning strategies, always with the contribution and support of the staff of the Language Center. The purpose of the Language Center is for students to be able to use foreign languages in their professional life as engineers.

University Restaurant – Cafes

Students may have meals for free at the University Restaurant provided that they fulfil certain financial and social requirements with regard to their personal or family status and that they apply to the Directorate of Academic Affairs. A considerable number of undergraduate and postgraduate students as well as Erasmus students have free meals while the rest of the students have meals at extremely low prices.

In the current academic year, students who are not entitled to free meals, pay 0,90€ for breakfast, 2,60€ for lunch and 2,02€ for dinner, per day. Students may also take their meals in packages if they wish (single-use plastic container/bag tax applies) . Apart from students, University personnel (faculty members, administrative employees) and visitors very often choose the university Restaurant for their meals, paying the same prices as mentioned above, per meal (it includes main course, salad, cheese, dessert).

Three cafeterias are open daily for snacks, coffee and refreshments or/and for relaxation and meetings with friends.

Medical care

Upon registration, students are entitled to full medical care by the National Health System as long as they don't have medical coverage directly or indirectly by another entity.

Sport facilities

Students have access to the inhouse sport facilities consisting of two 5x5 and 3x3 soccer fields, three tennis courts and a training wall, three basketball courts, a volleyball court, and a gym.

Mobility – ERASMUS+

The Technical University of Crete and the School of Environmental Engineering are participating in the ERASMUS + Mobility Program, which has been in force since January 1st, 2014, and deals with mobility for studies as well as for traineeships. ERASMUS + scholarships are funded by Foundation for State Scholarships (IKY). Further information is provided by the Erasmus office (tel.: +30-28210-37470) and at the Erasmus+ website. The Professor S.Rozakis (tel.: +30-28210-06160, office K3.A6, e-mail: srozakis@chenveng.tuc.gr) is the Academic Coordinator for the ERASMUS + program in connection to students of the School of Chemical and Environmental Engineering.

I.13 Duration & Curriculum

Studies

The minimum duration for the award of a postgraduate degree is three (3) semesters, the last of which is allocated for the preparation of a postgraduate thesis. The maximum duration for completing the requirements for the Master's degree is set at six (6) semesters.

In the event that the Postgraduate Student exceeds the maximum time limit, as defined above, he/she is automatically dismissed from the MSc, however he/she receives a certificate of attendance of the courses for which has successfully completed.

Part-time attendance

The possibility of part-time attendance is provided for working students and in exceptional cases for non-working students in the exclusive and only case of proven serious health problems. The duration of part-time study may not exceed twice the normal duration of study (3 semesters). A postgraduate student interested in the above category (part-time) is obliged to:

- Submit a request to the Board and the Departmental Assembly, stating the reasons for requesting this arrangement.

- Relevant evidence (in the case of an employee, a certificate of employment from the employer or a copy of an employment contract), proving the grounds relied upon in the application.

After examining the application, the Steering Committee shall recommend to the Departmental Assembly whether to approve it.

Suspension of studies

A temporary suspension of studies, not exceeding two (2) consecutive semesters, is allowed. The semesters of suspension of student status do not count against the maximum period of regular attendance. A Graduate Student who is interested in suspending studies is required to:

- Submit a request to the Board and the Departmental Assembly stating the reasons for requesting this arrangement.

- Relevant evidence where the grounds relied upon in the application are substantiated.

The Steering Committee, after examining the application, shall recommend to the Departmental Assembly whether to approve it.

Semesters and Official Holidays

The exact start and end dates for the semesters and the exam periods are determined by the Senate of the Technical University of Crete. Each semester includes at least thirteen (13) full weeks of classes and two (2) weeks of examinations.

Public Holidays during the academic year are:

- 28/10/2023: National "Ochi" (No) Day
- 17/11/2023: Commemoration of Nov 17, 1973
- 21/11/2023: The Presentation of Theotokos (local holiday)
- 25/12/2023: Christmas Day
- 01/01/2024: New Year Day
- 06/01/2024: Epiphany
- 27/02/2023: Ash Monday
- 25/03/2024: National Independence Day

- 01/05/2024: Labour Day
- 03/05/2024: Orthodox Good Friday
- 05/05/2024: Orthodox Easter Sunday
- 06/05/2024: Orthodox Easter Monday
- XX/0X/2024: Student Elections Day (no classes held)
- 24/06/2024: Monday of the Holy Spirit
- 15/08/2024: Dormition of the Theotokos

Duration and teaching format - Distance learning

All courses are in the form of lectures or seminars and include exercises, topics, presentations and discussions. The duration of instruction in all courses is a minimum of three (3) hours per week. All courses require 13 full weeks of instruction, of which at least seven (7) full weeks consist of lectures, presentations, discussions and the remaining six (6) weeks at least in collaboration with the instructors for solving applications and carrying out projects. In a limited number of courses defined from the beginning of the semester and which are conducted in a workshop format, the 13 weeks of instruction and exercises may be compressed into fewer weeks, but corresponding to the same total time of 13 weeks. In no case, however, may the previous condensation of the 13 full weeks be reduced to less than seven (7) full weeks.

Courses may also be offered at a distance using appropriate teaching methods and technological equipment (e-learning). Such teaching shall be provided within the time limits provided for in par. 3 of Article 30 of Law No. 4485/2017.

Course exams - Evaluation of Postgraduate Students' Performance

Programme and Course of Studies

The MSc consists of postgraduate courses and the preparation of a Master's Thesis. It is enriched with lectures by specially invited scientists, scientific thematic workshops and educational visits to gain knowledge and experience.

The following applies to the MSc programme:

-At the beginning of each academic year, the courses to be offered during the academic year are announced.

- The programme of postgraduate courses is set by the Departmental Assembly at the beginning of the academic year.

Registration for postgraduate courses is carried out electronically at the beginning of each semester within a period of time set by the Board of Directors.

- Nine (9) ECTS credits and three (3) for Research Lectures are assigned to each postgraduate course.

- Attendance of the courses is compulsory for the Graduate Students.

- All courses are semester-long, are in the form of lectures or seminars and include exercises, topics, presentations and discussions.

- The courses are conducted in English.

- The way of examination of the courses is determined by the lecturer and is conducted after the end of the respective semesters.

Course Grading

The completion of a postgraduate course in the first or second semester of study is considered successful when the student has achieved a grade of at least six (6) on a scale of 0 to 10. In the event that a graduate student enrolls in a course of the MSc and receives a grade of less than six (6.0), he/she is considered to have failed and must either repeat the course in the next semester after re-enrolling in it or enroll in another course from those offered by the MSc. The mode of examination of a course includes either a final examination or a project delivery, at the discretion of the instructor.

In order to become a holder of the M.Sc. degree, a graduate student must earn an average grade of at least seven (7.0) from the courses. If he/she obtains an average grade of less than 7.0 after completing six (6) courses or fails two (2) courses, i.e., a grade of less than six (6.0), the graduate student is removed from the M.Sc. However, he/she is awarded a certificate for all courses taught and successfully completed.

The postgraduate degree awarded shall bear a 'Characterisation' of performance which shall be in order of success:

- "Excellent" with a Course Grade Point Average of 9.0 to 10.0.
- "Very Good" with a Grade Point Average of 8.0 to 9.0 (inclusive).
- "Good" with an Average Grade Point Average of 7.0 to 8.0 (inclusive).

Requirements for the Diploma of Postgraduate Studies

For the award of the Diploma of Postgraduate Studies (D.M.S.) the following are required:

1. Successful attendance and completion of courses

2. Successful completion of a Master's Thesis (M.Sc.).

3. Completion of a total of 90 credit points (ECTS).

The courses, research activities, and any other educational and research activities required for the award of postgraduate degrees are defined as follows:

- 90 credit points (European Credit Transfer System - ECTS) and a minimum duration of three semesters are required for the award of the M.Sc. degree.

- The 60 credit points (ECTS) will be acquired from the 6 courses and the 2 courses of the 'Research Lectures'. Each postgraduate course is worth 9 credits according to the European Credit Transfer and Accumulation System (ECTS), with the exception of the 'Research Lectures', which are worth 3 ECTS credits each.

- The 30 credit points (ECTS) are obtained by the completion of a Master's Thesis.

- In each direction there are at least four (4) compulsory courses that postgraduate students must attend.
- All graduate students are required to take two (2) compulsory "Research Lectures" courses.
- In addition to the compulsory courses of the specialization, postgraduate students are required to select, in cooperation with the supervisor, and attend two (2) elective courses of the declared specialization of the MSc or of the courses common to both specializations.
- It is important to note that postgraduate students of both directions, with the agreement of their supervisor and after approval of the Departmental Assembly, may attend an elective course (a) of the other specialization or other Postgraduate Programmes of the Technical Univerisy of Crete b) from the courses offered for doctoral candidates c) from the courses offered at other universities in Greece and recognized equivalent institutions abroad.
- In case a postgraduate student registers for a course of the MSc and receives a grade of less than six (6,0), he/she is considered to have failed the course and must either re-register for the course or repeat it in the next semester or register for another course from those offered by the MSc.

Postgraduate Diploma Thesis

The Postgraduate Diploma Thesis is an individual project and is carried out by each student in the 3rd semester. The duration of the Thesis cannot be less than three (3) years, which corresponds to the maximum time for obtaining the postgraduate degree.

The topic of the Thesis is approved by the Departmental Assembly, following the recommendation of the Coordinating Committee for Postgraduate Studies. The Thesis must be of a research nature and must confirm the competence of the postgraduate student. It must be of an excellent linguistic and conceptual quality (grammatical and syntactical) and must attest to the postgraduate student's current understanding of the literature on the subject and his/her ability to make use of it for research purposes.

The Thesis is carried out under the guidance and supervision of a professor or lecturer (supervisor), who should be a tutor in the postgraduate programme and is appointed by the Coordinating Committee following a request from the student. This request should include the proposed title of the Thesis, the proposed supervisor and a summary of the proposed Thesis. The Thesis is evaluated by a three-member Examination Committee, consisting of the Supervisor and two other professors or lecturers, who are appointed by the Coordinating Committee during the third semester of study, on the recommendation of the supervisor. The members of the Examination Committee can be either from the Technical University of Crete or from other recognized academic and research institutions in Greece or abroad.

The student may, upon application to the Assembly of the Department, request a change of the Supervisor and the subject of his/her Thesis. Likewise, if the supervisor considers for any reason that he/she cannot supervise a postgraduate student, the Departmental Assembly may, upon request and at the request of the postgraduate student, appoint

another supervisor. In any other case, the Departmental Assembly shall make every effort to resolve the matter.

The Thesis is written in English. If the M.D.E. is approved by the Examination Committee, it must be posted on the Faculty's website.

The Thesis is evaluated through a public presentation (support) by the postgraduate student who is presenting the thesis before the Examination Committee on a date predetermined by the Departmental Assembly. Presentations of Master's Theses are made during the academic year outside the vacation period.

The Master's thesis is graded as " With Honours", " Sufficient" or " Insufficient" by the three-member Examination Committee with the agreement of at least two of its members.

If the Master's thesis is considered " Insufficient ", then the postgraduate student must complete the Thesis according to the Committee's recommendations and undergo a second and final examination.

Dismissal from the programme.

A postgraduate student is dismissed from the Master's programme upon request. In order to complete the disenrollment, the Secretariat checks if the student owes the institution's equipment, library books and is financially compliant.

Grounds for automatic dismissal from the MSc are as follows:

- Failure to complete the requirements for obtaining an M.Sc. as described, after the maximum duration.

- Non-payment of the tuition fees in the predefined periods of time set and announced by the Board.

In the event of a request for withdrawal from the MSc, the registration fees paid for the past semesters will not be refunded.

Tuition fees

The tuition fees for each postgraduate student who is not entitled to free tuition, according to article 35 of Law 4485/2017 for the three (3) semesters, are set at one thousand five hundred euros (1500) euros in total. For attendance over three (3) semesters, the tuition fees are set at 150 euros for each additional semester.

The tuition fee shall be paid in 3 equal instalments. Each of the three instalments shall be paid no later than the end of the period of enrolment for each of the three semesters of study. A copy of the proof of payment must be submitted to the Secretariat of the School of Environmental Engineering of the Technical University of Crete within the prescribed dates

Scholarships

According to article 35, paragraph 2 of Law 4485/2017, students of the P. M.S, whose individual income in the case of personal income, and the family's income in the case of group income do not exceed the one hundred percent (100%) or the seventy percent (70%) of the national median equivalent disposable income, correspondingly, based on the most

recent data published each time by the Hellenic Statistical Authority (EL.STAT.). This exemption is granted for participation in only one study programme.

In any case, the exempted students do not exceed thirty percent (30%) of the total number of students admitted to the programme. In case the number of eligible students exceeds the 30% of the total number of students admitted to the programme, they are selected in order of ranking, starting from those with the lowest income. A decision of the Minister of Education, Research and Religious Affairs, published in the Government Gazette, shall determine all matters relating to the general application of the regulations. A similar decision shall establish each year the amount corresponding to the national median disposable equivalent income, according to the data of the National Statistical Office. For the application of this regulation, the appointed Committee (based on paragraph 3 of Article 31 of Law 4485/2017) shall take into account the income of the last tax year for which, at the time of selection for the MSc, the tax clearance has been completed, in accordance with the provisions of the Income Tax Code.

The application for exemption from tuition fees is submitted after the completion of the selection process of students of the MSc. The financial situation of a candidate is in no case a reason for non-selection to a MSc. Those who receive a scholarship from another source are not entitled to exemption.

Scholarships based on academic criteria

Following the recommendation of the Departmental Assembly, a postgraduate student who completes the second semester of studies, successfully completes all the academic responsibilities of the first and second semesters of studies, and achieves the highest average marks in all the courses of the MSc, is exempted from paying the tuition fee for the entire duration of his/her studies by a percentage equal to 100%.

Evaluation of instructors and courses

The evaluation procedures of courses and teachers are applied in accordance with the provisions of article 44 of Law 4485/2017. At the end of each semester, each course and each instructor is evaluated by the postgraduate students, electronically, by completing a questionnaire, the content of which is prepared by the Committee and approved by the Departmental Assembly.

In addition to the internal and external evaluation procedures as well as quality assurance and certification procedures as provided for in Law 4009/2011, the external evaluation of the MSc is also carried out by the six-member Scientific Advisory Committee in accordance with the specific provisions of paragraphs 3, 4, 5, 6 and 7 of Article 44 of Law 4485/2017.

Graduation Ceremony and Diploma of Postgraduate Studies

After the thesis has been supported before the examination committee and the Postgraduate Diploma Thesis has been approved, the Departmental Assembly certifies the successful completion of the course of study in order to award the Master's Degree. The postgraduate student is declared holder of the Diploma of Postgraduate Studies on the day of the

successful completion of his/her studies by the Assembly of the Department and is awarded a Certificate of Postgraduate Diploma.

The ceremonial oath and the awarding of the Diploma of Postgraduate Studies shall take place after the decision of the Rectorate of the Institution and the date, place and time of the ceremony shall be determined.

The postgraduate student shall be awarded : a) Diploma of Postgraduate Studies and b) Diploma Supplement in accordance with Article 15 of Law No. 3374/2005 (A' 189) which is approved by the Departmental Assembly following the recommendation of the Board of Directors and is posted on the official website of the School.

Rights and Responsibilities of postgraduate students

Students of the MSc in Chemical and Environmental Engineering of the School of Chemical and Environmental Engineering of the Technical University of Crete have all the rights and benefits provided for students of the first cycle of studies, except for the right to free textbooks.

Students have:

-to enroll, attend and actively participate in the postgraduate courses and successfully complete the examinations, in accordance with the regulations at place. A student who has been absent without justification from any of the courses of the MSc for a total of more than three hours shall be considered as not having been adequately enrolled on that course.

-to complete the MSc in accordance with these regulations.

- to provide supplementary academic support to the Faculty, which is determined by the instructors in collaboration with the Steering Committee and after approval by the Departmental Assembly as to the load and scope of the work. The following are indicative examples of supplementary tasks: supervision in examinations of undergraduate courses, assistance in teaching undergraduate courses and assisting in the Faculty's laboratory courses.

V. CURRICULUM

Tables below list all required and elective courses of the curriculum per semester. For each course the title, ID code and credits according to the European Credit Transfer and Accumulation System (ECTS) are noted. At the end of each table, there is a list of all the elective courses that students can choose during their studies, as well as some restrictions that apply.

MSc Specialization Area A: Sustainable Water and Wastewater Management

1st Semester Courses (Fall)

ID	Required Courses	ECTS
A 105	Conventional Water and Wastewater Treatment	9
A 106	Decentralized Wastewater Treatment and Water Recycling	9
AB 301	Research Lectures	3

Elective courses

ID	Elective Courses	ECTS
AB 302	Environment and Public Health	9
AB 308	Applied Mathematics for Chemical and Environmental Engineers	9

2nd Semester courses (Spring)

ID	Required Courses	ECTS
A 102	Integrated Water Resources Management	9
A 103	Fate and Transport of Contaminants in the Water	9
A 104	Advanced Oxidation Processes for Water and Wastewater Treatment	9
AB 304	Research Lectures	3

Elective Courses

ID	Elective Courses	ECTS
AB 306	Computational dynamics with emphasis on earthquake engineering	9

MSc Specialization Area B: Sustainable Energy

1st Semester Courses (Fall)

ID	Required Courses	ECTS
B 201	Design of Sustainable Energy and Mobility Systems	9
B 208	Climate Change and Greenhouse Gas Emissions	9
B 202	Solid and toxic waste management	9
AB 301	Research Lectures	3

Elective Courses

ID	Elective Courses	ECTS
AB 302	Environment and Public Health	9
AB 308	Applied Mathematics for Chemical and Environmental Engineers	9

2nd Semester Courses (Spring)

ID	Required Courses	ECTS
B 205	Advanced Studies on Energy Efficiency and Environmental Quality in the Built Environment	9
B 210	Circular Economy	9
B 212	Climate Change Impact Assessment in Practice	9
B 214	Air Pollution – Fundamentals and Practice	9
AB 304	Research Lectures	3

Elective Courses

ID	Elective Courses	ECTS
B 207	Environmental Economics and Policy	9
AB 306	Computational dynamics with emphasis on earthquake engineering	9
AB 305	Environmental Low and Sustainable Development	9
AB 307	Groundwater and Climate Change	9
A 101	Advanced Topics in Environmental Chemistry	9

B 209	Advanced Energy Generation Technologies	9
B 211	Advanced Air Pollutant Treatment Technologies	9
GEnvE 868	Stochastic Behaviour Time Series Analysis	9

I.14 Courses description

1st Semester Courses (for both MSc Specialization Areas, A and B)

Required Courses

A 105	CONVENTIONAL WATER AND WASTEWATER TREATMENT

Course description and content:

The course aims at providing the fundamental analysis and design of the most important unit operations used for wastewater treatment and for water reuse. The main physical, chemical and biological processes used in conventional wastewater treatment applications are studied in detail. Also, the main principles for the design of wastewater management processes are explained.

• Introduction to water/wastewater pollution and quality control • General principles on water/wastewater treatment, Preliminary treatment • Sedimentation (Basic design principles) • Introduction to chemical reaction kinetics-Design of chemical reactors • Activated Sludge-I (Removal of organic load, Nitrification, Denitrification, Phosphorus removal) • Activated Sludge-II (Main design principles) • Coagulation-Flocculation, Filtration • Disinfection (Chlorination, Ozonation, UV radiation) • Biosolids management-I (Thickening, Dewatering, Composting) • Biosolids management-II (Anaerobic digestion) • Special systems for wastewater treatment (MBR, MBBR) • Water reclamation and reuse processes • Water resources Management

Learning Outcomes:

- Analyse Wastewater Treatment and Water Reuse Systems
- Design (Analyse) Wastewater Treatment and Water Reuse Systems
- Design (Synthesize) Wastewater Treatment and Water Reuse Systems
- Recognize Wastewater Treatment and Water Reuse Systems
- Compare (Evaluate) Wastewater Treatment and Water Reuse Systems

A 106	DECENTRALIZED WASTEWATER TREATMENT AND WATER RECYCLING

Course description and content:

The course is structured in two sections. The first discusses the decentralized wastewater treatment and the second the water reuse. More detailed, treatment processes, design aspects, operation and maintenance of ponds, free-water surface constructed wetlands, subsurface and vertical flow constructed wetlands, land treatment, and onsite treatment systems are discussed. In the second section, issues and applications of effluent reuse will be presented with emphasis on agricultural reuse, groundwater recharge, and indirect potable use.

• Introduction to decentralized wastewater treatment • Constructed wetlands: Treatment processes • Free-water surface constructed wetlands: Design, operation and maintenance • Subsurface constructed wetlands: Design, operation and maintenance • Vertical flow constructed wetlands: Design, operation and maintenance • Land treatment systems: Treatment processes • Land treatment systems: Design, operation and maintenance • Pond systems: Treatment processes and design • Onsite wastewater treatment systems • Water Reuse: History, applications, environmental and public health issues • Water reuse in Agriculture • Water reuse for groundwater recharge • Water reuse for indirect potable reuse

Learning Outcomes:

- Design (Analyse) Decentralized Wastewater Treatment systems (land systems and constructed wetlands
- Tell Basic mechanisms of treatment processes
- Review Recent advances in the field

B 201	DESIGN OF SUSTAINABLE ENERGY AND MOBILITY SYSTEMS

Course description and content:

Design principles. Demonstration of the use of the course's virtual Lab. Special renewable energy applications. Electrical systems. Wind - photovoltaic - hybrid. Desalination, autonomous energy systems. Solar air conditioning. Integration into the built environment. Biofuels. Energy, environmental and economic assessment. Multi-criteria analysis for the optimal choice of energy systems. Use of Life Cycle Analysis to study environmental impacts. Critical issues of large transport systems. Sustainable design of large-scale net-zero system (islands, cities). Applications, system dimensioning and examples.

• Basic design principles. • Demonstration of using the ReSEL-PLAN toolbox. • Use of Life Cycle Analysis to study environmental impacts. • Zero Energy Systems • Special

applications of renewable energy sources. Electrical systems. Wind - photovoltaic - hybrid. Desalination, autonomous energy systems. Solar air conditioning. Integration into the built environment. • Biofuels. Energy, environmental and economic assessment. • Multi-criteria analysis for the optimal choice of sustainable energy and transport systems. • Sustainable large-scale zero emission system design (islands, cities, ports). • Economics, system dimensioning.

Learning Outcomes:

- Research, analysis and synthesis of data and information, using the necessary technologies
- Project design and Management
- Respect for the natural environment
- Promoting free, creative and inductive thinking
- Problem Solving

B 202	**SOLID AND TOXIC WASTE MANAGEMENT**

Course description and content:

• Introduction to Integrated Solid Waste Management • Reduce, Reuse, Recycle, Recovery… The Rs of Solid Waste Management • Biological Conversion Technologies (aerobic composting - anaerobic digestion) • Thermal Conversion Technologies (incineration) • Advanced Thermal Systems (pyrolysis, gasification, air pollution control) • Waste disposal • Landfill design • Hazardous waste: main characteristics, classification, labeling, toxicology and risk analysis • Physico-chemical and thermal treatment of hazardous waste • Disposal of hazardous waste • Dioxins (PCDDs), Furans (PCDFs) and Polychlorinated Biphenyls (PCBs)

Learning Outcomes:

- Assess basic principles on solid and hazardous waste management
- Apply the best approach based on waste properties and characteristics
- Design (Synthesize) collection and transportation systems
- Estimate the landfill size or treatment facilities for specific case studies
- Evaluate physicochemical characteristics of degradation products (landfill leachate, biogas)
- Calculate risk assessment

B 208	CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS

Course description and content:

• Atmospheric structure and composition. • Air pollutants. • Radiation in the atmosphere. Greenhouse effect. • Energy balance and climate. • Emissions of gaseous components and aerosols. Air pollution dispersion. • Atmospheric chemistry and climate. • Atmospheric aerosols and effects on visibility and climate. • Climate Characteristics • Single cell models. Climate models. • GHG pollutants. • Formulation of an emission inventory. • Project for the calculation of the Carbon dioxide in the atmosphere. • Project for the calculation of the Carbon footprint.

Learning Outcomes:

- Analyse the basic characteristics of the Earth's atmosphere (structure, density, temperature lapse rate, pressure and energy balance).
- Assess the composition of the atmosphere Create • Will have knowledge of the impact of the greenhouse effect to the temperature balance of the planet.
- Calculate the basic characteristics of particulate matter (density, chemical properties, size and sources).
- Assemble the basic principles of the Eulerian and Lagrangian air quality models to calculate the concentration of pollutants in air.
- Combines Gaussian models for the calculation of air pollutants concentration.
- Demonstrate simple models for calculating the carbon footprint from houses and industrial facilities
- Compare (Evaluate) simple climate models for the calculation of GHG levels and emissions.
- Knowledge of the air quality and climate legislation concerning gaseous and particulate matter pollutants.

AB 301	RESEARCH LECTURES

Course description and content:

Under the frame of the Postgraduate Studies Programme of the School of Environmental Engineering of the Technical University of Crete, Postgraduate and Ph.D. Students of the PSP can attend research lectures/seminars delivered by members of the School (Faculty members, Ph.D. candidates and collaborators) and/or invited Experts from other Universities & Research Centers in Greece and abroad, as well as by public and private institutions. Each seminar will focus on one research and/or practical topic of the expertise of the Speaker kai will present the approach followed (description and difficulties, addressing methodologies, results and future studies, etc).

This course aims at the dissemination of knowledge of scientific research in the field of Environmental Engineering Science and at familiarizing the postgraduate Students to the challenges and methods of research procedure. Based on these, the main targets of the course are:

- Presentation and dissemination of research results on cutting-edge topics.
- Support the postgraduate Students in the process of implementing their research and completing their master thesis.
- Update of postgraduate Students on the research activities of the School of Environmental Engineering and their activation to enable their potential involvement in projects with an innovative research nature and continuing their doctoral studies.

Attending lectures (approximately 10 hourly lectures per semester) is mandatory, for those semesters specified by the curricula for the postgraduate and Ph.D Students of the School, while all lectures are open to the academic community.

Learning Outcomes:

- Comprehend
- Debate
- Discuss
- Recall

Elective Courses

AB 302	**ENVIRONMENT AND PUBLIC HEALTH**

Course description and content:

The overall objectives of the course comprise the following: a) introduction to the important microorganisms and viruses involved in environmental microbiology, which play important role on public health, b) definition of the nature of the different environments in which the microbes are situated and the methodologies used to monitor them and their activities, c) basic elements of epidemiology and risk assessment, d) the use of microorganisms and their application for wastewater treatment, nutrient cycling and bioremediation purposes, e) disinfection techniques for water and wastewater purification and f) effects of various pathogens/emerging pathogens/emerging micropollutants on human activities and public health.

• Introduction to microbiology of the aquatic environment. Groups of microorganisms: Prokaryotic, Eukaryotic microorganisms & Viruses. • Cell structure – chemical composition of biological systems. Metabolic pathways in microbial cells. • Major metabolic pathways in microorganisms (metabolism of nitrogen compounds, hydrocarbons). Microbial growth, kinetics and metabolic products. • Heterogeneous microbial growth – biofilm. Mixed

microbial cultures. Microbial interactions. • Public health microbiology. Elements of epidemiology (infection, types and reservoir of infectious agents, mode of transmission of pathogenic microorganisms & viruses, host susceptibility). Waterborne diseases. • Emerging/re-emerging & ESKAPE pathogens. Infectivity. Risk assessment. Microbiological quality of aquatic environment. • Monitoring of environmental quality using bioindicators & biosensors. Microbiological quality of bottled water & seawater. • Presence of antibiotics in the environment. Development of antibiotic resistant bacteria & dispersion of antibiotic resistance genes. • Wastewater and water treatment microbiology. Disinfection of water & wastewater. • Disinfection of water & wastewater. • The use of microorganisms for bioremediation purposes. • HACCP system.

Learning Outcomes:

- Recognise the basic groups of microorganisms that play an important role on public health.
- Define basic cellular structures and macromolecules that play important role on microbial function.
- Assess the role of microorganisms on biogeochemical cycles and wastewater treatment.
- Comprehend the use of microbial indicators, bioindicators and biosensors regarding the assessment of microbiological quality of the aquatic environment.
- Describe basic elements of epidemiology and risk assessment.
- Design (Analyse) disinfection processes for water and wastewater purification.
- Discuss the use of microorganisms for bioremediation purposes.
- Identify the presence of emerging pathogens and micropollutants in the environment and their importance to public health.

AB 308	**COMPUTATIONAL DYNAMICS WITH EMPHASIS ON EARTHQUAKE ENGINEERING**

Course description and content:

Earthquake Engineering & Computational dynamics: constitutes a major scientific and practical issue worldwide. In this course the theory / norms / numerical issues related to Earthquake Engineering will be covered. Goal: use of all available information and numerical tools to analyze the effects of earthquakes on structures and infrastructure that eventually have led to the current state-of-the-art seismic design guidelines and numerical applications in research and engineering practice. How to achieve it: Describe all major topics involved on earthquake engineering with emphasis on computational dynamics. Guide students how to use open-source computational platforms and software to perform advanced dynamic simulations. Students will be assigned a complex numerical project based on topics and software about which the students are particularly knowledgeable or

interested. Hopefully, by the end of the course, students will be able to perform advanced simulations of complex dynamic problems.

• Earthquakes Mechanics and Effects • Structural Dynamics of SDOF Systems • Structural Dynamics of MDOF Systems • Seismic Hazard Analysis • Inelastic Behavior of Materials and Structures • Concepts of Earthquake Engineering • Seismic Load Analysis • Seismic Design of Various Structural Systems • Performance Based Engineering • Geotechnical Earthquake Engineering • Advanced Dynamic Analysis Issues • Passive Energy Systems & Seismic Isolation • Presentation & Assessment of Projects

Learning Outcomes:

- Analyse The contemporary methods and norms that contribute to improving the seismic performance of structures.
- Calculate The seismic demand and resistance of buildings and other structures. Comprehend The impact of earthquake-related geohazards on the built environment.
- Identify The main challenges related to seismic design of buildings and infrastructure. Practise In real engineering applications.
- Use Available software tools and advanced numerical methodologies for the dynamic analysis of structures.
- Explain Scientific findings clearly and effectively.
- Demonstrate Present research projects coherently, integrating data, analyses, and implications into a structured presentation.

2nd Semester Courses (for both MSc Specialization Areas, A and B)

Required Courses

A 102	INTERGRATED WATER AND WASTEWATER RESOURCES MANAGEMENT

Course description and content:

The objective of the course is to train graduate students to conduct integrated water resources management according to the water framework directive. The course entails lectures with the basic principles of water resources management, examples of specialized studies of water management, evaluation of the impacts of climate change, development and evaluation of program of measures and use of Nature Based Solutions to mitigate the impacts of climate change. The course has 3 laboratories and 1 field visit at the Koiliaris River Critical Zone Observatory. The course will use the SWAT model for simulating surface and groundwater at the watershed level.

• Introduction to water resources management - Global environmental challenges and introduction to observatory science • Special management plans for rivers Koiliaris,

Evrotas, Keritis and Municipality of Kandanos watersheds. • Introduction to SWAT model - Water legislation • Application of SWAT • Water management plan for the Region of Crete • Field visit to Koiliaris CZO • Impacts of Climate change and program of measures • Simulation of climate change scenarios using SWAT • DPSIR analysis at the watershed level and methodology for the prioritization of the program of measures • Economic analysis of the program of measures • Nature Based Solutions for climate change adaptation and mitigation • Evaluation of the adaptation measures of climate change

Learning Outcomes:

- Analyse hydrologic simulation and water balance at the watershed level using the SWAT model
- Apply simulation of water quality parameters in surface and ground waters using the SWAT
- Assess climate change impacts on hydrologic processes and water quality
- Compare (Evaluate) impact of point and non-point sources of pollution
- Evaluate implementation of the water framework directive in a small basin
- Design (Analyse) nature base solutions to solve hydrologic and quality problems
- Prepare alterative scenarios to water management
- Prepare technical reports on project results.

A 104	**ADVANCED OXIDATION PROCESSES IN WATER AND WASTEWATER TREATMENT**

Course description and content:

• Water pollution • Water and wastewater treatment • UV photolysis • UV/H2O2 processes • Ozone in water and wastewater treatment, • Fenton processes • Semiconductor photocatalysis • Sulfate radical ion-based processes • Ultrasound processes • Electrochemical oxidation processes

Learning Outcomes:

- Analyse experimental results published in the scientific literature regarding the application of advanced oxidation processes for water and wastewater treatment
- Choose the most efficient method(s) for water and wastewater treatment
- Collect data published in the scientific literature concerning water pollution and advanced oxidation processes for water and wastewater treatment
- Compare (Analyse) the efficiency of the various advanced oxidation processes for the degradation of organic pollutants in aqueous matrices
- Comprehend the fundamental target of advanced oxidation processes for water and wastewater treatment
- Describe the general methods used for water and wastewater treatment

- Evaluate the various advanced oxidation processes in terms of their reactivity towards the degradation of organic pollutants in the aqueous phase
- Explain the basic mechanism of the various advanced oxidation processes
- Propose appropriate advanced oxidation processes for the degradation of various classes of organic pollutants
- Recognise the main advantages and disadvantages of the advanced oxidation processes Relate (Know) the structure of various organic pollutants with their reactivity towards advanced oxidation processes
- Review the basic principles of advanced oxidation processes
- Select the most efficient advanced oxidation processes in terms of their energy consumption and cost Use the knowledge gained in the course regarding advanced oxidation processes for large scale applications
- Design (Synthesise) a treatment train for water and wastewater

B 205	ADVANCED STUDIES ON ENERGY EFFICIENCY AND ENVIRONMENTAL QUALITY IN THE BUILT ENVIRONMENT

Course description and content:

The course aims to analyze, design, and evaluate the key technologies that contribute to improving the energy efficiency of buildings, districts and urban built environments. In addition, the course aims to analyze the environmental quality parameters indoors and in outdoor areas. Thermal comfort, visual comfort and indoor air quality are presented.

• Energy needs in buildings, communities and cities. Modern challenges for the built environment. • Indoor Environmental Quality in Buildings (Thermal Comfort - Air Quality and Ventilation - Air Conditioning Systems - Visual comfort and lighting) • Smart Buildings and Integrated Energy Design • Buildings Certification LEED and BREEAM Standards • Zero Energy Communities and Intelligent Energy Systems • Energy planning in the urban environment and urban heat island phenomenon • Smart cities and energy infrastructure • Case Study Analysis

Learning Outcomes:

- Analyse the key technologies that contribute to improving the energy efficiency of buildings, districts and urban built environments.
- Calculate the energy demand and energy consumption of buildings and communities.
- Comprehend the role of built environment in sustainable development goals.
- Identify the main challenges in buildings and living spaces related projects.
- Practice in real case studies examples.
- Use available tools and technologies for the reduction of the energy demand in the built environment.

B 210	CIRCULAR ECONOMY

Course description and content:

The course aims to present and analyze the basic principles and concept of Circular Economy. As a relatively new paradigm of economic development, Circular Economy is rapidly growing. The course will show how circularity can be applied in practice, in which disciplines and areas, and the opportunities that provides for multi- and interdisciplinary collaboration. The course also aims at supporting the participant to carry out or reflect upon her/his research and study with a transdisciplinary approach.

• Introduction to the Circular Economy • Sustainable growth and Circular Economy • Circular Economy Principles • Waste and Systems-Level Thinking • Enterprise Environmental Performance - Environmental Management Systems • Enterprise Environmental Performance & Environmental Practices • Material and Product Design • Environmental Quality Assurance Techniques • Circular Economy at the Urban and Regional Level

Learning Outcomes:

- Identify The environmental problems and issues that led to the need for paradigm shift
- Recognize The relation and interconnection between sustainability and circularity
- Distinguish The basic principles and approach of circular economy
- Develop The adoption of circularity in the business sector and the industry
- Propose The change in mindset and way of thinking in the decision-making process
- Illustrate The benefits of circular economy for the users, the economy, the society and the businesses

B 212	CLIMATE CHANGE IMPACT ASSESSMENT IN PRACTICE

Course description and content:

Climate change is a leading environmental and social issue globally. However, its impacts are experienced at regional and local scales; thus, their assessment and the planning for adaptation depend on the availability of regional and local climate information at appropriate scales and forms. This course covers the theory and application of climate change impact assessment as a tool for environmental science. The course discusses the use of climate data to analyse the effects of climate change and, eventually, to guide regional decision-making and adaptation plans. The course begins with an overview of climate change science and the adaptation and vulnerability of manmade and natural systems to climate change. The framework for the climate change impact assessment

(CCIA) is then presented and used in a number of case studies. A significant part of the course is dedicated to individual student projects. Instructors will assist students in designing a research project of their choice that will use open-source online platforms and tools to access projections of future climate generated by climate models participating in the most recent climate modelling phases. Students are encouraged to choose projects based on their prior research and professional experience or based on topics and regions about which the students are particularly knowledgeable or interested. By the end of the course, students will be able to work with observations and climate model outputs for CCIA, apply CCIA to real-world problems and professionally communicate scientific findings.

• Introduction to climate change and impact modelling. • The IPCC organization and the 6th assessment report on impacts adaptation and vulnerability • Key concepts for Assessing Climate Change Impact. • Climate Change Impacts (A Global and European Perspective - The IPCC interactive Atlas). • CCIA Projects Prospectus. • Climate model data: Sources, formats, software and repositories. The Copernicus Climate Data Store. Obtaining fit-for-purpose data for impact assessment. The Climate Data Operator (CDO) • Processing data for impact assessments (downscaling and impact modelling) • Detection and Attribution of Climate Change impacts

Learning Outcomes:

- Comprehend the foundational concepts of climate science and the implications of a changing climate on both global and localized scales.
- Identify key methodologies and principles of climate change impact assessment.
- Describe IPCC statements, reports, and findings.
- Collect, extract, and interpret fit-for-purpose climate data for impact assessments, using a variety of tools and platforms.
- Apply hands-on techniques such as downscaling, adjustment, and processing of climate data to predict potential impacts.
- Design (Synthesize) and execute a CCIA project, from initial brainstorming to final presentation, integrating observational data, model outputs, and real-world applications.
- Explain scientific findings clearly and effectively.
- Demonstrate and present research projects coherently, integrating data, analyses, and implications into a structured presentation.

B 214	AIR POLLUTION – FUNDAMENTALS AND PRACTICE

Course description and content:

The overall course objective is to introduce the students to the problem of air pollution, and to provide them with skills that will equip them to be able to measure, model, and predict quantities that are relevant to air pollution levels and air quality. Basic theoretical understanding of the fundamental aspects of the problem will be built, while more applied lectures and projects will provide knowledge and hands-on experience on modelling tools and measurement techniques of air pollution levels.

• Overview of the air pollution problem – history and current state •Gaseous pollutants • Aerosol pollutants •Air pollutants and climate change • Modelling air pollution and air quality • Problem •Measuring air pollution and air quality •Health and ecosystem effects of air pollution •Effects of weather phenomena on air pollutants •Air quality control policies and regulations •Indoor air quality / Project overview •Modelling dispersion of pollutants / Project progress

Learning Outcomes:

- Comprehend the problem of air pollution on different spatial and temporal scales.
- Differentiate the sources of different types of air pollutants around the world.
- Construct basic equations that predict the concentrations of air pollutants in the atmosphere.
- Relate (Know) the linkages between air pollution and climate change.
- Recognize the measurement techniques used for monitoring air pollution.
- Examine how models predicting atmospheric pollution work.
- Calculate the concentrations of certain pollutants given emission sources and sinks.
- Criticize policies that can improve air quality levels while also benefiting our climate.

AB 304	RESEARCH LECTURES

Course description and content:

Under the frame of the Postgraduate Studies Programme of the School of Environmental Engineering of the Technical University of Crete, Postgraduate and Ph.D. Students of the PSP can attend research lectures/seminars delivered by members of the School (Faculty members, Ph.D. candidates and collaborators) and/or invited Experts from other Universities & Research Centers in Greece and abroad, as well as by public and private institutions. Each seminar will focus on one research and/or practical topic of the expertise of the Speaker kai will present the approach followed (description and difficulties, addressing methodologies, results and future studies, etc).

This course aims at the dissemination of knowledge of scientific research in the field of Environmental Engineering Science and at familiarizing the postgraduate Students to the challenges and methods of research procedure. Based on these, the main targets of the course are:

- Presentation and dissemination of research results on cutting-edge topics.
- Support the postgraduate Students in the process of implementing their research and completing their master thesis.
- Update of postgraduate Students on the research activities of the School of Environmental Engineering and their activation to enable their potential involvement in projects with an innovative research nature and continuing their doctoral studies.

Attending lectures (approximately 10 hourly lectures per semester) is mandatory, for those semesters specified by the curricula for the postgraduate and Ph.D Students of the School, while all lectures are open to the academic community.

Learning Outcomes:

- Comprehend
- Debate
- Discuss
- Recall

Elective Courses

AB 306	**COMPUTATIONAL DYNAMICS WITH EMPHASIS ON EARTHQUAKE ENGINEERING**

Course description and content:

Earthquake Engineering & Computational dynamics: constitutes a major scientific and practical issue worldwide. In this course the theory / norms / numerical issues related to Earthquake Engineering will be covered.

Goal: use of all available information and numerical tools to analyze the effects of earthquakes on structures and infrastructure that eventually have led to the current state-of-the-art seismic design guidelines and numerical applications in research and engineering practice.

How to achieve it: Describe all major topics involved on earthquake engineering with emphasis on computational dynamics. Guide students how to use open-source computational platforms and software to perform advanced dynamic simulations. Students will be assigned a complex numerical project based on topics and software about which the students are particularly knowledgeable or interested. Hopefully, by the end of the

course, students will be able to perform advanced simulations of complex dynamic problems.

• Earthquakes Mechanics and Effects • Structural Dynamics of SDOF Systems • Structural Dynamics of MDOF Systems • Seismic Hazard Analysis • Inelastic Behavior of Materials and Structures • Concepts of Earthquake Engineering • Seismic Load Analysis • Seismic Design of Various Structural Systems • Performance Based Engineering • Geotechnical Earthquake Engineering • Advanced Dynamic Analysis Issues • Passive Energy Systems & Seismic Isolation • Presentation & Assessment of Projects

Learning Outcomes:

- Analyse The contemporary methods and norms that contribute to improving the seismic performance of structures.
- Calculate The seismic demand and resistance of buildings and other structures.
- Comprehend The impact of earthquake-related geohazards on the built environment.
- Identify The main challenges related to seismic design of buildings and infrastructure.
- Practice In real engineering applications.
- Use Available software tools and advanced numerical methodologies for the dynamic analysis of structures.
- Explain Scientific findings clearly and effectively.
- Demonstrate Present research projects coherently, integrating data, analyses, and implications into a structured presentation.

B 207	ENVIRONMENTAL ECONOMICS AND POLICY

Course description and content:

This course studies the economics of public policy toward the environment. Concepts discussed comprise demand and supply basics, the economic agents' surplus and welfare, the problem of market failure in the presence of externalities and public goods. Then, public policy responses to these market failures are discussed, including command-and-control regulations, tax and subsidy incentives, marketable pollution permits, voluntary programs, and information as regulation. Decision theory completes the course followed by an extensive overview of multi-criteria methods thereby implemented in relevant problems.

Learning Outcomes:

- Comprehend basic economic concepts such as supply and demand, economic surplus and welfare
- Recognize the problem of market failure in the presence of externalities and public goods
- Analyse public policy responses to market failures

- Select among command-and-control regulations, tax and subsidy incentives, marketable pollution permits, voluntary programs, and information as regulation
- Employ decision theory concepts to analyze environmental problems
- Practice multicriteria decision analysis to propose efficient solutions to problems

AB 305	ENVIRONMETAL LAW AND SUSTAINABLE DEVELOPMENT

Course description and content:

The core objective of the course is to help graduate students understand the role and the challenges of environmental law in the context of sustainable development. To that end this course, which is offered to graduate students of all cycles, will provide them with : a) a sound conceptual understanding of the purpose, content, functional levels and principles of environmental law, b) an overview of the evolution of theoretical approaches concerning the relationship between environmental law and sustainable development, c) an in depth analysis of the sustainable development principle, its integration in international, EU and national legislative tools as well as its interpretation in case-law. In addition, the course explores global environmental issues such as agro-biodiversity, water & waste management, Renewable Energy Sources from the perspective of sustainable development. Graduate students will gain familiarity with important leadership concepts of environmental law and sustainable development via theory, legislation as well as case studies.

• The notion of the environment. Content, types and characteristics of environmental insults. The role of the law in the environmental protection. Levels of environmental law: international, European Union and national environmental law. • The case-law contribution (national and EU) to the protection of the asset “environment”. • Principles of environmental law • The sustainable development principle • The relationship between environmental protection and economic development. Theoretical considerations on their interrelationship. Concept and content of sustainable development. • The history and development of the sustainable development principle, its integration into international, EU and national legislative tools and its interpretation in case-law. • Specialization of the sustainable development principle in specific areas. • Biodiversity protection - Agro-biodiversity • Water protection and management • Waste protection and management • Renewable Energy Sources

Learning Outcomes:

- *Express* the role and the challenges of environmental law in the context of sustainable development

- Describe the purpose, the content, the functional levels and the principles of environmental law
- Comprehend the evolution of theoretical approaches concerning the relationship between environmental law and sustainable development
- Explain the sustainable development principle, its integration in international, EU and national legislative tools as well as its interpretation in case-law
- Criticize global environmental issues such as agro-biodiversity, water & waste management, Renewable Energy Sources from the perspective of sustainable development
- Recall important leadership concepts of environmental law and sustainable development via theory, legislation as well as via case studies.

AB 307	GROUNDWATER AND CLIMATE CHANGE

Course description and content:

The course focuses on the impacts of climate change on water resources and specifically on groundwater. The main objective is to understand the impacts of climate change on groundwater and to use tools to predict future impacts. Groundwater simulation models will be a key tool where, taking into account climate forecasts, students will be able to simulate a groundwater system and assess future impacts.

The content is:

Introduction to the concepts of climate change water resources, a review of the main principles of groundwater flow and mass transport, introduction to equations governing groundwater flow and pollutant transport following by the theory of groundwater modeling, an overview of groundwater models focus on models using finite elements and finite differences, introduction to groundwater numerical simulator Princeton Transport Code (PTC), learn how to use and import PTC data in conjunction with the ARGUS-ONE pre and meta processor, project assignment - study Area - entering field data, calibration and simulation using the PTC model, alternative climate change scenarios, and project presentations

• Introduction to the concepts of climate change • Climate Change and Water Resources • Groundwater - Basic concepts • Equations governing groundwater flow and pollutant transport • Introduction to groundwater modeling • Groundwater Models Overview - Focus on Models Using Finite Elements and Finite Differences • First Homework Presentation • The groundwater model: Princeton Transport Code (PTC) • Learn how to use and import PTC data in conjunction with the ARGUS-ONE pre and meta processor • Project

assignment - Study Area - Entering field data • Study area - calibration and simulation using the PTC model • Alternative climate change scenarios - Impact study

Learning Outcomes:

- Define The basic principles of ground water flow and mass transport in subsurface systems, the mathematics that describe the movement of ground water and pollutants, and the basic concepts of climate change and climatic scenarios
- Collect the necessary field data to fully describe a groundwater aquifer
- Develop A groundwater flow and mass transport model (numerical simulator) for a specific field location
- Calculate Hydraulic heads, groundwater velocities, and pollutant concentrations
- Evaluate the aquifer status and identify if there is problem
- Choose remediation measurements
- Apply Global and regional climatic scenarios using the numerical simulator to predict future conditions
- Compose the results of the model and the application of future climatic scenarios
- Express your opinion and how you will approach similar situations

A 101	ADVANCED TOPICS IN ENVIRONMENTAL CHEMISTRY

Course description and content:

This course focuses on the fate and behavior of organic pollutants in the environment, by considering the fundamental principles and processes that control their fate in environmental systems. The latest developments in the field will be presented in accordance with the literature. The course will also cover the latest developments in analytical methods such as liquid chromatography (LC), gas chromatography (GC) and mass spectrometry (MS). Particular emphasis will be placed on how these methods can be used to solve various problems related to the environment. The latest developments in the field of sample preparation will be discussed in detail and cover various sample types. During the course, students will practice independently evaluating and choosing between different analysis and sampling methods. Students will also learn to work together to solve complex problems. The laboratory exercises are based on recent research studies.

Learning Outcomes:

- Analyse current global challenges in environmental chemistry
- Comprehend the fate of organic pollutants in the environment
- Practice in real case studies
- Use state-of-the art analytical tools and technologies for the detecting organic pollutants

- Research, analysis and synthesis of data and information, using the necessary technologies
- Adapting to new situations
- Autonomous work
- Teamwork
- Respect for the natural environment
- Written communication
- Oral communication
- Initiative
- Time Management
- Problem Solving
- Work in interdisciplinary environment

B 209	ADVANCED ENERGY GENERATION TECHNOLOGIES

Course description and content:

The course aims to analyze, design and evaluate key new technologies and trends that contribute to the improvement of energy storage and conservation and the transition to low carbon energy. New energy cycles and models are presented in the light of circular economy and environmental protection. Hydrogen energy technologies, Fuel Cells science and Technology, Biogas and Natural Gas advanced used and valorization, as well as CO2 capture and recycling/use are central subjects in this course.

• Introduction to Heterogeneous Catalysis, catalytic materials design; their role in modern energy generation technologies. • Introduction to Solid state Electrochemistry, electrocatalysis and devices. • Fuel cells: Operation principles and properties, thermodynamics, governing equations, design. • Fuel cells: specific applications for electrical power generation. Electrochemical reactors for cogeneration of useful chemicals and electricity. • Natural Gas and Biogas management and utilization: Advanced and environmentally friendly energy applications. • H2 energy and technologies: Production routes, transport, and applications. The power-to-gas technology. • Novel concepts for urban and industrial wastewater treatment with simultaneous energy generation. • Assignment of student projects on special topics for materials and processes of energy generation and saving processes. • Visit the lab for immediate practical course on catalytic production of H2 from natural gas or biogas in heterogeneous catalytic reactors. • Visit the lab for immediate practical course on the production methods of electrolyte and electrode materials and bench scale fuel cell's stacks. • Discussion on the progress of the undertaken topics. • Student projects presentation • Conclusions, assessment of the

methods and procedures, evaluation, and effectiveness of the modern energy generation trends.

Learning Outcomes:

- Research, analysis and synthesis of data and information, using the necessary technologies
- Adapting to new situations
- Decision-making
- Autonomous work
- Teamwork
- Production of new research ideas
- Project design and Management
- Respect for the natural environment
- Promoting free, creative and inductive thinking
- Written communication
- Initiative
- Alternative/ Innovative Thinking
- Time Management
- Problem Solving
- Work in interdisciplinary environment

B 211	ADVANCED AIR POLLUTANT TREATMENT TECHNOLOGIES

Course description and content:

The course deals with the air pollution problem and the advanced technologies that have been developed for gas emissions treatment/control. Alternative technologies aiming to the utilization of air pollutants for the production of high added value chemicals and fuels are of special interest and presented in detail.

• Introduction to the air pollution problem - Dispersion of pollutants in the atmosphere. • Description of the main atmospheric pollutants - sources of their origin (natural, anthropogenic, mobile and stationary sources) - Impact on the environment and human health - Climate change. • Gas pollution analysis and measurement technologies. • Basic concepts for the design of gas pollutant treatment processes. • Gas emissions control technologies: Absorption, adsorption and combustion. • Alternative anti-pollution technologies: Environmental catalysis-basic types of solid catalysts • Evaluation of catalytic properties-Advanced catalyst characterization techniques-desirable catalyst characteristics for gas emission control processes. • Advanced processes for the treatment of nitrous oxides (NOx and N2O) emissions. • Advanced processes for the

treatment of carbon monoxide (CO) emissions. • Advanced processes for the treatment of carbon dioxide (CO2) emissions. • Advanced processes for the treatment of methane (CH4) emissions. • Advanced processes for the treatment of volatile organic compounds (VOCs).

Learning Outcomes:

- *C*omprehend the air pollution problem, the atmospheric pollutants sources and their impact on both human health and environment
- Use available models for predicting the dispersion of pollutants into the atmosphere
- Analyse the key technologies (absorption, adsorption, condensation and combustion) that have been developed and used to control gas emissions
- Assess the contribution of heterogeneous catalysis as an alternative approach for gas emissions control
- Calculate the catalytic properties of inorganic materials using advanced characterization techniques
- Identify the desired catalyst characteristics in order to be used in catalytic anti-pollution technologies
- Discuss advanced technologies for the control and treatment of the main atmospheric pollutants (CO, CO2, NOx, N2O, CH4, VOCs) applied in industry or research.

GEnvE 868	STOCHASTIC BEHAVIOUR AND TIME SERIES ANALYSIS

Course description and content:

The aim of the course is the description of/introduction to the basic deterministic (decomposition of a t.s. and smoothing of a t.s.) and stochastic models (ARMA, ARIMA, SARIMA). Real life scenarios are being examined using these types of models, statistical techniques and suitable software.

A time series is a sequence of successive measurements/data points, made over a time interval (e.g. daily closing value of a stock market, ocean tides, counts of sunspots etc). Time series are used in:

• statistics, • signal processing, • pattern recognition, • econometrics, • weather forecasting, • earthquake prediction, • electroencephalography etc.

Time series analysis comprises methods for analyzing data in order to extract meaningful statistics and other characteristics of the data. There are two main types of time series models. If we make predictions using simply the history of the t.s., the model is called deterministic (randomness is an additive factor). If we use randomness as the factor

generating the t.s., the model is called stochastic. Forecasting is the use of a model to predict future values based on previously observed values.

Learning Outcomes:

- Calculate the 4 basic characteristics of a time series
- Recognise the 3 basic categories of time series analysis methods (deterministic and stochastic)
- Use the appropriate time series analysis method to solve problems (forecasts), the key element of which is data in relation to time
- Analyse experimental and numerical (time series) data
- Apply basic statistical methods, using special software, to Chemical and Environmental Engineering problems.
- Choose the appropriate statistical method(s) each time to assess the accuracy of results (predictions)
- Develop skills in modeling situations / phenomena in which time series occurs.

VI. CONTACT

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