

Technical University of Crete

**School of
Environmental
Engineering**



Undergraduate Program Guide

Environmental Engineering

2018-2019

Prologue

Dear Reader,

The School of Environmental Engineering (ENVENG) at the Technical University of Crete has been operating since academic year 1997-1998. Over the past 20 years, the School has awarded 647 Diplomas in Environmental Engineering, 418 Master degrees (M.Sc.) and 67 Doctoral degrees (Ph.D.).

The School's faculty with rich experience in research and teaching at Universities and Institutes abroad (USA, Canada and Europe) provides quality education to our students. Innovative and high quality research activity is conducted at the School in the fields of environmental management, quality assurance and restoration. The high quality scientific publications and the participation in research programs at national and European level evince the international recognition of the School.

The School aims to train engineers in the areas of environmental management, environmental processes and development planning, environmental hydraulics and geoenvironmental engineering. This is accomplished through the undergraduate program that includes courses designed for students to acquire high-quality, high-level theoretical background and laboratory experience.

Our students, with the contribution of the faculty, learn how to remedy mistakes of the past, to avoid creating or aggravating current environmental problems and to design development pathways to a better future with respect for man and the environment, all in a sustainable development framework.

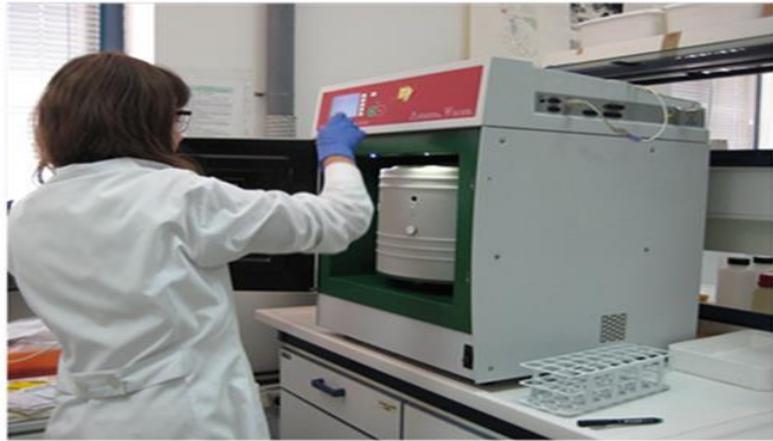
The School's graduates are members of the Technical Chamber of Greece (TEE), enlisted as civil engineers or chemical engineers based on their diploma thesis subject. Our graduates work in universities and research centers in Greece and abroad, industry, public services and as professional engineers.

On behalf of our School's faculty and staff, I warmly welcome and invite you for a tour through our website (www.enveng.tuc.gr).

Sincerely,

Professor Mihalis Lazaridis

Dean of the School



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1 Technical University of Crete



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 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 institution owns several traditional and historical buildings in the city, such as the former French School, which has been converted to a conference center.

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

The University Hall of Residences accommodates students in single 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.

2 The School of Environmental Engineering (ENVENG)



2.1 General information

The Department of Environmental Engineering was established at the Technical University of Crete (P.D. 232/1995, O.G. 134/22-6-1995/vol. A') and admitted its first students in Academic Year 1997-1998. The **School of Environmental Engineering**, which incorporated the former Department (O.G. 119/28-5-2013/vol. A'), was established in May 2013.

2.2 Objectives

The objectives of the School of the Environmental Engineering are to provide advanced education of a high standard in environmental science and engineering and to prepare qualified engineers to measure, monitor, assess, and treat of problems caused by human intervention in the environment.

The programs of study provide scientific expertise in the following areas:

- design, construction and operation of
 - wastewater treatment plants,
 - air pollutant emissions control systems,
 - solid waste management and treatment units,
 - agricultural and food industry waste treatment units
 - toxic and hazardous waste management and treatment units
- air pollution management,
- surface and subsurface water management,
- measurement systems for air, soil and water pollution,

- soil and ground water remediation,
- environmental impact and risk assessment,
- noise and radiation control,
- renewable energy sources and energy conservation systems.



2.3 Mission of the School of Environmental Engineering

The Mission of the School of Environmental Engineering is to:

- offer courses at the undergraduate and graduate level,
- advance multidisciplinary research on environmental issues, and,
- provide environmental services to the society and the scientific community.

Objectives of the Undergraduate Program

The objective of the Undergraduate Program (UP) of the School of Environmental Engineering is to provide future Professional Environmental Engineers with advanced technical and communication skills, in combination with up-to-date knowledge of global environmental issues, so that they may assume leading positions in environmental management.

Educational Objectives of the Undergraduate Program

In particular, the educational objectives of the UP are:

- To offer courses related to environmental engineering science, data analysis and system design.
- To help students develop basic skills such as the ability for synthesis, integrated systems logic, experimentation and cooperation.
- To incorporate social, economic, and cultural issues into the educational program aiming at optimal problem solving.



2.4 Environmental Engineering - The profession

The Environmental Engineering profession has matured over the years. Curriculum requirements provide engineering students with the thorough background, necessary to assume leading positions in either the private or public sector and to cooperate with other engineers and scientists.

The main activities of the Environmental Engineer are: the design and implementation of programs for the protection, development and general management of the Environment, the preparation or management of projects regarding natural or man-made environmental systems, as well as the study of the environmental impacts of technical works or other activities based on the legislation in force.

Employment opportunities for Environmental Engineers can be found in both the public and private sector, either as individual freelancers or in cooperation with engineers in other disciplines, as well as in educational institutions teaching courses on environmental subjects.

In today's world, characterized by an everlasting desire for technological progress, the skills and expertise of Environmental Engineers will always be in high demand in Greece and worldwide.



2.5 Administration

The School is managed by the General Assembly (GA) and the Dean, who chairs the GA. The responsibilities of the GA are determined by the current Higher Education Framework Law and its amendments.

DEAN

Professor **Mihalis Lazaridis** is the Dean of the Environmental Engineering School. Professor **George Karatzas** serves as deputy dean.

DEANERY OF THE SCHOOL

Members of the Deanery are:

- Professor **George Karatzas**
- Associate Professor **Efpraxia (Aithra) Maria**
- Assistant Professor **Nikolaos Paranychianakis**
- Professor **Elia Psillakis**
- Professor **Ioannis Yentekakis**

SECRETARY

Mrs. **Gina Poniridou** is Secretary, tenured employee, (B.A. in Management/Economics) graduate of Panteion University of Social and Political Sciences.

SCHOOL'S COMMITTEES AND REPRESENTATION IN TUC COMMITTEES

By decision of the GA of the Environmental School the following are appointed committee members:

1. Undergraduate Studies Committee

- N. Kalogerakis, Professor (co-ordinator)
- A. Manousakis, Associate Professor
- N. Paranychianakis, Associate Professor
- I. Yentekakis, Professor
- (One student representing the Undergraduate Students' Association)

A.1 Special Advising Committee for the New Undergraduate Program of Studies

- N. Kalogerakis, Professor
- A. Manousakis, Associate Professor
- N. Paranychianakis, Associate Professor

2. Postgraduate Studies Steering Committee

- E. Psillakis, Professor (Coordinator – Head of Postgraduate Studies)
- M. Lazaridis, Professor
- I. Tsanis, Professor

- N. Nikolaidis, Professor
 - C. Chrysikopoulos, Professor
3. Advising Committee for Undergraduate Students
 - I. Yentekakis, Professor
 - G. Karatzas, Professor
 - D. Kolokotsa, Associate Professor
 - E. Maria, Associate Professor
 - N. Xekoukolotakis, Assistant Professor
 4. Internship
 - D. Venieri, Associate Professor
 5. EnvEng ERASMUS+
 - N. Xekoukolotakis, Assistant Professor
 6. TUC Library Committee (EnvEng representative)
 - N. Xekoukolotakis, Assistant Professor
 7. EnvEng Energy Committee
 - D. Kolokotsa, Associate Professor
 - T. Tsoutsos, Professor
 8. EnvEng Health and Safety Committee
 - E. Psillakis, Professor
 - E. Koukouraki, LTS
 - R. Sarika, LTS
 - I. Gounaki, LTS
 9. EnvEng Fire Safety Committee
 - E. Kastanaki, STLS
 - R. Sarika, STLS
 10. EnvEng Students' Records Supervisor
 - A. Manousakis, Associate Professor
 11. EnvEng Financial Records
 - R. Sarika, STLS
 - N. Vakakis, STLS
 12. EnvEng Quality Assurance IT System and Students' Evaluation Recording
 - T. Glytsos, LTS
 - A. Koutroulis, LTS,
 - I. Kanakis, STLS
 13. EnvEng Internal Evaluation Team
 - A. Manousakis, Associate Professor
 - N. Paranychianakis, Associate Professor
 - D. Venieri, Associate Professor
 - N. Xekoukolotakis, Assistant Professor
 14. EnvEng Web site Content Management
 - A. Papadopoulou, LTS
 15. EnvEng Undergraduate and Postgraduate Studies Guide
 - A. Papadopoulou, LTS
 - K. Tyrovola, LTS

16. Outward activities- High Schools' visits planning
 - A. Pantidou, STLS
 - A. Spyridaki, LTS
17. TUC Special Research Funds Unit (EnvEng Representative)
 - E. Gidakos, Professor (member)
 - C. Chrysikopoulos, Professor (alternate member)
18. TUC Quality Assurance Unit (EnvEng Representative)
 - M. Lazaridis, Professor
19. TUC Property and Technological Park Development and Management Company
 - E. Gidakos, Professor (Vice-President)
20. TUC Health and Safety Committee
 - D. Venieri, Associate Professor (representing TUC Faculty members)
 - A. Pantidou, STLS (representing TUC STLS members)
21. TUC Committee on Continuous Learning
 - I.Kanakis, STLS

2.6 Structure of the School

The School of Environmental Engineering is organized in three Divisions, each including a number of laboratories on various subjects. The Divisions are:

ENVIRONMENTAL MANAGEMENT (DIVISION I):

The focus of Division I is on the following subjects: Collection, treatment, transfer and disposal technologies for gaseous, aqueous, solid, toxic and hazardous waste and sludge. Treatment technologies for potable water. Source inventory models. Monitoring of waste sources and ambient quality; Environmental meteorology. Air and water quality, hydraulic and hydrological models; Pollution risk assessment, ambient quality and emission standards. Energy conservation and alternative sources, transportation modeling and land planning. Development of optimal management plans. Ecology. Environmental Catalysis. Environmental impact assessment. Application of Geographic Information Systems. Compilation of environmental data and interlinking with relevant international databases. Environmental Law and governance. Stochastic models. Banach spaces.

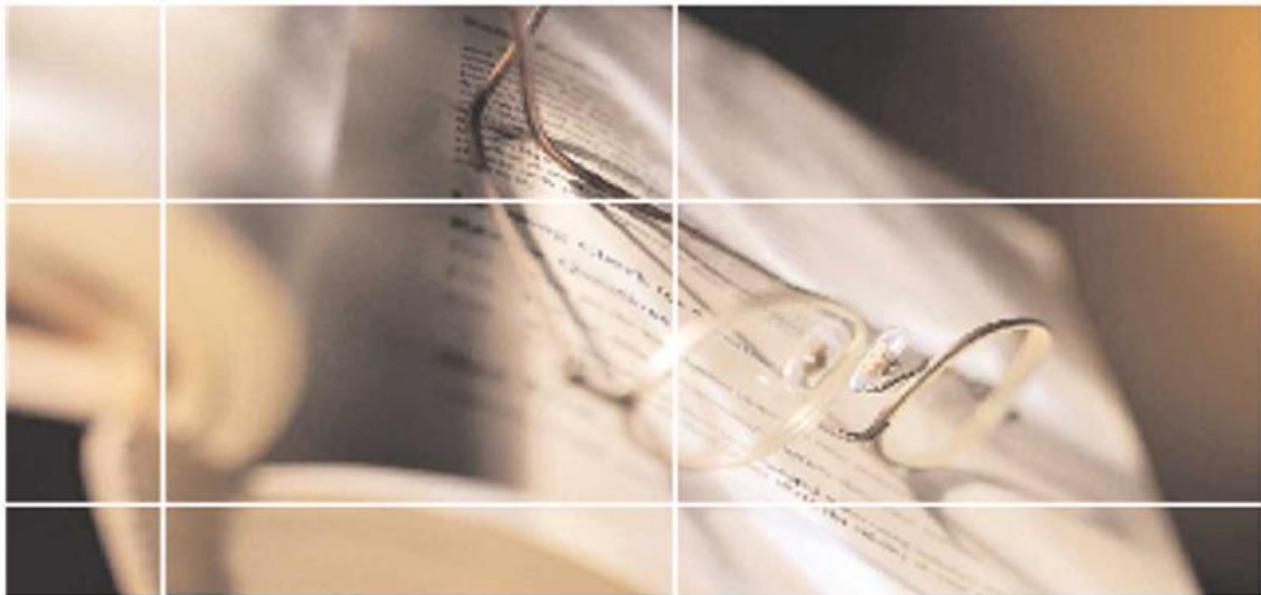


ENVIRONMENTAL PROCESS DESIGN AND ANALYSIS (DIVISION II):

The second Division covers the following scientific areas: Biochemical processes, biological treatment of solid, liquid and gas wastes, application of cell cultures to environmental protection. Environmental microbiology, environmental toxicology, environmental biotechnology, design of subsurface biological barriers. Phytoremediation and wetlands. Air pollution, indoor air quality, aerosol dynamics in the atmosphere. Biogeochemical cycles and energy flow in ecosystems. Fluid dynamics, heat & mass transfer, unit operations. Physico-chemical processes, chemical reaction engineering, environmental thermodynamics, thermo-physical properties, chemical equilibrium, partition of pollutants in the environmental phases. Environmental Organic Chemistry-Micropollutants.

ENVIRONMENTAL HYDRAULICS & GEOENVIRONMENTAL ENGINEERING DIVISION (DIVISION III):

The objectives of the Division III include: Environmental hydraulics, hydrology, geology and hydrogeology as well as the environmental applications of the forementioned subjects (wastewater pipe nets, irrigation, runoffs, water resources, flow in porous media, contamination of soils and ground waters, drinking water pipe systems). In addition some other interests of the Division III include remediation techniques for contaminated soils and ground waters, life-cycle analysis and performance-based design of structures and infrastructures, structural and geotechnical earthquake engineering, computational dynamics. Applications of Geographical Information Systems (GIS) to environmental data.



2.7 ACADEMIC STAFF

The Academic staff of the School is 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.



PROFESSORS

Full Professors

Constantinos Chrysikopoulos: 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.

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

Evan Diamadopoulos: Environmental Technology and Management, Dipl. in Chemical Engineering (1978) Aristotle University of Thessaloniki, Greece, M.Eng. (1982) McMaster University, Canada, Ph.D. (1985) McMaster University, Canada.

Nicolas Kalogerakis: 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.

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

Mihalis Lazaridis: 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.

Nikolaos Nikolaidis: 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.

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

Costas Synolakis: Environmental Hydraulics and Natural Hazards, B.Sc. Civil Engineering (1978) Caltech, USA, M.Sc. (1979) Civil Engineering Caltech, USA, Ph.D. Civil Engineering (1985) Caltech, USA.

Theocharis Tsoutsos: 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.

Ioannis Tsanis: Water resources management and coastal engineering, Dipl. in Civil Engineering (1976) Aristotle University of Thessaloniki, Greece, M.Sc. (1979) University of Toronto, Canada, Ph.D. (1986) University of Toronto, Canada.

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

Associate Professors

Petros Gikas: 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.

Dionysia Kolokotsa: 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.

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

Efpraxia (Aithra) Maria: 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.

Nikolaos Paranychianakis: 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.

Stelios Rozakis: 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).

Yiannis Tsompanakis: 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.

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

Assistant Professors

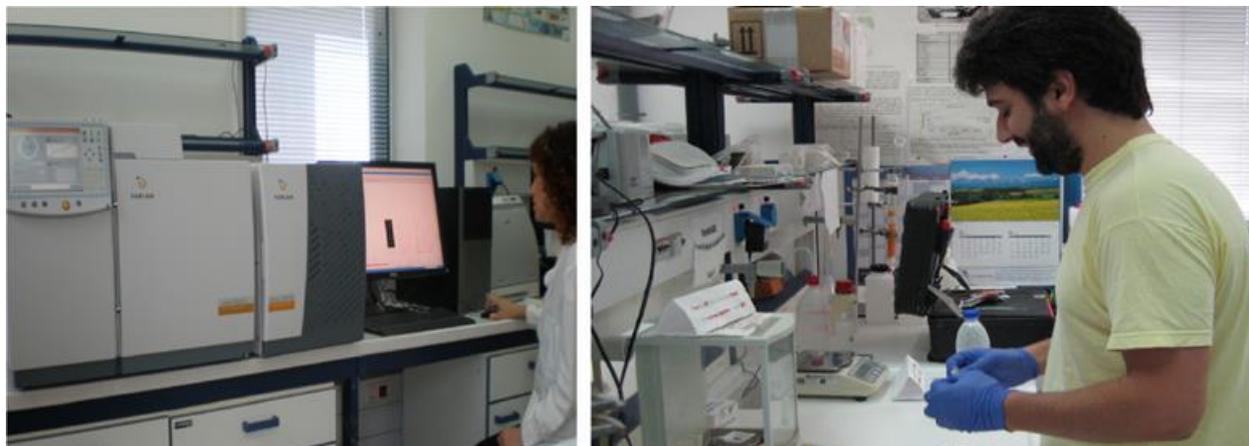
Apostolos Giannis: Municipal and Hazardous Solid Waste Management and Treatment. B.Sc. in Environmental Sciences (2001), Department of Environment, University of the Aegean, M.Sc., Department of Environmental Engineering (2003), Technical University of Crete, PhD, Department of Environmental Engineering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

Tryfon Daras: 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.

Paraskevi Panagiotopoulou: 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.

Androniki Tsouchlaraki: 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.

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



LABORATORY TEACHING STAFF (LTS)

Kalliopi Antelli: Diploma in Chemical Engineering (1999) National Technical University of Athens, M.Sc. “Quality Control & Environmental Management” (2001) Technical University of Crete. STLS for the Air, Water and Solid Wastes Management Laboratory.

Dr. Theodoros Glytsos: 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. LTS for the Atmospheric Aerosols Laboratory.

Ioannis Kanakis: 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. STLS for the Renewable and Sustainable Energy Systems Laboratory.

Dr. Aristeidis Koutroulis: Diploma in Mineral Resources Engineering (2002) Technical University of Crete, M.Sc. (2005) and Ph.D. (2010) in Environmental Engineering Technical University of Crete. LTS for the Water Resources Management and Coastal Engineering Laboratory.

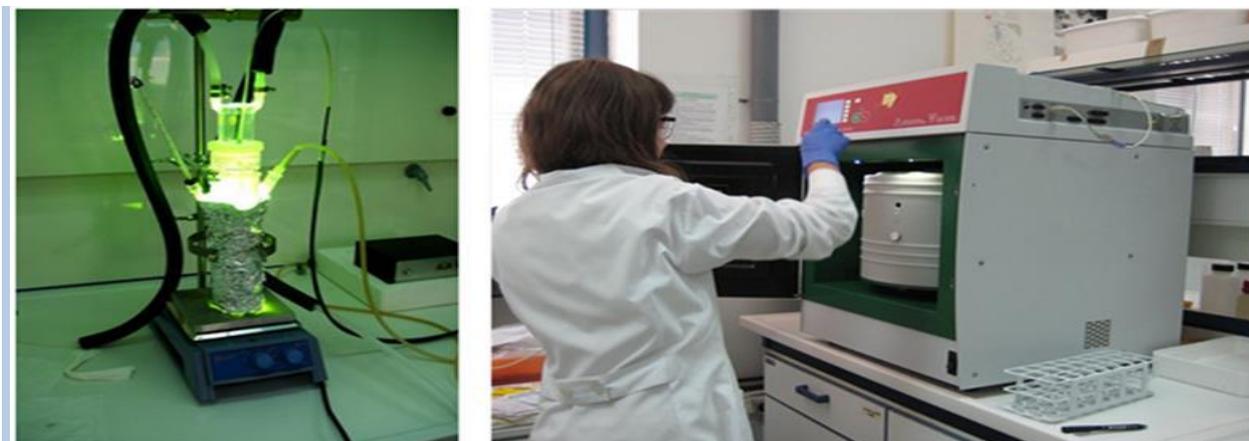
Dr. Athanasios Papadopoulos: B.Sc. in Physics with Environmental Science (1998) University of Sussex, M.Sc. in Oceanography (1999) University of Southampton, Ph.D. in Environmental Engineering (2009) Technical University of Crete. LTS for the Natural Hazards, Tsunami and Coastal Engineering Laboratory.

Dr. Aphrodite Papadopoulou: Diploma in Chemical Engineering (1988) Aristotle University of Thessaloniki, Ph.D. in Chemical Engineering (1993) University of Illinois at Urbana-Champaign, USA. LTS for the Transport Phenomena & Applied Thermodynamics Laboratory.

Dr. Athena Spyridaki: 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. LTS for the Energy Management in the Built Environment Laboratory.

Dr. Konstantina Tyrovola: Degree in Chemistry (1998) University of Crete, M.Sc. (2001) and Ph.D. (2007) in Environmental Engineering Technical University of Crete. LTS for the Biochemical Engineering & Environmental Biotechnology Laboratory.

Dr. Emmanouil Varouchakis: Dipl.Ch.Eng., B.Sc. in Chemical & Process Engineering (1999) University of Newcastle Upon Tyne, UK, M.Sc. in Clean Technology (2000) University of Newcastle Upon Tyne, UK, M.Sc. (2006) and Ph.D. (2012) in Mineral Resources Engineering Technical University of Crete. LTS for the Geoenvironmental Engineering Laboratory.



SPECIALIZED TECHNICAL LABORATORY STAFF (STLS)

Efprepios Baradakis: 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.

Georgia Botzolaki: 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. STLS for the Physical Chemistry and Chemical Processes Laboratory.

Iosifina Gounaki: Degree in Biology (1983) Aristotle University of Thessaloniki, M.Sc. “Quality Control & Environmental Management” (2005) Technical University of Crete. STLS for the Environmental Microbiology Research Unit and the Ecology and Biodiversity Laboratory.

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

Elisavet Koukouraki: Degree in Chemistry (1992) University of Crete, M.Sc. “Quality Control & Environmental Management” (2002) Technical University of Crete. STLS for the Environmental Engineering and Management Laboratory.

Irene Koutsogiannaki: 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. STLS for Computational Dynamics & Energy Laboratory (CODEN)

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

Roika Sarika: Diploma in Chemical Engineering (1985) National Technical University of Athens, M.Sc. “Quality Control & Environmental Management” (2004) Technical University of Crete. STLS for the Chemical Processes and Wastewater Treatment Laboratory.

Nikos Vakakis: Degree in Physics (1997) University of Crete, M.Sc. “Materials science and technology” (2001), National Technical University of Athens. STLS for the Physical Chemistry and Chemical Processes Laboratory.

ADMINISTRATIVE STAFF

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

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



2.8 FACILITIES

BUILDING FACILITIES

The School of Environmental Engineering occupies three buildings on campus (K1, K2 and K3) with a total area of 3000 m². 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.

LABORATORY FACILITIES

The educational and research processes at the School of Environmental Engineering are supported by the following laboratories:



Toxic and Hazardous Waste Management Laboratory

Division I – Evangelos Gidaracos, 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.



Renewable and Sustainable Energy Systems Laboratory

Division I – 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).

Design of Environmental Processes Laboratory

Division I – Petros Gikas, Associate Professor

The major research activities of the "Design of Environmental Processes" Research Unit is the scale-up of Environmental Engineering processes. 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 – Dionysia Kolokotsa, Associate 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 environment.



Environmental Law and Governance Laboratory

Division I – Efpraxia (Aithra) Maria, Associate Professor

Study, research and implementation of Environmental Law and Governance basic principles in novel interdisciplinary issues with International, EU and national character.

Banach space theory Laboratory

Division I – Antonis Manousakis, Associate Professor

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

Stochastic models for tumor growth Laboratory

Division I – Tryfon Daras, Assistant Professor

The Laboratory study and construct mathematical models (deterministic and stochastic) for the growth of various types of tumors. Special interest is given in breast tumor growth.

Environmental Catalysis Laboratory

Division I – Paraskevi Panagiotopoulou, Assistant 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

Biochemical Engineering & Environmental Biotechnology Laboratory

Division II – Nicolas Kalogerakis, 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.

Atmospheric Aerosols Laboratory

Division II – 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.

Environmental Engineering and Management Laboratory

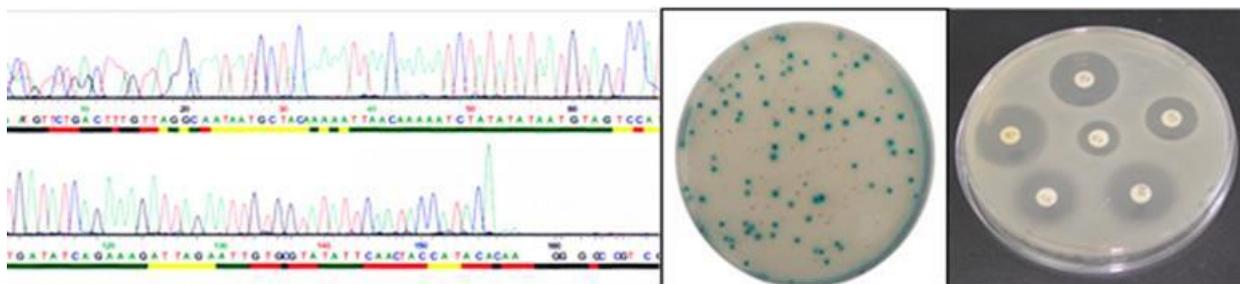
Division II – Evan Diamadopoulos, Professor

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.

Aquatic Chemistry Laboratory

Division II – Elia Psillakis, 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.



Environmental Microbiology Laboratory

Division II – Danae Venieri, Assistant 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.

Ecology and Biodiversity Laboratory

Division II – Danae Venieri, Assistant Professor

The Ecology and Biodiversity Laboratory is focused on the study of ecosystems, the interactions developed among communities and the determining

environmental factors which affect population growth. Main research topics include the followings: Systems & ecosystems. Organisms and species interactions. Energy and nutrient relations. Primary production and energy flow. Nutrient cycling and retention. Succession and stability. Population ecology, communities and ecosystems. Introduction to models. Ecological quality and degradation of natural environment.

Environmental Organic Chemistry and Micro-pollution Laboratory

Division II – Nikolaos Xekoukoulotakis, 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.



Physical Chemistry & Chemical Processes Laboratory

Division II – Ioannis Yentekakis, Professor

The laboratory of Physical Chemistry and Chemical Process 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.

Water Resources Management and Coastal Engineering Laboratory

Division III – Ioannis K. Tsanis, Professor

The Water Resources Management and Coastal Engineering Laboratory, develops innovative tools for solving complex environmental/water resources engineering problems. We focus on the development and application of advanced state-of-the-art computer models to be used in computational hydraulics and hydrology supporting decision making for engineering design

projects, contingency planning studies, and regulatory compliance support. Water Resources Management activities: Climate Change and weather extremes impact on water resources, agriculture and tourism, Study of hydrological extremes (floods - water scarcity & droughts leading to desertification), Flash flood forecasting with radars – Watershed analysis – water balance and water availability forecasting, Application of hydrologic models in modelling surface and ground water in basins. Application of GIS/Remote Sensing Technologies with high resolution satellite data for the determination of hydraulic parameters like land use, soil type and Digital Terrains, Development of new technologies of neural networks for estimating and forecasting the groundwater level. Evaluation and remediation of aquifers. Collection and organization of environmental data with the use of geographic information systems. Planning of urban networks for sewerage and irrigation. Coastal Engineering activities: Mathematical simulation of diffusion and dispersion of pollutants in water bodies (rivers, lakes, coasts). Alternative planning of acceptable liquid effluent for reduction of their negative impacts in the environment and in human health. Environmental flow impacts in surface and coastal waters. Mathematic models of wave propagation. Coastal effects on waves, coastal sediment transport, coastal morphology, environmental impact of coastal structures.

Geoenvironmental Engineering Laboratory

Division III – George P. Karatzas, 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

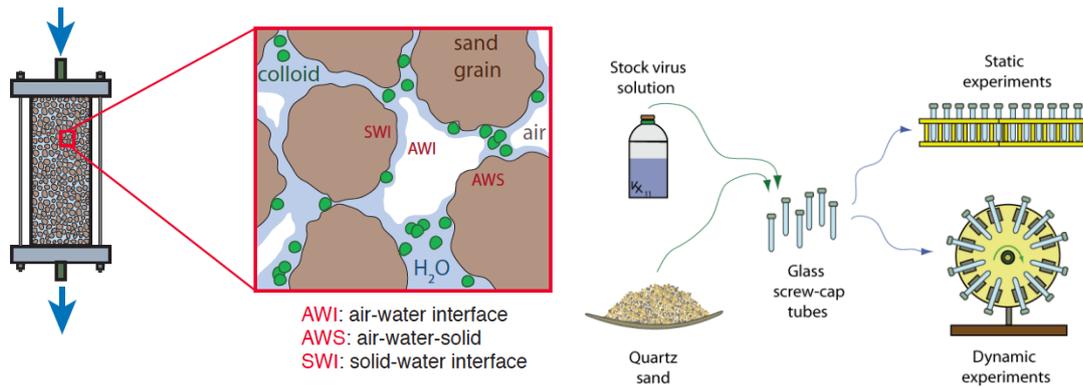
Division III – Nikolaos P. Nikolaidis, Professor

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.

Environmental Engineering Laboratory (TUCeeL)

Division III – Constantinos V. Chrysikopoulos, 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.



Natural Hazards, Tsunami and Coastal Engineering Laboratory
Division III – Costas Synolakis, Professor

Natural Hazards: Research is focused in mitigation of natural hazards and extreme events, (such as bush fires, flooding, storms and sea level rise) and the evaluation of their impact. (See publications and also read the editorials of the laboratory in Wall Street Journal 2005, 2006 and 2007 and the reports in New York Times 2004 and 2006).

Tsunami: Research includes experimental, analytical and numerical simulation of tsunamis generated by either underwater landslides or earthquakes and the evaluation of run-up and inundation on beaches, preparation of inundation maps for civil protection agencies and field surveys following tsunamis to measure run-up and inundation.

Coastal Engineering: Research is focused on coastal protection from erosion, extreme events, and sea level rise due to greenhouse effect and the restoration and long term maintenance of beaches using soft solutions, such as beach nourishment and artificial reefs. Research covers the Pacific and Indian Ocean and the Mediterranean Sea and findings have been presented in more than 20 documentaries in Discovery, BBC, History, ZDF and National Geographic from 1997 until today



Geodesy and Geographical Information Systems Laboratory
Division III – Androniki Tsouchlaraki, Assistant Professor

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

Computational Dynamics & Energy Laboratory

Division III – Yiannis Tsompanakis, Associate 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.



3 Undergraduate Program Regulation

3.1 Registration

New undergraduate students originally register via a web application of the Ministry of Education in the electronic address:

<https://eregister.it.minedu.gov.gr>

Further details are given in the relevant Ministry press release.

Then students should be presented to the Secretariat of the School of Environmental Engineering for final registration. Students should submit to the Secretariat the following:

1. Printed registration form provided by the electronic application of the Ministry
2. Copy of their ID card
3. Certificate copy for their participation in the Panhellenic Exams
4. Copy of secondary education certificate
5. One passport photo

Alternatively, the above documents can be sent by mail to the address of the School Secretariat. In this case, the printed registration form must be endorsed with the signature authenticity.



3.2 Student Identity Card and Certificates

Each student receives, immediately upon registration, a Student Identity Card and a Transportation Pass that qualifies the student for reduced transportation fare as stated by the relevant provisions. Student status is acquired on registration and terminates upon diploma award. Students have full medical and hospital coverage.

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

The above documents can also be issued in English.

Books and notes, recommended by faculty members and instructors to cover teaching needs, are distributed free of charge via the Eudoxus system (<http://eudoxus.gr/>).



3.3 Student Status

Student status is acquired on registration to the School of Environmental Engineering and terminated upon the award of the Diploma. Student status is automatically lost upon expiration of the maximum study period.

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 lose temporarily their student status for the period of suspension. Student status is restored immediately upon return from suspension.

3.4 Services to Students

Upon registration, students are entitled to full medical care by the Technical University of Crete so long as they don't have medical coverage directly or indirectly by another entity.

Additionally, the Eudoxus system is a digital innovative service for the immediate and integrated provision of university books and notes to students (<http://eudoxus.gr>)

In addition, students have free access to both the library and the Digital Library Services (<http://www.library.tuc.gr/>) 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 library services.

Scholarships to undergraduate students are granted as follows:

S.S.F. Scholarships: The State Scholarship Foundation awards scholarships to students who top the School entrance exams and to the students at the top of their class.

ERASMUS+ exchange programme Scholarships: The Technical University of Crete and the Environmental Engineering School participate in the ERASMUS+ exchange programme, in force since January 1, 2014, which supports student

mobility for the purposes of studying (Lifelong Learning Program, LLP) and training (Placements). ERASMUS+ scholarships are funded by the State Scholarship Foundation. For more information, students may contact the University Erasmus office (Mrs. Elena Papadogeorgaki, tel.: 2821037470, e-mail: erasmus@isc.tuc.gr, building E5, office 015, University Campus) or visit the website <http://www.tuc.gr/145.html>. Coordinator for the ERASMUS+ programme at the Environmental Engineering School is Dr. Nikos Xekoukoulotakis, Assistant Professor (tel.: 2821037772, e-mail: nikos.xekoukoulotaki@enveng.tuc.gr, building K2, office 115).

Michailakis Scholarships: Dr. E. Michailakis awards scholarships to the student who topped the School entrance examinations and to the top student of each class.

Limmat Scholarships: The Swiss non-profit Limmat Stiftung Foundation awards scholarships for excellent performance to the top three graduates of the Environmental Engineering School.

3.5 Qualification Exams

Graduates of other Higher Educational Institutes, of Technological Educational Institutes or of Schools with two-year degree programs may register at the School of Environmental Engineering after passing the entrance qualification examination. This examination is on specific courses announced at the end of the spring semester of each academic year. Applications for participation in the entrance qualification examination must be submitted during the first half of November and the examination is held in early December each year. The content of the courses the candidates are examined on is described in the current Undergraduate Studies Program Guide.



3.6 Duration & Curriculum

STUDIES

The academic year begins on **September 1st** of each year and ends on **August 31st** of the following year. The educational program of studies for each academic year is divided in **two semesters**.

The teaching methods employed by the School of Environmental Engineering follow modern educational standards and, depending on the course, include open lectures to broad audiences, targeted seminars to small groups, tutorials and recitations, laboratory exercises and practical training.

Open lectures are not mandatory, although attendance is strongly recommended.

Additional educational activities take place in small, predefined groups of students and attendance is mandatory.

Laboratory exercises play an important role in the training of Environmental Engineers. Specialized laboratories provide consolidated knowledge and practice via planned experiments.

The total duration of undergraduate studies is **ten (10) semesters**, including the diploma thesis project.

ACADEMIC 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.

Official Holidays during the academic year are:

- Fall Semester
 - October 28 (National holiday)
 - November 17 (Commemoration of the Athens Polytechnic uprising against the Greek junta in 1973)

- November 21 (Local religious holiday of Chania - The Presentation of Virgin Mary)
- December 24 to January 6 (Christmas Holiday Break)
- January 30 (Three Hierarchs – National holiday for all educational institutions)
- Spring semester
 - Ash Monday
 - March 25 (National holiday)
 - Holy Week and Easter Week (Easter Holiday Break)
 - May 1 (Labour Day)
 - Student elections day
 - Whit Monday

CURRICULUM

The curriculum for an academic year is determined at the end of the spring semester of the preceding academic year.

The curriculum includes:

- the titles of required and elective courses,
- the numbers of hours per week for lectures and tutorials for each course,
- the number of hours per week for laboratory work for each course,
- the number of credits for each course,
- the number of ECTS credits for each course,
- the detailed content description for each course.

Courses are divided in two categories: (a) **required** and (b) **elective**.

The first category includes core courses that provide students with fundamental knowledge; students should register for and successfully complete all required courses.

The second category includes a large number of specialized courses; each student should select, register for and successfully complete a predetermined minimum number of elective courses.

The organisation of courses in semesters and their ordering in the curriculum is indicative and not mandatory except for the sequences of prerequisite courses. The course ordering is presented in the Standard Undergraduate Program Guide of the Environmental Engineering School.

COURSE REGISTRATION AND ATTENDANCE

In each semester, students are allowed to register for up to $v+7$ courses, where v represents for the number of courses in the curriculum for the corresponding semester. In the 9th semester, students may register for up to 14 courses and from the 10th semester onwards students may register for up to 16 courses.

Students have the opportunity to participate in two (2) examination periods for each course they have registered for during an academic semester. For the fall semester, the first examination period is held in January while the second in September. For the spring semester, the first examination period is held in June whereas the second one is also held in September.

Students who do not satisfy the requirements for the successful completion of a course even after the second examination period have to re-register again for

the particular course in a subsequent semester and fulfil all attendance and examination requirements anew.

Course registration is conducted electronically via the special Students Records Web-site of the Technical University of Crete <http://websrv.stdnet.tuc.gr/unistudent>. Students are required to have an E-services account which is created at the Computer Centre of the University. If you do not have such an account, please create one and properly notify the Secretariat of the School of Environmental Engineering.

EDUCATIONAL VISITS

Educational visits, including visits to companies and industries, of up to one week duration, are foreseen in the frame of the required courses for the third and fourth year of studies. Field trips take place during a prearranged, in the academic calendar, time period and are held only if participation exceeds 70% of the year's student population.

INTERNSHIP

The internship provides students of the School of Environmental Engineering an excellent opportunity to learn from close up about activities related, directly or indirectly, to their field of studies.

Taking into account the young age of the School (the first class of students graduated in 2002) and the as of yet unrecognised (institutionally and in practice) professional rights of Environmental Engineers, contact with the labor market is necessary in order to make known the human resources that will be soon available to staff companies, organisations and businesses.

On the other hand, faculty members get the opportunity to establish links with the industry and possibly develop partnerships beyond the scope of training (for example at research level).

In addition, the School takes the opportunity to assess the quality of the education provided to its students based on the evaluations from company executives.

COURSE GRADES

Grades for all courses are expressed on a 0-10 scale in increments of 0.5 with 5 (five) being the lowest passing grade. Instructors are responsible for submitting to the Secretariat the grades for the courses taught in a semester within a maximum of three (3) weeks from the end of the semester examination period.

The weighting factor for each course depends on the number of credit units assigned to the course according to the following table:

CREDIT UNITS	WEIGHTING FACTOR
1-2	1.0
3-4	1.5
More than 4	2

COURSE EQUIVALENCY

It is possible for students enrolled in the School of Environmental Engineering through transfer from another higher education institution or after passing the entrance qualification examination to transfer credit for courses taken at another institution on the basis of course equivalency. In order to establish the equivalence of a course to a corresponding course required by the School for the diploma in Environmental Engineering, the following conditions must be met:

- The student must have successfully completed the course in another School of the Technical University of Crete or in other Higher Education Institution in Greece or abroad.
- The Undergraduate Studies Committee, in cooperation with the instructor responsible for the corresponding course, must ascertain the equivalence of the course's content to that of the corresponding course as described in the undergraduate studies program of the Environmental Engineering School.
- In the case of equivalence, the student is credited with the Credit Units of the corresponding course. If the course was taken at a higher education institution in Greece, the course grade is also transferred. If the course was taken at a university abroad, the student is credited with the Credit Units of the corresponding course and with an equivalent grade.

In ambiguous cases not covered by the conditions above, the Undergraduate Studies Committee makes a recommendation to the General Assembly, which ultimately decides on the course equivalency.

DIPLOMA THESIS

Starting the Diploma Thesis

According to the university studies regulations, the 10th semester is free of courses and intended for work on the diploma thesis, which is a requirement for the completion of the undergraduate studies. Students who have completed the eighth semester and have less than ten courses left to complete the course requirements may start working on their thesis in order to be able to complete it by the end of the 10th semester.

The topic of the diploma thesis may fall into a wide range of fields of specialization within Environmental Engineering. The objective of the thesis is twofold: first to introduce undergraduate students to research and second, to further develop the science of Environmental Engineering.

Thesis topics and a brief description of the study objectives for each topic are drafted by the School Faculty each academic year, and are available at the Secretariat.



Composition of the three-member Supervisory Committee

The three-member supervisory committee is a committee that supervises a student's work towards his/her diploma thesis. It consists of a primary supervisor (advisor), who acts as chair, and two committee members. Serving as members of the supervisory committee may be professors of the School of Environmental Engineering or, of any other School of the Technical University of Crete, professors of any other approved higher education institution in Greece or abroad, Ph.D. holders employed as researchers in recognized institutions/organisations or scientists of recognized standing working in the private sector. However, the primary supervisor must be a member of the faculty of the School of Environmental Engineering. The committee members have the task of making suggestions for changes and improvements. The thesis advisor meets with the student on a regular basis to review progress on the thesis. All three committee members must be present during the thesis defense.

The diploma thesis topic and the composition of the three-member supervisory committee must be approved by the General Assembly.

Diploma Thesis content

The subject of the thesis should be a standalone research topic. The final written report for the diploma thesis should include: documentation supporting the research gap addressed in the work, full literature review, description of the adopted experimental procedure and methodology, presentation and discussion of the derived results, conclusions and recommendations. The thesis report should also include all data documenting the results, such as tables, graphs, figures and photos, compiled in annexes. Thus, every student should pursue the in-depth study of the subject as well as provide a coherent and comprehensive presentation of the work.

Diploma Thesis duration and deadlines

The minimum time for the diploma thesis preparation is one academic semester. The preparation should be continual, intensive and well-organized in order to make efficient use of time and minimize the required preparation time. In the case of collaborative work among two or, at most, three students, a single written report must be prepared irrespective of the number of collaborating students; however, each student is evaluated separately. In order to be able to set a thesis defense date, a student must have successfully completed all courses in the curriculum. The date and time for the oral defense is set in consultation with the supervisory committee. A summary of the thesis is uploaded to the university's website prior to the oral defense. The thesis oral defense must take place within 20 days of the completion of an examination period (January, June, September) for a student to be awarded the diploma in the diploma award ceremony that follows that examination period.

Diploma Thesis Grade

Each of the three supervisory committee members grades the diploma thesis with respect to the quality of content, the quality of the written report and that of the oral presentation. The thesis grade is the average of the members' grades and contributes 20% to the final diploma grade, that is, the thesis grade corresponds to the average grade of approximately two semesters. Following the successful thesis defense, students must submit one (1) copy to the library of the Technical University of Crete and three (3) copies to the members of the supervisory committee.

3.7 Requirements for the Diploma in Environmental Engineering

The requirements for earning the Diploma in Environmental Engineering are as follows:

- Enrollment in the Environmental Engineering School and registration for courses for at least ten (10) semesters, for regularly enrolled students.
- The required number of courses leading to the Diploma in Environmental Engineering is that described by the curriculum in force during the student's first enrollment in the Undergraduate Program. However, students may have to take additional courses due to changes in the undergraduate program of studies included in amendments to the Undergraduate Program Guide during the period of their studies.
- The Diploma grade is calculated from the grades of all courses required for graduation and from the Diploma thesis grade. The Diploma Thesis grade contributes 20% to the final Diploma grade.
- In the calculation of the Diploma grade, the grade for every course is multiplied by the course weighting factor. The sum of the weighted grades divided by the sum of the weighting factors for all courses yields the mean course grade. The mean course grade contributes 80% to the final Diploma grade while the Diploma thesis grade contributes the remaining 20%.

Diploma Ranking	Grade range
Good	from 5.0 – 6.5 (not included)
Very Good	from 6.5 – 8.5 (not included)
Excellent	from 8.5 – 10

4 Detailed Undergraduate Courses Curriculum

All courses in the curriculum are listed in academic semesters in the following summary tables. The code, the title, the number of hours per week for lectures (T), tutorials (E) and laboratories (L), the total number of hours per week (H), the number of Teaching Units (T.U.), as well as the number of ECTS credits are listed for each course. A list of all elective courses offered per semester from which students are free to choose is also presented along with some restrictions on each choice.

1ST SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
MATH 101	Differential and Integral Calculus I	(3-1-0)	4	4	5
PHYS 101	Physics I	(2-1-2)	5	3	5
MRED 121	Environmental Geology	(2-0-2)	4	3	4
ENVE 133	Environmental System Using Computer Aided Design	(2-0-3)	5	4	4
MATH 105	Introduction To Computer Programming	(3-0-2)	5	4	4
ENVE 112	Ecology	(2-0-2)	4	4	4
ENVE 113	Introduction to Environmental Engineering Science	(2-1-0)	3	3	4
Seminars					
English I					
German I					
TOTAL OF ECTS					30

2ND SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
MATH 102	Differential and Integral Calculus II	(3-1-0)	4	4	5
ENVE 132	General Chemistry	(2-1-0)	3	4	5
MECH 102	Technical Mechanics - Statics	(2-2-1)	5	3	5
MATH 106	Scientific Programming	(2-0-1)	3	3	5
ENVE 162	Geodesy	(1-0-3/2)	3	3	5
ENVE 126	Environmental Microbiology	(2-0-2)	4	3	5
Seminars					
English II					
German II					
TOTAL OF ECTS					30

3RD SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
MATH 201	Numerical Linear Algebra	(4-0-1)	5	3	5
MATH 203	Ordinary Differential Equations	(3-0-0)	3	3	5
MATH 204	Probability & Statistics	(3-0-0)	3	3	5
MECH 201	Engineering Mechanics–Strength of Materials	(3-1-1)	5	4	6
ENVE 221	Fluid Mechanics	(3-1-2)	6	5	6
Code	Required Course: English or German	(T-E-L)	H	T.U.	ECTS
LANG 201	English III	(2-0-2)	4	2	3
LANG 203	German III	(2-0-2)	4	2	3
TOTAL OF ECTS					30

4TH SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
CHEM 201	Physical Chemistry	(3-0-4/2)	5	4	6
ENVE 224	Geographical Information Systems	(1-0-3)	4	3	6
ENVE 264	Soil Mechanics and Foundations	(2-2-0)	4	3	5
ENVE 212	Water Pollution Control	(1-0-2)	3	3	5
ENVE 229	Environmental Thermodynamics	(3-1-0)	4	3	5
Code	Required Course: English or German	(T-E-L)	H	T.U.	ECTS
LANG 204	English IV	(2-0-2)	4	2	3
LANG 204	German IV	(2-0-2)	4	2	3
TOTAL OF ECTS					30

5TH SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
ENVE 321	Structural Analysis and Reinforced Concrete	(3-1-0)	4	3	5
ENVE 332	Environmental Meteorology and Air Quality Models	(2-1-0)	3	3	4
ENVE 317	Reaction Engineering (Chemical And Biochemical Processes)	(3-1-4/4)	5	4	5
ENVE 345	Aquatic Chemistry	(2-1-0)	3	3	4
ENVE 331	Hydrology	(2-1-0)	3	3	4
ENVE 322	Heat & Mass Transfer	(2-1-0)	3	3	4
Code	Elective Courses (2 out of 7 SocSci available in the 5 th and 6 th semester)	(T-E-L)	H	T.U.	ECTS
SSCI 101	Sociology	(3-0-0)	3	3	4
SSCI 203	Philosophy and History of Science	(3-0-0)	3	3	4
SSCI 301	Art and Technology	(3-0-0)	3	3	4
TOTAL OF ECTS					30

6TH SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
ENVE 340	Field Studies I			1	
ENVE 311	Air Pollution	(2-0-0)	2	3	3
ENVE 324	Unit Operations for Water and Wastewater Treatment	(2-1-4/2)	5	4	5
ENVE 336	Numerical Methods in Environmental Engineering	(4-0-1)	5	3	5
ENVE 326	Hydraulics I	(3-1-0)	4	4	5
ENVE 303	Energy and Environmental Technologies	(0-0-4)	4	4	3
ENVE 335	Optimization of Environmental Systems	(3-1-0)	4	4	5
Code	Elective Courses (2 out of 7 SS available in the 5 th and 6 th semester)	(T-E-L)	H	T.U.	ECTS
SSCI 104	Introduction to Philosophy	(3-0-0)	3	3	4
SSCI 102	Political Economy	(3-0-0)	3	3	4
SSCI 202	History of Civilization	(3-0-0)	3	3	4
SSCI 302	Industrial Sociology	(3-0-0)	3	3	4
ENVE 346	Internship				5
Internship					
TOTAL OF ECTS					30

7TH SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
ENVE 421	Applications in Environmental Modelling	(2-1-0)	3	3	5
ENVE 437	Chemical Processes For Water And Wastewater Treatment	(2-1-4/2)	5	4	6
ENVE 338	Municipal Solid Waste: System Management and Design	(3-1-2/2)	5	4	6
ENVE 435	Project Management	(3-0-1)	4	4	5
ENVE 433	Hydraulics II	(0-0-3)	3	3	5
Code	Specialization Courses (1 out of 5)	(T-E-L)	H	T.U.	ECTS
ENVE 443	Sustainable Development (ISO14000 & LCA)	(2-1-0)	3	3	3
ENVE 451	Agricultural Engineering Systems	(2-1-0)	3	3	3
ENVE 419	Engineering Seismology and Seismic Norms	(2-1-0)	3	3	3
ENVE 417	Health and Safety at Work	(2-1-0)	3	3	3
ENVE 249	Noise Control	(2-1-0)	3	3	3
TOTAL OF ECTS					30

8TH SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
ENVE 430	Field Studies II			2	
ENVE 432	Groundwater Flow & Contaminant Transport	(3-1-2/2)	5	4	6
ENVE 438	Treatment and Management of Toxic and Hazardous Wastes	(3-1-2/2)	5	4	6
ENVE 442	Biological Processes in Wastewater Treatment	(3-0-2/2)	4	4	4
ENVE 531	Design of Hydraulic Structures	(2-1-0)	3	3	3
ENVE 444	Renewable Energy Sources	(2-1-0)	3	3	4
ENVE 554	Design of Environmental Plants and Environmental Impact Assessment I	(2-0-1)	3	3	4
Code	Specialization Courses (1 out of 5)	(T-E-L)	H	T.U.	ECTS
ENVE 446	Biological Methods of Environmental Remediation	(2-1-0)	3	3	3
ENVE 450	Analysis of Municipal Transportation Systems	(2-1-0)	3	3	3
ENVE 434	Decentralized Wastewater Treatment Systems	(2-0-1)	3	3	3
ENVE 436	Water Resources Management	(2-0-2/2)	3	3	3
ENVE 545	Buildings' Energy Efficiency	(2-1-0)	3	3	3
ENVE 441	Strategic Management and Innovative Entrepreneurship	(2-2-0)	4	3	3
DPEM433	Small & Medium Enterprises (SMEs) and Innovation	(2-0-2)	4	3	3
Internship					
TOTAL OF ECTS					30

9TH SEMESTER COURSES

Code	Required Courses	(T-E-L)	H	T.U.	ECTS
SSCI 304	Environmental & Technical Legislation	(3-0-0)	3	3	5
ENVE 555	Design of Environmental Plants and Environmental Impact Assessment II	(2-2-1)	5	5	15
Code	Specialization Courses (2 out of the following offered)	(T-E-L)	H	T.U.	ECTS
ENVE 501	Fundamental principles of aerosol science	(2-1-0)	3	3	5
ENVE 537	Indoor Air Quality	(2-1-0)	3	3	5
ENVE 535	Coastal Engineering	(2-1-0)	3	3	5
ENVE 541	Risk Analysis	(2-1-0)	3	3	5
ENVE 539	Soil & Groundwater Remediation Technologies	(2-1-0)	3	3	5
ENVE 553	Agro-Industrial Waste Process Technologies	(2-1-0)	3	3	5
ENVE 511	Design of Energy Systems	(2-1-0)	3	3	5
ENVE 452	Gas-emissions Treatment Technology	(2-1-0)	3	3	5
TOTAL OF ECTS					30

10TH SEMESTER COURSES

THESIS	TOTAL	ECTS	30
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5 Detailed descriptions of courses

1st Semester

Required Courses

[MATH 101] DIFFERENTIAL AND INTEGRAL CALCULUS I

Real variables. Principle of Mathematical induction. Sequences, limits of sequences, recursively defined sequences. Series (Convergence criteria) Functions of one real variable. Limits and continuity of functions. Derivatives. Geometric interpretation of the derivative. Differentials. Applications of the derivative. Definite integrals. Basic theorems of integral calculus. Applications of integration: Areas between two curves, volumes and surfaces of solids by revolution, arc length, moments and centroids, hydrostatic pressure). Exponential Functions. Inverse functions. Hyperbolic functions. Indefinite integral. Integration techniques. Integration by parts, by substitution. Integration of trigonometric functions. Rational functions. Integrals of type $\sqrt{a^2 \pm x^2}$, $1/\sqrt{a^2 \pm x^2}$. Improper integrals. Power series and Taylor series. Applications of series.

[PHYS 101] PHYSICS I

Rectilinear motion, Velocity, Acceleration, Lateral movement, Vectors. Newton's laws of motion, Gravitational forces, Conveyor balance, Friction - Momentum, Conservation of momentum, Center of mass - Kinetic energy, Energy conservation law, work, power, potential energy, conservative forces, Relationship between force and potential energy. Smooth (or not) particle circular motion, rotational motion of a body, moment of inertia, torque, torque and rotation, General condition engineering balance. Spin point and rigid body, torque and angular momentum, angular momentum conservation law, precession. Plain harmonic oscillator (AAT), simple, complex and torsional pendulum, AAT and damping. Restrictions on the movement system, generalized coordinates, equations of motion of Lagrange, equations of motion of Hamilton - Law Coulomb, Electric field, Movement load electric field, Gauss Law and Applications to Electrostatic - Point loads and electrical potential difference, absolute potential, electric dipole, electric fields of dynamic electric potential energy. Ideal gas law, specific heat, thermal expansion, heat diffusion methods. Work produced by the change in volume, first thermodynamic law. Reversible changes - Cycle Carnot, second thermodynamic postulate, entropy.

[MRED 121] ENVIRONMENTAL GEOLOGY

Approaches to natural phenomena, Geosciences and their research objectives, Cosmology, the Milky Way galaxy, the components of the universe, Earth structure, crystalline state of matter - Crystals, Elements of Orictology, Magmatic, sedimentary and metamorphic rocks, Stratigraphic correlations, absolute and relative age of rocks, tectonic - petrological - geochemical cycle, Carbon cycle, the hydrologic cycle, geomorphological and morphotectonical elements.

Sequence of stratigraphic geological processes and principles, introduction to topographic maps, topographic cross-sections of varying scale, introduction to geological maps, simple geological cross-section, geological cross-section of

successive layers of different thicknesses, geological cross-section mismatch layers, geological cross-section of faults, geological structure with intercept disparity layers, fracture and venous infiltration, geological cross-section of strands, problem reversing - definition of marshaling evidence boreholes, construction of geological cross-section from geologic maps.

[ENVE 133] ENVIRONMENTAL SYSTEM USING COMPUTER AIDED DESIGN

Introduction to the techniques of designing in PC with use of CAD. Configuration of drawing environment (objects, scales, printers). Basic concepts of CAD system, structure and drawing processing. Properties of objects. Dimensions, text introduction and processing. Surface and solid elements in design space. Axonometric and perspective projections of objects.

[MATH 105] INTRODUCTION TO COMPUTER PROGRAMMING

Introduction to Algorithms. Structured Programming. Programming in UNIX environment using FORTRAN and C (basic commands, tables and arrays, subroutines-functions). Laboratory Exercises.

[ENVE 112] ECOLOGY

Systems & ecosystems. Organisms and species interactions. Energy and nutrient relations. Primary production and energy flow. Nutrient cycling and retention. Succession and stability. Population ecology, communities and ecosystems. Introduction to models. Ecological quality and degradation of natural environment.

[ENVE 113] INTRODUCTION TO ENVIRONMENTAL ENGINEERING SCIENCE

Introduction to the basic concepts of the Environmental Engineering Science (pollution, remediation, protection, environmental management), basic design concepts (flow diagrams, process efficiency, mass and energy balances, environmental applications), introduction to waste water, solid waste and air pollution treatment.

ENGLISH I [Seminars]

English I is a non-credited course/seminar offered to students in preparation for the advanced level courses English III and English IV. The target level of English I is B2, according to *The Common European Framework of Reference for Languages* (CEFR). For students who have not achieved a certificate at level B2, classroom teaching aims at preparing them for the certificate examinations in English at this level.

GERMAN I [Seminars]

The course teaches German to students who already have basic knowledge of the German language. It aims at developing students' skills in writing and speaking at a practical level. It includes introduction in reading comprehension strategies, analysis of authentic, contemporary texts of graded level, exercises to enrich one's vocabulary, as well as, practice in selected grammar topics. The e-classroom, the electronic exercises on the Language Centre website along with the audiovisual material of autonomous learning are complementary to

the course. Students have even the possibility to enrol in a speaking and writing practice course.

Beginners' courses are also offered in **German A I and A II** as prerequisites for the German I course. These courses aim at teaching the written and spoken language necessary for everyday communication in a German-speaking environment. They include weekly classroom attendance as well as the use of the autonomous learning audiovisual material of the e-classroom.

2nd Semester

Required Courses

[MATH 102] DIFFERENTIAL AND INTEGRAL CALCULUS II

Functions of two and more variables. Equations of solids (cone, cylinder, etc.). Cylindrical polar spherical coordinates. Parametric representation of curves and figures Differential Geometry (Curvature, vertical vectors. etc.). Inner and outer product of vectors. Partial Derivatives of functions of several variables, dir, grad, Curl and basic theory of vector fields. Lagrange multipliers and other extrema criteria for functions of several variables. Differential functions of several variables. Line Integrals. Double triple integrals. Applications in Physics and Geometry (Calculating volumes, moments of inertia, surface area, etc.). Surface Integrals. Applications to the flow of fluids. The theorem of Green, vector expression of TH Green, parametric representation of surfaces and applications (flow, etc.). The Theorem of Stokes (Applications in Physics). The Divergence Theorem.

[ENVE 132] GENERAL CHEMISTRY

Structure and properties of matter. Atoms, molecules and ions. Electronic structure of atoms. Periodic table of the elements. Chemical bonding and molecular geometry. Intermolecular forces and states of matter. Solutions. Chemical reaction and stoichiometry. Basic concepts of chemical kinetics and chemical equilibrium. Acids, bases and salts. Redox reactions and electrochemistry. Chemistry of coordination compounds. Organic chemistry.

[MECH 102] TECHNICAL MECHANICS - STATICS

General principles of mechanics of structures. Force and moment vectors. Equilibrium of a particle. Equilibrium of a rigid body. Types of loads and supports. Free body diagram. Analysis of 2-D simple trusses frames and cables. Diagrams of internal forces and moments. Center of gravity and centroid. Friction and structural stability. Analytical, experimental and computational projects.

[MATH 106] SCIENTIFIC PROGRAMMING

Introduction to Matlab. Numerical operations - Variables - Complex Numbers - M-files - Functions - Recursive procedures - External files - Matrices - Polynomials - Charts. Symbolic Variables and Computations - Derivatives - Integrals. Plots - 2- and 3-Dimensional Symbolic Graphs - Linear system solutions using Symbolic Math Toolbox. Laboratory lectures on Unix platforms.

[ENVE 162] GEODESY

Introduction and historical review. Shape and size of earth. Reference surfaces. Reference point definition of the position, computational problems. Geodesy measurements, measurements and errors, instruments and methods of measuring distances and elevation angles, positioning point, the positioning system GPS, introduction to cartography, cartographic projections, the topographical map, a representation of terrain.

[ENVE 126] ENVIRONMENTAL MICROBIOLOGY

Introduction to Environmental Microbiology. Chemical composition of the cell. Classification of cells / organisms (eubacteria, archaea, fungi, protozoa, algae, viruses). Bacterial growth. Aquatic, earth and extreme environments. Detection, enumeration and identification of microorganisms. Microbial communication, activities and interactions with environment and nutrient cycling. Bacterial communities in natural ecosystems. Water and foodborne pathogens (environmentally transmitted pathogens, indicator microorganisms). Wastewater treatment and biosolids reuse. Drinking water treatment. Disinfection. Remediation of organic and metal pollutants.

ENGLISH II [Seminars]

English II is a continuation of English I non-credited course/seminar offered to students in preparation for the advanced level courses English III and English IV. The target level of English II is B2 according to *The Common European Framework of Reference for Languages* (CEFR). For students who have not achieved a certificate at level B2, classroom teaching aims at preparing them for the certificate examinations in English at this level.

GERMAN II [Seminars]

German II deepens and reinforces fundamental knowledge acquired in German I. The objective of the course is to develop students' ability to process and comprehend various kinds of authentic texts on their own, autonomously, to expand their vocabulary and produce written and spoken speech. Special emphasis is given on listening comprehension skills. Sentence structure is the main point of reference regarding grammar.

The e-classroom, the electronic exercises on the Language Centre website along with the audiovisual material of autonomous learning are complementary to the course. Students have even the possibility to enroll in a speaking and writing practice course.

3rd Semester

Required Courses

[MATH 201] NUMERICAL LINEAR ALGEBRA

Introduction to Linear Algebra and Matrix Algebra. Direct Methods for Solving Linear Systems. Driving Strategies. Error Analysis. Matrix Condition number. Determinants. Eigenvalues and Eigenvectors. Diagonalization. Iterative methods for solving linear systems.

[MATH 203] ORDINARY DIFFERENTIAL EQUATIONS

Introductory concepts, the initial value problem. Simple differential equations of first and second order, separable, homogeneous, Bernoulli, Riccati, Euler, accurate method of integral factor. The differential equation of Newton and applications to basic problems of mechanics. Linear independence and dependence, Vronskiani, the transformation $y = gY$. Linear differential equations with constant coefficients. The method of transformation Laplace. Applications in mechanics and electricity. Systems of differential equations with constant coefficients. Linear differential equations with variable coefficients. The method of power series.

[MATH 204] PROBABILITY & STATISTICS

Review of basic topics in Probability theory. Descriptive Statistics (review). Estimation theory. Confidence intervals. Hypothesis testing. Chi-square goodness of fit test. Chi-square test of independence. Correlation and regression analysis. Analysis of variance.

[MECH 201] ENGINEERING MECHANICS – STRENGTH OF MATERIALS

Destructive tests, Non-destructive tests, Experimental mechanics of materials, Factor of Safety, Internal forces, stresses. Strains. Stress-strain relations. Stress concentrations. Optimized choice of materials. Statically indeterminate structures. Problems with temperature changes. Shear strain. Stress-strain distribution. Torsion. Simple bending. Asymmetric bending. Transverse loading. Stresses under combined loading. Stress transformations. Mohr cycles. Elastic curve of loaded beams. Energy methods.

[ENVE 221] FLUID MECHANICS

Properties and characteristics of fluids, Measurement Units, Viscosity, Continuity, Density, Specific Volume, Specific Gravity, Perfect Gases, Pressure, Vapour pressure, surface tension and capillary phenomena with applications in a porous medium (soil). Pressure point, Basic Equations Fluid Statics, measurements using a manometer in Environmental Applications, Forces on submerged Flat and curved surfaces, buoyancy, forces on dams, sluice. Types of Forces, Fundamental Laws (Conservation of Mass Principle, Second Law of Newton - momentum theorem, Principle of Conservation of Energy), Concept and System Selected Volume Reporting continuity equation, momentum equation, Equation of Energy, Mass and Energy Balances in Environmental Systems, Transfer of Pollutants in Aquatic Systems. Non dimensional Numbers for Analysis of Environmental Systems, Dimensions and Units, Theorem P, Non dimensional Parameters, Similarity, Reynolds Number, Froude Number, Dimensional Analysis for Flow Models Closed Pipe and Plumbing Construction. Permanent Two-dimensional flow between plates, Flow in Streams, Rivers and closed conduits, major and minor losses, boundary layer, Friction.

[LANG 201] ENGLISH III

English III combines a programme of self-access learning at the Language Centre with a series of thematic work modules to be covered in class based on a student's field of study. The modules focus on language, texts, and writing

skills specifically targeted at what students learn within the context of their School. Students are also expected to register and participate in the e-class for the course as well as utilize the recommended or required resources at the Language Centre.

The final mark will be based on the exam at the end of the semester as well as the quizzes in the e-class. Quizzes count for thirty percent (30%) of the final mark.

[LANG 203] GERMAN III

German III focuses on introducing and teaching terminology, at the written as well as the spoken level. The course includes reading, processing and critically approaching authentic texts (articles, technical texts) of graded level, directly related to the terminology of the School of Environmental Engineering. Forms and structures of writing production are reinforced. Special emphasis is given on listening comprehension skills.

The e-classroom, the electronic exercises on the Language Centre website along with the audiovisual material of autonomous learning are complementary to the course. Students have even the possibility to enroll in a speaking and writing practice course.

4th Semester

Required Courses

[CHEM 201] PHYSICAL CHEMISTRY

States of matter and basic properties. The gaseous state of matter: Ideal and non-ideal behavior, empirical laws, equations (ideal and non-ideal gas), crucial and converted variables, theorem of corresponding states. Diffusion of gas converted variables, theorem of corresponding states. Diffusion of gases. Phases equilibrium. Equilibrium between liquid mixture and its vapor. Laws that govern it. Distance. Physico-chemical analysis and design of distillation. Differential and fractional distillation. Gas-Liquid, liquid-liquid and liquid-solid equilibrium. Physico-chemical analysis of Absorption, Extraction and Adsorption processes. Physical and chemical sorption, isothermal. Chemical kinetics: constant speed theory of Arrhenius. Rate equations. Kinetic study of reactions. Standard reactors. Kinetics and Mechanisms of homogeneous and heterogeneous catalytic reactions. Thermodynamics: first law and applications. Chemical Thermodynamics. Second law and applications. Enthalpy, Entropy, Gibbs Free Energy and Helmholtz. Chemical potential. Chemical equilibrium. Chemical kinetics of heterogeneous catalytic reactions of environmental importance (Environmental Catalysis). Electrochemistry, fuel cells. The knowledge is supplemented by laboratory exercises and Adsorption.

[ENVE 224] GEOGRAPHICAL INFORMATION SYSTEMS

Systematic components of GIS, geographic data, hardware and software for GIS, geographic data collection, organization and storage of geographic data, data models, introduction to databases, data structures, database management systems, processing and analysis of geographic data, evidence of

geographical data and results analysis, applications of GIS (GIS specific environmental issues).

[ENVE 264] SOIL MECHANICS AND FOUNDATIONS

Soil mechanics: Nature and properties of soils. Soil classification systems. Particle size distribution. Relative density. Atterberg limits. Soil permeability. Role of water in the mechanical behavior of soils. Soil behavior under saturated and unsaturated conditions. Consolidation and settlements. Mechanical behavior of soils. Stresses in soils. Strains and deformation of soils. Shear strength of soils. Failure criteria. Mohr-Coulomb theory. Lateral soil pressures. Methods for calculating active and passive pressures. Slope stability. Landslides. Analysis methods and retaining systems.

Foundations: Applications in structures and infrastructure. Soil investigation and characterization. Laboratory and in situ tests. Soil Improvement. Condensation. Shallow foundations. Morphology of shallow foundations. Soil strength and settlements. Bearing capacity of shallow foundations. Calculation of load capacity. Deep foundations & excavations. Piles & Shafts. Eurocode 7 design principles for reinforced concrete foundations. Limit states and safety factors.

[ENVE 212] WATER POLLUTION AND MONITORING

Introduction. Sensory water characteristics. Natural water characteristics. Mineral water characteristics. Organic water characteristics (COD, BOD, TOC). Sampling. Basic principles of spectroscopy. Spectrometer. Atomic spectroscopy. Introduction to analytical separations. Gas and Liquid Chromatography. Automated analysis and remote monitoring. Chemometrics basics. Water quality thresholds and wastewater treatment requirements.

[ENVE 229] ENVIRONMENTAL THERMODYNAMICS

Introduction to thermodynamics; basic concepts; forms of energy; properties of pure substances; energy balances in open and closed systems (first law); second law of thermodynamics; entropy; Maxwell relations; air and steam thermodynamic cycles; refrigeration cycles; mixtures and phase equilibria; chemical potential, activity and fugacity.

[LANG 202] ENGLISH IV

Students in English IV will be required to study texts and language based on materials related to their field of study. Students are also expected to register and participate in the e-class for the course as well as utilize the recommended or required resources at the Language Centre.

The final mark will be based on the exam at the end of the semester as well as the quizzes in the e-class. Quizzes count for thirty percent (30%) of the final mark.

[LANG 204] GERMAN IV

The objective of the course is to familiarize students with the terminology of the School of Environmental Engineering through scientific and authentic texts of specialized content as well as to improve students' writing skills. The

framework of thinking; coping and working in a German scientific environment is taught to completion. Special emphasis is given on listening comprehension, as well as speaking and writing skills in order to achieve further fluency in transnational communication.

The e-classroom, the electronic exercises on the Language Centre website along with the audiovisual material of autonomous learning are complementary to the course. Students have even the possibility to enroll in a speaking and writing practice course.

5th Semester

Required Courses

[ENVE 321] STRUCTURAL ANALYSIS & REINFORCED CONCRETE STRUCTURES

Structural analysis of 2-D frame and truss structures utilizing direct stiffness method. Types of loads and supports. Stiffness and transformation matrices. Formulation and solution of equilibrium equations. Evaluation of member actions. Computer implementation of the direct stiffness method. Introduction to the finite element method.

Basic theory of reinforced concrete structures analysis and design. Properties of concrete and reinforcement steel. Types of loads, limit states and related checks: compression, tension, bending moments, shear forces and moments. Design principles under Greek regulations and Eurocodes. Computations for basic structural elements (slabs, beams, columns) of reinforced concrete buildings. Code requirements and detailing provisions. Analytical and computational projects.

[ENVE 332] ENVIRONMENTAL METEOROLOGY & AIR QUALITY MODELS

This course provides general information on the Earth's atmosphere, which would be of concern to an environmental engineer. The atmospheric chemical composition along with the vertical atmospheric structure are described. The Energy Balance in conjunction with the Greenhouse Effect, as well as the Radiation Balance are examined. Detailed study of Heat Transport and Surface Heat Balance is provided, as well. Particular emphasis is given to the Thermodynamics of the Atmosphere, especially inside the Atmospheric Boundary Layer. Analysis of the equations governing the air masses circulation, particularly inside the boundary layer is presented. Stability of the Atmosphere and the Turbulent Kinetic Energy and prognostic equations for turbulent flow are examined in detail. Topics related to Precipitation, Atmospheric Moisture and Cloud Hydrodynamics/Formation – Classification are developed. A brief presentation of the weather systems takes place, with special focus on Climate Change.

[ENVE 317] REACTION ENGINEERING (CHEMICAL AND BIOCHEMICAL PROCESSES)

Stoichiometry and kinetics of chemical reactions. The Arrhenius equation. Design of isothermal homogeneous reactors (batch, CSTR, PFR). CSTR reactors in series. Recycling. Tubular reactors. Analysis of kinetic data from reactors. Catalysis and chemical catalysts. Design of catalytic reactors. Reactions of free

enzymes. Michaelis-Menten kinetics. Determination of kinetic parameters. Obstruction of enzymatic reactions. Mathematical models for microorganisms growth (one variable, limiting substrate, maintenance and endogenous metabolism). Design of bioreactors (batch, fed-batch, CSTR). Sterilization kinetics. Aeration and shaking bioreactors. Determining the optimal operating conditions. Applications.

[ENVE 345] AQUATIC CHEMISTRY

Global Biogeochemical Cycles, Determination of natural water pH, Carbon Equilibrium, chemical species in the solution, regulating tension and neutralization ability, creation of natural waters composition, Law of mass action - Determination of equilibrium constants, chemical activity and ionic strength, 'fate' of metals in the environment, hydrolysis and metals complexation, inorganic compounds as substituents, competitive binding of substituents, interaction of aquatic solutions with sediments and soils, Solubility and Absorption, Effect of chemical species in the solubility, Surface complexes formation, redox geochemistry, Heterogeneous reactions and cycles, redox equilibrium, capacity and redox volumetric measurements (pH scale), Applications of environmental geochemistry.

[ENVE 331] HYDROLOGY

Hydrologic Cycle, Hydrometeorology, Precipitation, Evaporation and Evapotranspiration, Losses, snow hydrology, Infiltration, excess rainfall, hydrological measurements, flood runoff hydrographs, flood redirection, watershed hydrology and watershed models. Applications to computers.

[ENVE 322] HEAT & MASS TRANSFER

Introduction to transport phenomena – Fundamental Principles. Mass transfer mechanisms. Concentration, mass flow and flux, diffusion. Mass balance. Steady state and transient state diffusion. Diffusion and chemical reaction. Similarities in momentum, heat and mass transfer. Dimensional analysis. Analytic solutions of simple mass and heat transfer systems. Applications.

Elective Courses

[SSCI 101] SOCIOLOGY

The course is an introduction to Sociology, with analytical and synthetic study of concepts on key elements of social context in which the productive human activity is carried out. Terms such as: society, social issues and roles, social change, social stratification and mobility, social categories and classes, socio-political institutions, socio-economic institutions and transformations are studied.

[SSCI 203] PHILOSOPHY AND HISTORY OF SCIENCE

After an introductory presentation, the course is oriented around two axes. A) Milestones in the history of individual sciences (astronomy, logic, mathematics, physics, etc.) and related philosophies. B) Basic theoretical currents and individual tendencies in philosophy and history of science, from the logical empiricism and later on (study texts of R. Carnap, K. Popper, TS Kuhn, I.

Lakatos, P. Feyerabend, A. Koyre, G. Bachelard, G. Canguilhem, L. Geymonat, E. Bitsakis).

[SSCI 301] ART AND TECHNOLOGY

Historical-sociological approach to relationships between Technology and Art, Technology and Culture. Examination of the historical circumstances in which the separation of Art and Technology occurred. Consideration for today's integration capabilities or harmonious cooperation. Examination of the development of new technologies within the existing socio-economic formation, its impact on art and culture, the needs of "know-how" for optimal control of (new) technologies.

6th Semester

Required Courses

[ENVE 340] FIELD STUDIES I

The Field Studies imply the practical acquaintance of students of topics taught during the courses of the 2nd and 3rd year of the Curriculum. They include environmental applications of Thermodynamics, i.e. Stirling cycles, heliothermic systems and systems of wind energy. Also desertification phenomena, visiting places in Crete where this phenomenon is manifested and studying methods to avoid the problem.

[ENVE 311] AIR POLLUTION

Sources and nature of primary air pollutants; Formation of secondary air pollutants; Air pollutant removal mechanisms; Global effects of air pollution (Ozone depletion and greenhouse effect, trans-boundary pollution). Local effects of air pollution (on health and vegetation); Air quality standards and indicators; Emission standards; Basic methods for measuring gas flows in ducts and stacks and monitoring pollutant concentrations in the ambient air and in stacks; Ambient air quality monitoring with stationary and mobile station networks; Laboratory training with monitoring of ambient (TSP, PM10 and PM2.5) concentrations; measurement of gas flow and pollutant concentrations in stacks (SO₂, NO, NO₂, CO, CO₂ and TSP with isokinetic sampling); Calculation of emission factors from measurement results.

[ENVE 324] UNIT OPERATIONS FOR WATER AND WASTEWATER TREATMENT

Screening, Flow equalization, Sedimentation, Flotation, Deep bed filtration, Membrane separation processes (Reverse osmosis, nanofiltration, sand bed dewatering). Surface filtration (filterpress, Vacuum filter, drying beds)

[ENVE 336] NUMERICAL METHODS IN ENVIRONMENTAL ENGINEERING

Errors, numerical solution of non-linear equations, interpolation and polynomial approximation, numerical differentiation and integration, approximation theory, numerical methods for initial-value and boundary-value problems for ordinary differential equations - Applications in environmental engineering.

[ENVE 326] HYDRAULICS I

Open channel flow: Open channel hydraulics, categories and states of flow, analytical methods, basic steady flow equations, specific energy, critical depth and applications, alternate depths. Subcritical and supercritical flows, hydraulic jump analysis, control cross-sections, discharge measurements (Venturi), uniform depth, Chezy and Manning equations, optimal hydraulic cross-section - nonuniform flows, gradually varied flows (BMP), surface profiles, classification and characteristics of flow profiles, BMP calculations – hydraulic jump - gates, spillways. River flow. Three (3) open channel experiments (hydraulic jump, energy losses, flow measurement with triangular and square spillways).

[ENVE 303] ENERGY AND ENVIRONMENTAL TECHNOLOGIES

Introduction to Energy and the Environment. Assessment of climatic and meteorological data. Lab exercises: 1) Study and evaluation of solar energy potential 2) Study and evaluation of wind energy potential. Introduction to Air Pollution. Assessment of air pollution emissions. Lab exercises: 3) Measurement of air pollution emissions from a heating boiler 4) Indoor air pollution and energy efficiency. Technologies exploiting solar energy to produce heating and cooling. Technologies exploiting solar energy to produce electricity. Lab exercises: 5) Solar collector-thermosiphon efficiency, 6) Study of the photovoltaic frames.

[ENVE 335] OPTIMIZATION OF ENVIRONMENTAL SYSTEMS

Introduction, Classification of the optimization models, Nonlinear optimization, Convex and Concave sets, Theorems of Mathematical Optimization, The Geometry of the Optimization Problem, Unconstrained Optimization Problems, Lagrange Multipliers, Linear Programming Problems, Simplex method, Nonlinear Programming Problems, Constrained Optimization, Dynamic Programming, applications of optimization methods to Water Resources Management, Design of Groundwater Systems, Optimal Groundwater remediation design, Optimal Saltwater Systems, and Optimal waste-water management systems, Sustainable water resources management.

Elective Courses

[SSCI 104] INTRODUCTION TO PHILOSOPHY

Short historical overview of the ancient Greek philosophers until the philosophical patterns of the 20th century. Further examination of fundamental laws, concepts and categories of modern philosophy: Evolution and universal connection of phenomena. Unity and struggle of opposites. Passage of quantitative changes in qualitative. Denial of denial. Single, partial and general. Cause and effect. Content and form. Necessity and chance. Substance and effect. Possibility and reality. Pattern and structure. Historicity and wholeness.

[SSCI 102] POLITICAL ECONOMY

This course includes an analysis of basic concepts and relations of Political Economy, as well as a brief review of recent economic history. It refers more specifically to the theory of value, surplus-value and prices, as well as to the

relation between competition and distribution, to fundamental trends and contradictions of growth, and to the phenomena of economic crisis.

[SSCI 202] HISTORY OF CIVILIZATION

Starting with basic knowledge derived from individual branches of social sciences (sociology, anthropology, philosophy, political economy, etc.), students approximate analytical and synthetic concepts and issues relating to the history of civilization in general and certain critical periods (Eastern despotism, Ancient Greece, Western European Middle Ages, Renaissance, etc.). In the frame of the course critical perspectives of some theories that attempt to interpret contemporary culture (behaviorism, postmodernism, etc.) are examined.

[SSCI 302] INDUSTRIAL SOCIOLOGY

The content of the course is the Sociology of Labour and Development, with a central core of the changes in production systems in general and specifically in the manufacturing sector (crafts, industry), in conjunction with relevant branches of the productive and scientific activity. The course examines explicitly-synthetic and in various scales (international, national, local-regional) issues concerning labor relations, production processes, research and development, know-how, industrial policy, inter-sectoral and inter-industrial relationships.

[ENVE 417] HEALTH AND SAFETY AT WORK

Introduction to Occupational Safety and Health/ Regulatory framework/ Safety, health, ergonomic hazards/ Workplace requirements/ Personal Protective Equipment/ Safe chemicals handling/ Chemicals labeling and classification/ Occupational safety and health risk assessment/ Requirements of a comprehensive Occupational Safety Management System.

INTERNSHIP

7th Semester

Required Courses

[ENVE 421] APPLICATIONS IN ENVIRONMENTAL MODELING

Introduction to Environmental Systems Modeling, Transport Phenomena, Dispersive Systems, Advective Systems, Advective/Dispersive Systems, Compartmentalization, Sediment Transport, Simple Transport Models, Parameter Estimation, Chemical Reaction Kinetics, Eutrophication, Ecosystem Models, Conventional Pollutants in Rivers and Estuaries, Toxic Organic Chemicals in Lakes, Rivers and Estuaries.

[ENVE 437] CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT

Principles of water equilibrium chemistry, Solubility of salts, Chemical precipitation, Coagulation-Flocculation, Adsorption, Ion exchange, Disinfection processes.

[ENVE 338] MUNICIPAL SOLID WASTE: SYSTEM MANAGEMENT AND DESIGN

Solid waste classification and characterization, properties and characteristics, principles of integrated solid waste management based on their characteristics, basic stages of solid waste management: collection, transfer, storage, recycling, treatment, final disposal. Available methods of solid waste treatment based on their characteristics (composting, thermal treatment, land filling), advantages and disadvantages, available methods selection criteria. Energy from waste (waste-to-energy) - mass and energy balances. Analysis of solid waste collection systems: temporary storage system, design factors (bins, selection of total bins and garbage trucks capacity), collection and transfer systems (planning routes for the collection, evaluation and selection of garbage trucks, capacity, design parameters, equivalent annual cost of collection and transport, planning examples), municipal solid waste transfer stations (structure and operation of systems, dimensioning, selection criteria and compatibility of technologies, location, annual costs, economic evaluation of garbage trucks and transfer station combination). Methods for the estimation of the required number of Landfill Sites (LS) or Integrated Waste Management Facilities (IWMF) in a study area. Selection criteria of LS locations, location selection among various alternatives. Biological and chemical processes of waste degradation. Quantitative and qualitative characterization of degradation products (leachate, biogas). Design of LS: phases of development and capacities, earthworks and sealing, leachate and biogas collection and management, technical infrastructure (fencing, gates, weight ramp, access roads, etc.), mechanical equipment, organization of operation, supervision and monitoring, final restoration and future monitoring.

[ENVE 435] PROJECT MANAGEMENT

Life cycle of projects - from conception, to planning, implementing, monitoring, and final delivery of projects. Principles of Costing - costing based on the volume and cost-based activities. Project scheduling - network models, numerical programming, analysis under conditions of certainty and uncertainty. Planning and control of resources - numerical models and approximate methods. Construction Management - planning, organization, direction and control. Applications in MS Project using data from actual projects.

[ENVE 433] HYDRAULICS II

Closed-Conduit Flow - Pipes in series and in parallel, branching pipes. Open channel flow - flow elements: open channel characteristics, types of flows, basic equations for constant flow conditions, specific energy, critical depth conditions and applications, specific force - alternate flow depths. Sub-critical and supercritical flow, Critical depth, measurement cross-sections - Discharge measurement (Venturi meter) - uniform flow, gradually varied flow, surface profile classification, characteristics of flow distribution, hydraulic jump - flow control gates, overflows, fittings. Introduction of mixing in rivers, reservoirs and lakes. Diffusers and sewage field. Submerged pipe outfall design.

Elective Courses

[ENVE 443] SUSTAINABLE DEVELOPMENT (ISO14000 & LCA)

Introduction. Terms. Monetary system and the environment. Sustainability. Examples. The meaning of development. Income. Impact of the development rate. Development level and categorization of countries. Determinants of the development. Development with and without technology progress. Productivity. Natural sources. Relation monetary sphere/biosphere. Examples in energy and recycling. Sustainable management. Monetary development models. Non balanced development. Agricultural, industrial, postindustrial development. International financial dealings and technology transfer. Desirable development rate. Relation between economic development and environmental protection. Re-estimation of the national income and welfare. National capital depreciation. Examples from the World Bank. Sustainable economic Welfare indicators. Long-term development and sustainability. Economics of ecology. IPAT equation. Economics of the Climate Change. Cost-benefit analysis. EMAS Environmental Management Systems. Life Cycle Analysis. European policies on sustainability. The Framework Programmes on sustainable development. Environmental taxes. Transition in sustainable production systems. The example of energy.

[ENVE 451] AGRICULTURAL ENGINEERING

Agricultural systems and environmental pollution. Sustainability. Irrigation systems and methods (surface, dripping, subsurface). Irrigation networks (closed and open conduits, network equipment, pumps and pumping stations). Drainage works. Soils management (flattening, drainage, and desalination). Water abstraction technical works (rain water collection reservoirs, floating reservoirs and spring water collection systems).

[ENVE 419] ENGINEERING SEISMOLOGY AND SEISMIC NORMS

Introduction to earthquake hazard and seismic mitigation of structures. Seismotectonics of Greece. Engineering seismology and soil dynamics. Local site conditions. Records and spectra. Introduction to structural dynamics. Single and multiple degrees of freedom systems. Greek and European seismic norms. Geotechnical/geoenvironmental earthquake engineering case studies. Analytical and computational projects.

[ENVE 249] NOISE CONTROL

Measurement, evaluation, prediction and responses to noise from various sources to the environment. Existing institutional capacity and inadequate control of noise in the country and the country's obligations within the framework of European policy to tackle noise. Topics: Introduction acoustics and noise effects of noise exposure, the recommended noise levels for different areas, measurements and evaluation of noise, environmental, industrial, traffic, aviation, social and workplace noise, earplugs, basic noise law, noise prediction models.

[ENVE 430] FIELD STUDIES II

The Field Studies II has the objective of providing practical acquaintance of students with basic topics taught in the 3rd and 4th year of their curriculum. More specifically, they include exercises related to: The management of air, water and solid wastes and with the operation of relevant collection, recycling, transport, treatment and final disposal installation; Environmental applications of Fluid Dynamics, i.e. Hydraulics, surface and subsurface waters, hydrology, fate of pollutants in surface and subsurface waters, and; The operation of wind energy systems.

[ENVE 432] GROUNDWATER FLOW & CONTAMINANT TRANSPORT

Introduction to porous media, Distribution of Groundwater, Porosity, Hydrogeological formations, Hydraulic head and Hydraulic Gradient Hydraulic conductivity, Darcy's Law, Homogeneity and Anisotropy, Unconfined aquifers, Confined aquifers, Continuity Equation, Numerical Groundwater Models, Wells, Steady flow towards a well (confined, unconfined and leaking aquifers), Unsteady groundwater flow, Pumping test, Unsaturated zone, Soil properties, Water Budget, Contaminant sources, mass transport processes, Advection and groundwater contamination, Fick's Law, Molecular diffusion, Diffusion in porous media, Dispersion, applications of 1-D and 2-D flow and mass transport to groundwater contamination problems, Numerical Models of groundwater contamination.

[ENVE 438] TREATMENT AND MANAGEMENT OF TOXIC AND HAZARDOUS WASTES

Definition of toxic and hazardous waste, basic hazardous waste characteristics, classification, labeling, current legal framework, reduction-minimization of waste production at source, reuse and recovery, recycling, recycling efficiency evaluation, storage, use and management of containers, tank management, waste compatibility, transfer, treatment, final disposal, life cycle analysis (LCA), toxic waste landfilling, physicochemical, thermal and biological treatment processes, specific classes of toxic waste, basic concepts of toxicology, acute and chronic toxicity, basic principles of risk analysis, hazard identification, exposure and toxicity assessment, hazard characterization.

[ENVE 442] BIOLOGICAL PROCESSES IN WASTEWATER TREATMENT

Basic operating principles and design of treatment systems: Activated sludge treatment; Aeration and secondary settling tanks; Trickling filters; Aerated lagoons; Stabilization ponds; Sludge treatment (aerobic/anaerobic digestion); Anaerobic processes; Thermochemical and advanced oxidation processes for industrial effluents treatment; Integrated physicochemical and biological treatments.

[ENVE 531] HYDRAULIC WORKS

Water Supply: water needs, design period, pipe network and reservoir design, pipe materials and appurtenances, pump mains, service reservoirs, network analysis, Hardy-Cross method. Sewer network design: combined and separate

sewer systems, stormwater and wastewater design flow rates, return period, I-D-F curves, velocities and slopes, network design and analysis, pipe materials.

[ENVE 444] RENEWABLE ENERGY SOURCES

Introduction, terms. Energy and environment. Main aspects of the Renewable Energy Sources. Biomass-biofuels. Solar energy exploitation systems. Active-passive systems, Photovoltaics, Bioclimatic. Wind energy. Small hydro systems. Geothermal energy. Main aspects of energy saving. Prototype energy applications (desalination, autonomous energy systems, solar cooling). Dimensioning of RES systems. Environmental impacts from the renewable and conventional energy sources.

[ENVE 554] DESIGN OF ENVIRONMENTAL PLANTS AND ENVIRONMENTAL IMPACT ASSESSMENT I

Theory and methodology for the design of environmental plants. Methodology for the composition of Environmental Impact Assessment (EIA) studies. The students work in teams to accomplish the design study for an environmental plant, based on primary data. The work involves the search/calculation of the design parameters, the design and the cost estimation of the plant, as well as the composition of the relative Environmental Assessment Study. With the completion of the semester, the students have to present the outcome of their study to an open audience.

Elective Courses

[ENVE 446] BIOLOGICAL METHODS OF ENVIRONMENTAL SANITATION

Design of in situ and ex situ remediation systems for contaminated soil and groundwater with organic compounds (chlorinated and non-chlorinated). Design of subsurface barriers (in situ reactive walls). SBR operation of bioreactors for ex situ bioremediation. Natural attenuation. Phytoremediation technologies for decontamination of soils and groundwater from heavy metals and organics. Air biofilter technology. Predicting the byproducts from bioremediation of organic compounds. Field applications.

[ENVE 450] ANALYSIS OF MUNICIPAL TRANSPORTATION SYSTEMS

Analysis of traffic conditions within urban transportation systems in order to identify and reduce potential negative environmental impacts. Analysis of urban transportation system: data collection, trip generation, trip distribution, modal split, and traffic assignment. Prediction of future transportation needs. Software tools for the analysis and the investigation of alternative strategies aiming to the reduction of any potentially negative consequences, and the continuous improvement of the environmental conditions within the considered systems.

[ENVE 434] DECENTRALIZED WASTEWATER TREATMENT SYSTEMS

Wastewater treatment requirements and receiver water quality limits based on the WHO guidelines and the E.U. directives; Analysis of alternative wastewater reuse and disposal options through the use of models for assessing the irrigation water requirements, the assimilative capacities of rivers and lakes and the size or performance of submarine outfalls. Optimal design and

performance simulation of selected treatment systems, with emphasis on waste stabilization ponds, constructed wetlands with surface and subsurface flows, slow rate land treatment and onsite treatment. Use of an expert system for the analysis of water pollution problems and the synthesis of an optimal dynamic (season-dependent) management schemes through simultaneous consideration of the alternative treatment, reuse for irrigation, and disposal options. Cost estimation of wastewater management projects.

[ENVE 436] WATER RESOURCES MANAGEMENT

Introduction to Water Resources Management (surface water – groundwater). Quantitative and qualitative water resources management in the context of anthropogenic interventions and climate change Application of Water Directive Environmental Protection Systems – Pollution categories, Legislation. Water Resources Management Models in GIS environment, SWAT model

[DPEM 433] SMALL & MEDIUM ENTERPRISES (SMES) AND INNOVATION

Establishment and operation of SMEs. Classification of SMEs. Management accounting. Corporate and tax legislation for SMEs. Cost accounting for SMEs. Financing of SMEs and development of business plans.

[ENVE 545] BUILDINGS' ENERGY EFFICIENCY

Basic principles, aims and benefits of energy efficiency audits. Introductory information on energy regulations. Systems and instrumentation for energy monitoring. Design and installation of energy monitoring, diagnostic error and warning systems. Energy audits of building envelope and services. Energy analysis and the importance of energy pricing and cost. Calibration and energy certification of different building types. Alternative energy calibration methodologies at international level. Proposals for buildings energy efficiency. Computational tools.

[ENVE 411] STRATEGIC MANAGEMENT & INNOVATIVE ENTREPRENEURSHIP

FINANCIAL ANALYSIS: Accounting and balance sheet, business ratios, cost assessment and pricing, break-even point, funding sources. GREEN ENTREPRENEURSHIP: Green accounting and cost assessment. EXTERNAL ENVIRONMENT: Economy, Technology, Nature, Society, Institutions, Politics. Porter model and competition. Barriers to entry, buyers and sellers, competitive position and programming. INTERNAL ENVIROMENT: Sources and capabilities, competitive advantage, value chains, comparative modeling, outsourcing. MISSION – ORGANIZATIONAL STRUCTURE – STRATEGY: Business mission, success factors, strategy levels and classification. INNOVATION – NEW VENTURE DEVELOPMENT: evaluation of inventions commercial value, new products/process/technologies. Start-ups and spin-offs. THE BUSINESS PLAN: Set-up and implementation, specialized software use

INTERNSHIP

[SSCI 304] ENVIRONMENTAL & TECHNICAL LEGISLATION

Introduction to the legal system. Basic law classification. Elements of public, private and European Union law. Introduction to the technical legislation. Procedures for undertaking, elaboration and construction of public works and studies, contractual liability, procedures to resolve conflicts in public works, organisation of public works contractors. Harmonisation of the Greek legislation to the EU directives.

International, EU and Greek environmental legislation. Main international environmental Conventions. Environmental protection in EU law. Principles of the EU environmental law.

The EU primary law and the horizontal environmental directives (Access to Environmental Information, Integrated Prevention and Pollution Control). Case law of the EU Court of Justice.

Environmental protection in domestic law. (Constitution and Ordinary law). Constitutional protection of the environment (the article 24 of the Greek Constitution). Content and characteristics of the right to the environment. Enlargement of “locus standi” in the environmental process (“ecological neighbourhood”).

The sustainable development (historical evolution- sustainable development in international, EU and domestic law-the case of Greek law). Environmental protection in ordinary law. The Greek Acte 1650/1986 for the protection of the environment and other indicative environmental laws.

The Courts’ role in environmental protection (environmental case law). The legislative framework for Renewable Energy Sources as an example of combined implementation of legislation and case law.

The administrative organisation for the environmental protection. Procedures for environmental authorization – Approval of Environmental Terms. Historical evolution (L. 1650/1986, L. 3010/2002, L. 4014/2011). EU directives for Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA). Content, specifications and evaluation of environmental studies. The case law of the Hellenic Council of State and of the EU Court of Justice for the environmental impact assessment.

[ENVE 555] DESIGN OF ENVIRONMENTAL PLANTS AND ENVIRONMENTAL IMPACT ASSESSMENT II

Theory and methodology for the design of environmental plants. Methodology for the composition of Environmental Impact Assessment (EIA) studies. The students work in teams to accomplish the design study for an environmental plant, based on primary data. The work involves the search/calculation of the design parameters, the design and the cost estimation of the plant, as well as the composition of the relative Environmental Assessment Study. With the completion of the semester, the students have to present the outcome of their study to an open audience.

Elective Courses

[ENVE 501] FUNDAMENTAL PRINCIPLES OF AEROSOL SCIENCE

Fundamentals principles of aerosol science and technological applications. Aerosol dynamics, mechanisms of condensation, evaporation, coagulation and nucleation. Study of aerosols in atmospheric conditions. Optical properties of aerosols. Study of the physico-chemical properties of aerosols in indoor conditions and in the atmosphere. Measurements in conjunction of sources and aerosol concentrations in the atmosphere. Deposition of aerosols in the human respiratory track. Human exposure and dose. Radioactive aerosols.

[ENVE 537] INDOOR AIR QUALITY

Introduction to indoor air quality. Gaseous and aerosol air pollutants in indoor air. Radon, cigarette smoke, carbon dioxide, PAHs, bioaerosols, heavy metals, asbestos, lead, formaldehyde, pesticides, sources of indoor pollutants, materials, odors. Human exposure, climatic parameters, infiltration. Microenvironmental models, measurements of indoor air pollutants. Indoor air quality in residential houses, in industry and museums. Protection of human health from indoor air pollutants, health impacts.

[ENVE 535] COASTAL ENGINEERING

Introduction to coastal engineering (surface wave formation, wave measurement). Wave theories (mathematical wave theory, linear wave theory, spectral wave theory). Wave shoaling, refraction, diffraction, breaking and reflection. Wind waves forecasting. Mathematical simulation of wind and tidal waves. Solute transport in the coastal zone. Sediment transport and coastal erosion. Environmental control of projects in the coastal zone.

[ENVE 541] RISK ANALYSIS

Introduction. Uncertainty and Risk Analysis, Risk for the human health. Examples from the natural systems. Risk assessment methodology. Risk factors. Methods to estimate the parameters. Sensitivity analysis. Correlation between risk and cost/benefit. Statistical value of life. Years of life loss. Expose/response functions of populations in pollution. Risk management – Safety. Occupational Safety. Quality management and risk. Risk depiction in local/regional level. Decision making under uncertainty. Decision trees. Simulation. Environmental safety. Information on Risk and public perception. Environmental Impact Assessment. Methods. Examples

[ENVE 539] SOIL & GROUNDWATER REMEDIATION TECHNOLOGIES

Transport and fate of contaminants in the soil. Hydrodynamic (vection, dispersion, diffusion), abiotic (adsorption, evaporation, ion exchange, hydrolysis, etc) and biotic processes that take place in the underground. Soil remediation technologies (physicochemical, biological and thermal methods) - basic characteristics, systems design, performance and suitability, advantages and disadvantages. Remediation technologies of contaminated aquifers (in-situ, ex-situ and on-site technologies) - basic characteristics, systems design, performance and suitability, advantages and disadvantages. Examples of applications.

[ENVE 553] AGRO-INDUSTRIAL WASTE PROCESS TECHNOLOGIES

Introduction to agro-industrial waste, basic concepts and issues (definitions, properties, pollution load of agro-chemicals activities, gaseous, solid and liquid waste). Organization and environment (inputs, outputs, life cycle analysis, ISO Standards). Hygiene designing in food processing (requirements, HACCP principles, general designing principles, equipment specifications, cleaning and disinfection, energy cleaning, CIP design). Food Industry, environment and recovery (waste production stages in the supply chain, functional components for recovery purposes, recovery steps, conventional technologies, emerging non-thermal technologies, comparison of conventional and emerging technologies in terms of energy efficiency and cost). The “*Universal Recovery Strategy*” (macroscopic pretreatment, macro- and micro-molecules separation, extraction, isolation and purification, product formation). Commercial applications of recovered components from food waste (commercialization stages, legal issues, implementation problems of innovations, scale up, marketing, real products). Separation of functional macromolecules and micromolecules using ultrafiltration and nanofiltration. Agriculture and environment (agrochemicals, insecticides, classification and mechanism of action, fungicides, herbicides and their classification, fertilizers, gaseous, solid and liquid pollutants, pesticides residues in food and health effects, the Venom Circle, farming, control and distribution of organic products). Agriculture and energy management (energy greenhouses needs, heat pumps, combined heat and power systems and electricity, recycling heat from industries, use of solar energy for heating, use of geothermal energy, solid biomass and biogas to heat the greenhouse, anaerobic treatment, Biodiesel production, generation of pellets from oil-pruning and other agricultural residues). Waste treatment (pre-treatment, primary treatment, secondary treatment, aerobic treatment, anaerobic treatment, activated sludge treatment, tertiary treatment, composting, biochar production). Livestock & environment unit (choice of waste treatment system, septic precipitation tank, neutralization unit of gases, wetland feeding well). Management of treated wastewater (biological treatment, surface flow wetland, vegetation species in wetlands, optimal wastewater treatment, chlorination system, performance of artificial wetland, water reuse, control of environmental impacts).

[ENVE 511] DESIGN OF ENERGY SYSTEMS

Introduction and heat transfer for buildings. Energy load calculations: heating load, cooling load. Energy consumption for heating cooling and lighting. Presentation of Energy Plus. Energy efficiency in buildings. Case studies of energy efficiency in the built environment. Deepening and design of energy systems. Presentation of the virtual Lab of the course. Special RES applications. Desalination. Autonomous energy systems. RES integration in the built environment. Life Cycle Analysis in the Environmental Impact Assessment

[ENVE 452] GAS-EMISSIONS TREATMENT TECHNOLOGY

Atmospheric pollution from anthropogenic emissions; an introduction. The pollutants and their origin. Their behavior and changes into the atmosphere. Global scale pollution influences. National and international laws and

registrations in respect to emissions. Gas emissions control technologies: mobile sources (automotive pollution control, etc). Gas emissions control technologies: stationary sources (industry emissions control, etc). Particulate matter pollution and its control. Novel, alternative clean technologies for energy and chemicals production

10th Semester

No courses are offered during the 10th Semester due to the students' obligation to complete their diploma thesis.

6 Hellenic Association of Environmental Engineering

<http://www.enveng.gr/>

The Association was established by decision No.787/04-02-2003 of the Athens Court of First Instance with registration number 24493, as a scientific Association, collective body of Greek Environmental Engineers, under the name: Hellenic Association of Environmental Engineering (PA.S.D.MH.P.), based in Athens with nationwide organization.

Aims of the Association as indicated in Article 2 of its statute are:

- To promote in every scientific way the view that the "Environment" cannot be seen as another specialized engineering skill, but requires a completely different approach, different starting points for reflection, fully addressing in a systematic and multidisciplinary way the issue of constitutionally protected Sustainable Development where other engineering disciplines are involved in a specific, predetermined role to the extent deemed necessary.
- To advance, protect and promote the science of Environmental Engineering related to the management and protection of the natural and man-made environment.
- To contribute substantially to strengthening and raising the sense of social solidarity and responsibility towards the environment and to developing methods and techniques for the protection of the environment, the improvement of the quality of life and the protection of public health.
- To improve working conditions for Environmental Engineers, protect the reputation of the profession, promote its social role and safeguard professional rights and activities.
- To promote all forms of cooperation among its members for the advancement of the science of Environmental Engineering towards Sustainable Development.
- To contribute to the design and implementation of any kind of national techno-economic development programs.

7 Contacts

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