Undergraduate Program Guide Academic Year 2020-21





School of Environmental Engineering Technical University of Crete

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 22 years, the School has awarded 797 Diplomas in Environmental Engineering, 465 Master degrees (M.Sc.) and 79 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 (<u>www.enveng.tuc.gr</u>).

Sincerely,

Professor Mihalis Lazaridis Dean of the School

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I. TECHNICAL UNIVERSITY OF CRETE (TUC)



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

- School of Production Engineering & Management
- School of Mineral Resources Engineering
- School of Electronic and Computer Engineering
- School of 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 Δ 1).

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.





II. SCHOOL OF ENVIRONMENTAL ENGINEERING (ENVENG)



II.1 General Information

The Department of Environmental Engineering was established¹ at the Technical University of Crete and admitted its first students in Academic Year 1997-1998. The School of Environmental Engineering², which incorporated the former Department), was established in May 2013.

II.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.

¹ P.D. 232/1995, O.G. 134/22-6-1995/vol. A'

² O.G. 119/28-5-2013/vol. A'

II.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.

II.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.

II.5 Administration

The School is managed by the Departmental Assembly (DA) and the Dean, who chairs the DA. The responsibilities of the DA 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

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 DA of the School the following are appointed committee members:

- 1. Undergraduate Studies Committee
 - I. Yentekakis, Professor
 - A. Giannis, Assistant Professor
 - A. Manousakis, Associate Professor
 - N. Paranychianakis, Associate Professor
 - T. Tsoutsos, Professor
 - (One student representing the Undergraduate Students' Association)
- 2. Postgraduate Studies Steering Committee
 - D. Kolokotsa, Associate Professor (Coordinator Head of Postgraduate Studies)
 - M. Lazaridis, Professor
 - D. Venieri, Associate Professor
 - P. Panagiotopoulou, Assistant Professor
 - T. Tsoutsos, Professor
- 3. Advising Committee for Undergraduate Students
 - E. Maria, Associate Professor
- 4. Internship
 - D. Venieri, Associate Professor
- 5. EnvEng ERASMUS+
 - P. Panagiotopoulou, Assistant Professor
 - N. Paranychianakis, Associate Professor
- 6. TUC Library Committee (EnvEng representative)
 - N. Xekoukolotakis, Assistant Professor
 - N. Paranychianakis, Associate 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
 - A. Giannis, Assistant Professor,
 - A. Pantidou, STLS
 - K. Antelli, LTS
 - I. Kanakis, LTS
 - A. Spyridaki, LTS
- 10. EnvEng Students' Records Supervisor
 - A. Manousakis, Associate Professor
- 11. EnvEng Financial Records
 - E. Baradakis, STLS
 - A. Papadopoulos, LTS
- 12. EnvEng Quality Assurance IT System and Students' Evaluation Recording
 - T. Glytsos, LTS
 - A. Koutroulis, LTS
 - G. Botzolaki, LTS
- 13. EnvEng Internal Evaluation Team
 - A. Manousakis, Associate Professor
 - N. Paranychianakis, Associate Professor
 - D. Venieri, Associate Professor
 - N. Xekoukoulotakis, Assistant Professor
- 14. EnvEng Web site Content Management
 - A. Papadopoulou, LTS
 - I. Kanakis, LTS
- 15. EnvEng Undergraduate and Postgraduate Studies Guide
 - A. Papadopoulou, LTS
 - K. Tyrovola, LTS
 - E. Kastanaki, LTS
- 16. Outward activities- High Schools' visits planning
 - A. Pantidou, STLS
 - A. Spyridaki, LTS
- 17. TUC Special Research Funds Unit (EnvEng Representative)
 - T. Tsoutsos, Professor (member)
 - I. Yentekakis, Professor (alternate member)
- 18. TUC Quality Assurance Unit (EnvEng Representative)
 - M. Lazaridis, Professor and Dean
 - A. Pantidou, STLS (representing TUC STLS members)

II.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.

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 environmental microbiology, 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 aforementioned 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.



II.7 Academic Staff

The Academic staff of the School fall in the following categories:

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

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

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

Faculty [Professors]

Professors

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





Diamadopoulos, Evan: 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.

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



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



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



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

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

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

Associate Professors

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

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

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

Greece.









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





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

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





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

Economics and Rural Development, Agricultural University of Athens (2000).



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

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



Assistants Professors



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



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

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



Thrace, Ph.D. in Environmental Engineering (2011), Department of Environmental Engineering, Democritus University of Thrace, Greece

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

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

Emeritus Professors

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

Laboratory Teaching Staff (LTS)

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

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

> Dr. Glytsos, Theodoros: 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.

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

> Kanakis, Ioannis: 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. LTS for the Renewable and Sustainable Energy Systems Laboratory.

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















Koukouraki, Elisavet: 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.

Dr. Koutroulis, Aristeidis: 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.





Koutsogiannaki, Irene: 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)

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





Dr. Papadopoulou, Aphrodite: 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.

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





Dr. Spyridaki, Athina: 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. Tyrovola, Konstantina: 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.





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

Specialized Technical Laboratory Staff (STLS)



Baradakis, Efprepios: Diploma in School of Mineral Resources Engineering (2000), Technical University of Crete, M.Sc. in School of Mineral Resources Engineering (2017), Technical University of Crete. STLS for the Renewable and Sustainable Energy Systems Laboratory. **Pantidou, Ariadni:** Degree in Chemistry (1992) University of Crete, M.Sc. "Mechanistic Organic Chemistry" (1995) University of Crete. STLS for the Biochemical Engineering & Environmental Biotechnology Laboratory.



Administration



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

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





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

II.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:



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).

Laboratory of Bioeconomy and Biosystems economics

Division I – Stelios Rozakis, Associate Professor

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



Toxic and Hazardous Waste Management Laboratory

Division I – Evangelos Gidarakos, Emeritus 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.

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.

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 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

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.

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.

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.

Ecology and Biodiversity Laboratory

Division II – Danae Venieri, Associate 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 Microbiology Laboratory

Division II – Danae Venieri, Associate Professor

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

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

Environmental Organic Chemistry and Micro-pollution Laboratory

Division 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 (O₃), homogeneous and heterogeneous photocatalysis and electrochemical oxidation. Green Chemistry and Technology with emphasis on the development and implementation of environmentally friendly processes.

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.

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

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.



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.



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.

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.



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.

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.

Natural Hazards, Tsunami and Coastal Engineering Laboratory

Division III

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.

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.



III. Undergraduate Program Regulation

III.1 Registration

The Ministry of Educations decides every year the selection criteria, the number of new undergraduate students and the registration dates.

New undergraduate students initially register via a web application of the Ministry of Education in the electronic address: <u>https://eregister.it.minedu.gov.gr</u>. Further details, i.e. documents required for registration, are given in the central <u>TUC</u>, and the <u>EnvEng School</u> web pages.

The finalization of the registration occurs at the School where new students submit, in person, all documents required, during the period announced by TUC. Alternatively, these 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.

Upon completion of registration, students obtain their personal accounts from the Computer Center of TUC (user name, password) and thus gain access to all online services (academic identity, selection of texts on the <u>Eudoxus</u> platform, food / housing applications, etc.)

III.2 Student Identity Card and Certificates

Students can apply for the Academic Identity Card (AIC) online throughout the academic year and at no cost, via the Ministry of Education's "Academic Identity" service [<u>http://academicid.minedu.</u>gov.gr/]. In order to apply, it is necessary for the student to have access to the online services of the

Technical University of Crete. The AIC allows for a reduced (student) ticket to public transport as well as to various social events (cinemas, theatres, concerts, etc.)

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

It is noted that following the approval of the reissue by the Secretariat, the process of acquiring academic identity is repeated. In case of re-issuance the student must pay a fee of \notin 1.60 upon receipt of the new academic identity card.

Certificates

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

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

The above documents can also be issued in English.





III.3 Student Status

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

Students have the right to discontinue their studies for a maximum period of ten (10) semesters, consecutive or not, by submitting a written request to the School Secretariat. These semesters are not counted towards the maximum duration of study. Students who discontinue their studies loose

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

III.4 Services to Students

University textbooks and notes, recommended by faculty members and instructors to cover teaching needs, are distributed free of charge via the Eudoxus [https://service.eudoxus.gr/] system. The maximum number of free textbooks each student is entitled to during his/her studies equals the minimum number of courses required to obtain a diploma according to the curriculum.

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 the Library.

Students can claim free meals at the student club and / or free accommodation at the University of Crete student accommodation provided they meet the necessary requirements based on their individual and family financial status and locality.

Students may have meals for free at the university restaurant and/or accommodation at the University Hall of Residences provided that they fulfil certain financial and social requirements with regard to their personal or family status and after their application to the Directorate of Academic Affairs.

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

Students can be financially supported during their studies through performance grants and awards of excellence, scholarships and interest-free educational loans.

ERASMUS+: The Technical University of Crete and the School of Environmental Engineering are participating in the ERASMUS + Mobility Program, which has been in force since January 1st, 2014, and deals with mobility for studies as well as for traineeships. ERASMUS + scholarships are funded by Foundation for State Scholarships (IKY). Further information is provided by the Erasmus office (tel.: +30-28210-37470) and at the <u>Erasmus+ site</u>. The Assistant Professor P. Panagiotopoulou (tel.: +30-28210-37770, office K2.119, e-mail: <u>ppanagiotopoulou@isc.tuc.gr</u>) is the Academic Coordinator for the ERASMUS + program in connection to students of the School of Environmental Engineering.

III.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.

In compliance with the Article 15 of Law 3404/2005 (260 A'), as amended and in force by Articles 57 of Law 4186/2013 (193 A), 74 of Law 4485/2017 (114 A), article 6 § 10 of Law 4218/2013 (268 A) as well as the Ministerial Decision Φ 1 / 192329 / B3 / 19-12-2013 (Government Gazette 3185 / Vol. B) "Higher Education Graduate Classification Procedure", which was issued with the authorization

of Law 4186/2013 (193 A), the courses in question to be examined at the School of Environmental Engineering, for the academic year 2019-2020, and their respective content are:

MATH 101 Differential and Integral Calculus I.

Functions of one variable. Limits and continuity of functions. Differentiation of functions. Differentiation Rules. Chain rule. Implicit differentiation. Applications of derivatives to the study of functions (Monotony, curvature, extremes). Definite integral. Fundamental theorems of integral calculus. Indefinite integral. Integration techniques: Integration by substitution, Integrations by parts, Trigonometric Integrals. Trigonometric substitutions. Partial fractions. Improper integrals. Absolute convergence of integrals. Calculating Areas. Calculating Volumes. Arc Length. Applications in Physics (Moments and center of mass, work, fluid pressure and force). Exponential functions. Inverse functions. Hyperbolic functions. Sequences. Infinite Series. Convergence criteria. Power and Taylor series.

ENVE 132 General Chemistry

Chemistry and Measurement. Introduction to Chemistry: Contemporary Chemistry: A Brief Look, Experiment and Interpretation, the Law of Conservation of Mass. Material: Physical State and Chemical Composition. Physical Measurements: Measurements and Significant Digits, SI Units, Fundamental and Derived quantities and Units, Units and Dimensional Analysis (Conversion Factors Method). Atoms, Molecules and Ions. Atomic Theory and Atomic Structure: The Atomic Theory of matter, the Structure of the Atom, the Nucleus - Isotope Structure, Atomic Mass, Periodic Table of Elements. Chemicals: Types and Names: Chemical types - Molecular and Ionic Compounds, Organic Compounds, and Nomenclature of simple compounds. Chemical Reactions: Equations: Writing Chemical Equations, Balancing Chemical Equations. Calculations with Chemical Formulas and equations of mass and moles of a substance: Molecular sass and Standard mass, the concept of a Mole. Stoichiometry: Quantitative relationships in chemical reactions: Molecular interpretation of a Chemical equation, Quantities of substances in a chemical reaction, Limiting reactant: Theoretical and Percentage Yields. Chemical reactions of ions in aquatic solutions. The ion theory of solutions and solubility rules, Molecular and ion equations. Types of chemical reactions: Acid-base reactions. Working with Solutions: Molar concentration, Solution dilution. Quantitative Analysis: Volumetric Analysis. States of Material: Liquids and Solids: Comparison of Gases, Liquids and Solids, State Changes: Phase Transitions. Liquid State: Liquid Properties: Surface tension and viscosity, Intermolecular Forces: Interpretation of Liquid Properties. Solid State: Classification of solids according to the attraction type of their structural units. Solutions. Solution Formation: Types of solutions, Solubility and dissolution process, Effects of temperature and pressure on solubility. Cumulative Properties: Various expressions for Concentration. Reaction Rate: Definition of reaction rate, Experimental rate determination, Dependence of rate on concentration. Chemical Equilibrium. Description of Chemical Equilibrium: Chemical equilibrium, A dynamic equilibrium, the equilibrium constant, Heterogeneous equilibrium: Solvents in homogeneous equilibria. Using the reaction rate: Qualitative Interpretation of reaction rate, Calculating concentrations at equilibrium. Acids and Bases: Acid-Base Theories: Arrhenius acids and bases, Brønsted-Lowry acids and bases, Lewis acids and bases. Acid and Base strength: Relative strength of acids and bases. Water self-ionization and pH: Self-ionization of water, Solutions of strong acids and bases, the pH of a solution. Acid-Base Equilibria, Weak Acid or Base Solutions: Ionizing acids equilibria, Polyprotic Acids, Ionizing Base Equilibria, Acid-Base properties of salt solutions. Weak Acid or Base Solutions in the presence of other soluble substances: Common Ionic Effect, Buffers, Acid-Base Titration Curves.

ENVE 221 – Fluid Mechanics

1. Introduction - Fluid Properties and Characteristics, Units of Measurement, Viscosity, Continuity, Density, Specific Volume, Specific Weight, Specific Gravity, Perfect Gases, Pressure, Vapor Pressure, Surface tension and Capillary phenomena in porous media (soil).

2. Fluid Equilibria - Hydrostatic Pressure at a point, Basic equations for fluid statics, Measurements using manometers in environmental applications, Forces at submerged levels and curved surfaces, Buoyancy, Forces on dams, Weirs and locks.

3. Fluid Kinematics - Methods for describing Fluid Motion, Kinematic flow characterization in environmental systems, Characteristic streamlines of the flow field (Underground and Surface).

4. Fluid Dynamics - Forces, Fundamental Laws (Mass Conservation Principle, Newton's Second Law - Quantity of Motion Theorem, Energy Conservation Principle), The idea of the system and the selected control volume, Continuity equation, Volume movement equation, Energy equation, Mass and Energy Balance in Environmental Systems, Pollution Transfer in Water Systems.

5. Dimensional Analysis- Dimensionless numbers for the analysis of environmental systems, Dimensions and Units, the π Theorem, Dimensionless Parameters, Similarity, Reynolds Number, Froude Number, Dimensional Analysis for closed-conduit flow models and in hydraulic structures.

6. Applications of the ideal fluid theory - Outflow from a hole under pressure, Gravitational Outflow, Overflow Flow, Flow under a gate, Container outflow time.

7. Linear and Turbulent Flow - Two-dimensional steady flow between plates, Flow in Rivers, Rivers and Closed Pipelines, Head and minor Losses, Boundary Layer, Friction.



III.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

At the beginning of each semester, course registration is conducted electronically via the special Students Records Web-site of the Technical University of Crete <u>http://websrv.stdnet.tuc.gr/</u><u>unistudent</u>. Students are required to have an E-services account which is created at the Computer Centre of the University. Otherwise, they should create one and properly notify the Secretariat of the School of Environmental Engineering.

Students are required, to register electronically for the courses they wish to attend, within the dates and according to the instructions announced on TUC and Enveng websites. Students cannot be examined nor obtained free textbooks for a course that was not included in their statement.

In each semester, students are allowed to register for up to v+7 courses, where v stands 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 10^{th} 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 for the particular course in a subsequent semester and fulfil all attendance and examination requirements anew.

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 offers students the opportunity to gain an initial professional experience as well as the connection of the School with enterprises and businesses. The Internship at Technical University of Crete is implemented within the framework of the funding project $E\Sigma\Pi A$ 2014-2020 and it is an elective course with 5 ECTS credits in the curriculum of the School of Environmental Engineering, but without any grade. ECTS of Internship are not included in the requirements for the Diploma in Environmental Engineering. It is offered in the third year of studies, at the 6th semester (Course ID: ENVE 346 INTERNSHIP) and its duration is 2 months. During Internship, students are employed in enterprises and businesses in Greece, while working positions abroad are not excluded. Nevertheless, the amount of payment remains the same in all cases and is defined by the budget of the funding project each year. Students, who conduct an Internship, have the opportunity to work at enterprises/businesses registered in the School website and/or in http://atlas.grnet.gr (interconnected companies). Furthermore, students have the potential to conduct Internship at a company of their own choice. Further information regarding the implementation of Internship may be found in the School website (www.enveng.tuc.gr).

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 work

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, who chairs the committee, must be a member of the faculty of the School of Environmental Engineering. 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. The thesis advisor meets with the student on a regular basis to review progress on the thesis.

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. A summary of the thesis is to be uploaded to the university's website a week prior to the oral defense. The exact date and time for the oral defense is set in consultation with the supervisory committee.

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 upload a final copy of the thesis on the Institutional Repository of TUC.

Guide for the compilation and structure of a Diploma Thesis

Special guidelines for the completion and structure of a Diploma Thesis are given in the Appendix.

III.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

IV. CURRICULUM

The Table below lists all required and elective courses of the curriculum per semester. For each course the title, ID code, weekly teaching hours (T), weekly tutorial hours (E), weekly laboratory hours (L), teaching units (IU), and credits according to the European Credit Transfer and Accumulation System (ECTS) are noted

1 st Semester					
ID	Required Courses	(T-E-L)	Η	IU	ECTS
MATH 101	Differential and Integral Calculus I	(3-1-0)	4	4	5
PHYS 101	Physics I	(2-1-2)	5	3	5
ENVE 100	Environmental Geology	(2-0-2)	4	3	4
ENVE 133	Environmental System Using Computer Aided Design /Y	(2-0-3)	5	4	4
MATH 105	Introduction to Computer Programming I	(3-0-2)	5	4	4
ENVE 112	Ecology	(2-0-2)	4	4	4
ENVE 113	Introduction to Environmental Engineering	(2-1-0)	3	3	4
Furthermore, the following language courses are offered without credit					

		German I (Seminars)		
German I (Seminars)	ECTS Total			30
\mathbf{O}		German I (Seminars)		

2 nd Semester					
ID	Required Courses	(T-E-L)	Η	IU	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	Introduction to Computer Programming II	(2-0-2)	4	3	5
ENVE 162	Geodesy	(1-0-3/2)	3	3	5
ENVE 126	Environmental Microbiology	(2-0-2)	4	3	5
Furthermore	, the following language courses are offered without crea	dit			
	English II (Seminars)				
	German II (Seminars)				

ECTS Total

3 rd Semester					
ID	Required Courses	(T-E-L)	Η	IU	ECTS
MATH 201	Linear Algebra	(4-0-1)	5	3	5
MATH 203	Ordinary Differential Equations	(3-0-0)	3	3	5
MATH 204	Probability and 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

30

One of the two languages required for credit

...

ID	Elective Courses	(T-E-L)	Η	IU	ECTS
LANG 201	English III	(2-0-2)	4	2	3
LANG 203	German III	(2-0-2)	4	2	3
ECTS Total					30

4 th Semester					
ID	Required Courses	(T-E-L)	Η	IU	ECTS
CHEM 201	Physical Chemistry	(3-0-6/2)	6	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
One of the tw	vo languages required for credit				
ID	Elective Courses	(T-E-L)	Η	IU	ECTS
LANG 202	English IV	(2-0-2)	4	2	3
LANG 204	German IV	(2-0-2)	4	2	3
ECTS Total					30

5 th Semester	•				
ID	Required Courses	(T-E-L)	Η	IU	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 and Mass Transfer	(2-1-0)	3	3	4
Elective Courses (2 out of 7 SSci available in the 5 th and 6 th semester)					
ID	Elective Courses	(T-E-L)	Η	IU	ECTS

שו	Elective Courses	(I-E-L)	п	IU	ECIS
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
ECTS Total					30

6 th Semester	ſ				
ID	Required Courses	(T-E-L)	Η	IU	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	(1-0-3)	4	4	3
ENVE 335	Optimization of Environmental Systems	(3-1-0)	4	4	5

Elective Courses (2 out of 7 SSci available in the 5th and 6th semester)

ID	Elective Courses	(T-E-L)	Η	IU	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
ECTS Total					30

7 th Semester					
ID	Required Courses	(T-E-L)	Н	IU	ECTS
ENVE 421	Applications in Environmental Modeling	(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

Elective Courses (1 out of the 5 courses available)

ID	Elective Courses	(T-E-L)	Η	IU	ECTS
ENVE 443	Sustainable Development (ISO 14000 & LCA)	(2-1-0)	3	3	3
ENVE 451	Agricultural Engineering	(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
ECTS Total					30

8 th Semester					
ID	Required Courses	(T-E-L)	Η	IU	ECTS
ENVE 430	Field Studies II			2	
ENVE 432	Groundwater flow and 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
ENVE554	Design of Environmental Plants and Environmental Impact Assessment I	(2-2-1)	5	3	4

Elective Courses (1 out of the 7 courses available)

ID	Elective Courses	(T-E-L)	Η	IU	ECTS
ENVE 446	Biological Methods for 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 Sytems	(2-0-1)	3	3	3
ENVE 436	Water Resources Management	(2-0-2/2)	3	3	3
DPEM 433	Small & Medium Enterprises (SMEs) and Innovation	(2-0-2)	4	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
ECTS Total					30

9 th Semester					
ID	Required Courses	(T-E-L)	Η	IU	ECTS
SSCI 304	Environmental and Technical Legislation	(3-0-0)	3	3	5
ENVE 555	Design of Environmental Plants and Environmental Impact Assessment Studies II	(2-2-1)	5	5	15

Elective Courses (2 out of the 7 courses available)

	· · ·				
ID	Elective Courses	(T-E-L)	Η	IU	ECTS
ENVE 501	Fundamental Principles and Applications of Aerozol 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 and Groundwater Remediation Tehnologies	(2-1-0)	3	3	5
ENVE 553	Agro-industrial Waste Process Technologies	(2-1-0)	3	3	5
ENVE 452	Gas-Emissions Treatment Technology	(2-1-0)	3	3	5
ENVE 511	Design of energy systems	(2-1-0)	3	3	5
ECTS Total					30

10 th Semester	
DIPLOMA THESIS ECT	TS Total 30

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, fluid pressure and fluid force. Exponential Functions. Inverse functions. Hyperbolic functions. • Indefinite integral. Integration techniques: Integration by Parts, Trigonometric Integrals, Trigonometric Substitutions, Integration of Partial Fractions • Improper Integrals. • Power series and Taylor series. Applications of series.

[PHYS 101] PHYSICS I

Systems of measurements and Units. • Vectors • Point Particle motion along a straight line and two or three dimensions • Force • Kinetic Energy, Potential Energy and Work • Center of mass and Linear Momentum • Rotation of a rigid body • Torque and Angular Momentum • Rolling of a rigid body • Equilibrium and Elasticity • Fluid density and Pressure • Motion of Fluids.

[ENVE 100] ENVIRONMENTAL GEOLOGY

Geology and Human. Geosciences • Planet Earth, structure, properties. Geographic coordinates. Geological time. • Endogenous Geodynamic Processes. Plate tectonic theory. Volcanism. Geotectonic and morphotectonic processes. Stress and strain. Folds. Orogenesis. Tectonic basins. Tectonic discontinuities. Faults. Seismicity. The Hellenic Orogen and the Hellenic Arc • Crystallization. Minerals and Rocks. Geological formations. Geomechanical properties • Stratigraphy. Geostructures • Terrestrial and coastal geoenvironment • Climate. Hydrological cycle. Surface and underground waters. Hydrologic and hydrogeological characteristics • Exogenous geological processes. Weathering. Erosion • Natural resources • Geoenvironment and Geodiversity • Human impact on the Geoenvironment • Natural Hazards. Failures phenomenon. Landslides and Slope failures • Interaction of geological factors and anthropogenic influences in the geoenvironmental and engineering geological conditions. "Geofactors Interaction Matrix".

Applications: Presentation of a wide range scientific geological researches and studies related to Applied Environmental Geology, elaborated in the framework of the Conservation, the Protection and the Encasement of the Geoenvironment, as well as in the frame of Water Resources Utilization, Spatial Planning and Urban Development, General Designs & Studies of Major Infrastructure Development Projects.

Laboratory exercises: Ten lab exercises related to the following themes: Topographic maps at various scales • Geothematic Maps. Practice on their data. Maps of Morphological Relief, Slopes, Geological Information, Tectonic Discontinuities, Geological Suitability, Hydrogeological

characteristics, Engineering Geological properties etc • Geological compass - measurements. Geological Maps. Geological cross sections. Simple and complex geological structures • Matrix Representation of the various geofactors interaction in the geoenvironmental conditions.

[ENVE 133] ENVIRONMENTAL SYSTEM USING COMPUTER AIDED DESIGN

Theory: Scale • Area of rectilinear figure • Area of curved figure •Cartesian and polar coordinates • Elevation and elevation zone • Slopes •Contour lines • Incisions and visibility • Ground plan • Plan and elevation

Exercises: Historical data for the program Autocad • Description of the design environment (environmental tour of Autocad) • Introduction (how to run commands, Drawing units/ limits, procurement before design, setting environmental design (tools <options <display), shortcut menus, function keys, toolbars) • File Manager (open file, create a new file – file without creating settings, file creation using standard file creation using wizard), Save the file, file simultaneous appearance on the screen, close the file, send file with e-mail, file information • Screen management commands (Zoom, Pan, Aerial design, cleaning the screen, display window view, display quality circles and arcs) • Absolute/relative Cartesian coordinates • Drawing commands (line) • Polar coordinates • Precision Mechanisms OSNAPS (endpoint & midpoint) • Design Commands (point, rectangular) • Design Commands (other than Line – point – rectangular) • Object editing commands (Scale, Stretch, Rotate, array, mirror, explode) • Grips (controls) • Dimensions • Marking • Insert text • Layers • Insert Block

[MATH 105] INTRODUCTION TO COMPUTER PROGRAMMING I

Theory: Introduction to algorithms. Structured Programming. Development of correct and efficient algorithms. Main features of modern programming languages. Programming using Fortran language: Data input/output commands, use of data variables, arithmetic operations, iterations, control structures, vectors and matrices, use of data files, subroutines and functions. Assignments.

Laboratories: Hands-on training on Fortran programming in a Unix environment.

[ENVE 112] ECOLOGY

Systems & ecosystems (The concept of system, Mathematical models, System stability, Application of models in ecology) • Organisms in the environment (Categories of organisms, Chemical synthesis of the cell, Metabolism – enzymes, Photosynthesis – Respiration – Chemosynthesis, Limiting factor, Interactions between organisms and the environment) • Populations (Populations dynamics, Models on population growth, Populations interactions, Natural selection & evolution, Population growth strategies) • Ecosystems (The flux of energy through ecosystems, Limiting factors in various environments, Nutrient cycling, Aquatic ecosystems) • Deterioration of natural environment (Deforestation, Corrosion, Desertification, Salination, Biodiversity) • Toxic pollution (Toxic pollutants, Bioaccumulation, Volatile organic compounds, Xenobiotics, Heavy metals & inorganic compounds) • Water pollution (Sources & effects of aquatic pollution, Oxygen deficiency, Eutrophication, Contamination, Toxic pollutants, Oil spills, Thermal pollution) • Atmospheric pollution (Sources & effects of atmospheric pollutants, Acid rain, Ozone layer depletion, Greenhouse effect, Climate change) • Environmental management (Aquatic pollution prevention & control, Environmental indicators & life cycle analysis)

[ENVE 113] INTRODUCTION TO ENVIRONMENTAL ENGINEERING

Introduction to Environmental Engineering • Units of Measurement and physical quantities in Environmental Engineering • Mass and Energy Balances in Environmental Engineering • Case studies

1 out of 2 foreign languages

ENGLISH I (SEMINARS)

English I, 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 th e audiovisual material of autonomous learning are complementary to the course. Students have even the possibility to enroll 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

[MATH 102] DIFFERENTIAL AND INTEGRAL CALCULUS II

Vectors in space (Dot, Cross, triple product) • Equations of Lines and planes in Space • Curves in the space and their Tangents (Integrals and derivatives of Vector Functions • Velocity, Acceleration, Tangential and Normal components • Functions of several variables • Partial Derivatives • Chain rules for functions of several variables • Directional Derivatives and the Gradient • Tangent Planes and differentials • Extreme values and Saddle points • Lagrange multipliers • Double and Triple integrals (Applications in Physics and Geometry: Moments and Centers of Mass, Volumes of Solids • Change of variables in Multiple integrals • Vector Fields • Line Integrals (Path independence, Conservative Fields) • Green's theorem • Divergence and Curl • Surface Integrals (Stoke's Theorem, The divergence Theorem).

[ENVE 132] GENERAL CHEMISTRY

An Introduction to Chemistry (Law of Conservation of Mass, Classifications of Matter, Properties of Matter, Physical and Chemical Properties) • Atoms, Molecules, and Ions (The Atomic Theory of Matter, The Discovery of Atomic Structure, The Modern View of Atomic Structure, Atomic Numbers, Mass Numbers, and Isotopes, Atomic Weights, The Periodic Table, Molecules and Molecular Compounds, Ions and Ionic Compounds) • Chemical Reactions and Reaction Stoichiometry (Chemical Equations, Balancing Equations, Formula Weights, Avogadro's Number and the Mole, Properties of Solutions, Expressing Solution Concentration) • Electronic Structure of Atoms (The Wave Nature of Light, Quantized Energy and Photons, Line Spectra and the Bohr Model, The Wave Behavior of Matter, Quantum Mechanics and Atomic Orbitals, Representations of Orbitals, Many-Electron Atoms, Electron Configurations) • Periodic Properties of the Elements (Development of the Periodic Table, Electron Configurations and the Periodic Table, Metals, Nonmetals, and Metalloids) Basic Concepts of Chemical Bonding (Lewis Symbols and the Octet Rule, Ionic Bonding, Covalent Bonding) • Molecular Geometry (Molecular Shapes, The VSEPR Model, Molecular Shape and Molecular Polarity) • Liquids and Intermolecular Forces (A Molecular Comparison of Gases, Liquids, and Solids, Intermolecular Forces, Hydrogen bond) • Acid–Base Equilibria (Acids and Bases: A Brief Review, Brønsted–Lowry Acids and Bases, The Autoionization of Water and the pH Scale, Strong Acids and Bases, Weak Acids and Weak Bases, Relationship between Ka and Kb, Acid-Base Properties of Salt Solutions, The Common-Ion Effect, Buffers, Acid–Base Titrations)

[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, beams, frames and cables • Diagrams of internal forces and moments • Center of gravity and centroid • Friction and structural stability • Analytical, experimental and computational case studies.

[MATH 106] INTRODUCTION TO COMPUTER PROGRAMMING II

Theory: Introduction to the computing environment of Matlab software. Numerical Operations. Programming in the Matlab Software Environment - Introduction to Variables - Complex Numbers -Mfiles - Functions - Retrospective Functions - External Files - Tables - Polynomials - Graphs. Symbolic Variables and Operations - Derivatives - Integrals. Histograms - Three-dimensional Symbolic Diagrams - Solving Linear Systems in Matlab using the Symbolic Math Toolbox. Assignments.

Laboratories: Laboratory exercises using computer systems in a Unix environment - Programming using Matlab software.

[ENVE 162] GEODESY

Theory: Introduction to Geodesy • Instruments • Errors in Measurement • The Cartesian Coordinate System • Reference Systems • Fundamental problems of Geodesy • Triangulation • Altimetry • Area Calculation • Small Area Land Surveying • Satellite Geodesy.

Laboratory exercises: Errors in measurement • Instruments • Fundamental problems of Geodesy • Triangulation • Small Area Land Surveying – GPS

[ENVE 126] ENVIRONMENTAL MICROBIOLOGY

Chemical synthesis of the cell • Molecules/Macromolecules of the cell • Introduction to Microbiology • Cellular structure • Prokaryotic microorganisms • Eukaryotic microorganisms • Viruses • Evolution of microorganisms • Metabolism of heterotrophic microorganisms • Nutrition & physiology of microorganisms • Microbial growth • Measurement of microbial growth • Microorganisms & biogeochemical cycling • Microbiology of aquatic environment (water & wastewater) • Microbiological quality of water • Fecal pollution & remediation of the aquatic environment • Wastewater treatment plant • Disinfection • Wastewater reuse • Enteric viruses in wastewater • Fate of pathogenic microorganisms in the environment • Application of microorganisms for remediation purposes.

1 out of 2 foreign languages

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.

[MATH 201] LINEAR AGEBRA

Theory: Introduction to linear algebra and the algebra of vectors and matrices • Direct methods of solving systems of linear equations • Determinants • Vector spaces, subspaces • Linear dependence, independence, basis of a vector space • Fundamental subspaces of a matrix • Eigenvector, eigenvalues • Diagonalization and applications • Gram-Schmidt process of orthonormalization, least square method • Iterative methods for solving linear systems.

Laboratories: Introduction to MATLAB software with emphasis on the problems and the theory of Linear Algebra as well as the linear systems solving algorithms. Supported Operations for Vectors and Matrices. Creating, Concatenating vectors and matrices, expanding matrices. Functions and Subfunctions.

[MATH 203] ORDINARY DIFFERENTIAL EQUATIONS

Introduction • 1st and 2nd order d.e.: separation of variables, homogenous, exact, Bernoulli, Ricati, Euler, integrating factors • Newton's differential equation and applications in engineering problems • Linear independence, Wronskian • Linear differential equations with constant coefficients • Laplace transform method • Applications in Engineering and Electricity • 1st order systems with constant coefficients • Power series method.

[MATH 204] PROBABILITY AND STATISTICS

Basic topics of Probability Theory • Descriptive Statistics • Sampling distributions • Estimation theory • Confidence intervals • Hypothesis testing • Simple linear regression • Multiple linear regression • Analysis of variance • Non parametric Statistics.

[MECH 201] ENGINEERING MECHANICS-STRENGTH OF MATERIALS

The basic contents of this lesson are: Basic concepts of material strength • Mechanical properties, performance and durability of materials • Laboratory testing of strength of materials • Advanced methods of material strength control • Optimum dimensioning of cross-sections and safety factors • Impact of dimensioning and selection of construction material of cross-sections of loading bearing system in design and economy of construction • Introduction to the effect of axial forces on the dimensioning of structural elements • Introduction to the effect of bending moments on the dimensioning of structural elements • Introduction to the effect of shear forces of torsional torque on the dimensioning of structural elements.

The laboratory has as content: Testing of tensile strength of materials • Testing of compressive strength of materials • Testing of bending strength of materials.

[ENVE 221] FLUID MECHANICS

Properties and characteristics of fluids • Measurement Units • Viscosity • Continuity • Density, Specific Volume, Specific Gravity • Perfect Gases, Pressure, Vapor 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.

1 out of 2 foreign languages

[LANG 201] ENGLISH III

Terminology for Environmental Engineering • Academic Word List • Grammatical features conducive to proper academic style in writing, reading, and spoken English • Exposure to academic talks in English • Autonomous language laboratory exercises • Teaching of text written for academic purposes • Examination of articles written on topics in Environmental Engineering

[LANG 203] GERMAN III

Introduction to specialized terminology • Learning specialized terminology in written and spoken German • Reading, editing and critical approach of authentic texts (articles, technical texts) at various levels, which are directly related to the terminology of the School of Environmental Engineering • Writing • Listening comprehension • The online classroom, the exercises on the Language Center website, as well as the audiovisual self-learning material, work complementary to classroom lessons.

[CHEM 201] PHYSICAL CHEMISTRY

The states and properties of matter • The Ideal gas and its PVT behavior and relationships • Mixtures of ideal gases; the Dalton's law. Diffusion of gases and liquids and calculations • PVT behavior of real gases: equations of states; the critical region; the virial and van der Waals equations; the law of corresponding states, etc. • Chemical kinetics: rate constant and Arrhenius theory; reaction rate equations; experimental methods in kinetic data acquisition (batch, CST and PF reactors) and determination or reaction order; Reaction mechanism and rate equation; Kinetics and mechanisms of heterogeneous catalytic reactions (Eley-Rideal and Langmuir-Hinshelwood models); Applications for the design of chemical reactors • Thermodynamics: First law and applications; chemical thermodynamics; second law and applications; Enthalpy; Entropy; Gibbs and Helmholtz free energy; chemical potential; chemical equilibrium and calculations • Changes of states: Phases and Phases equilibrium; Liquid-vapor equilibrium and distillation; fractional distillation analysis and design; gas-liquid equilibrium and absorption; gas-solid surfaces equilibrium and adsorption; liquid-liquid equilibrium and extraction • Introduction to electrochemistry and fuel cells.

[ENVE 224] GEOGRAPHICAL INFORMATION SYSTEMS

Introduction to GIS • Collection – digitization – data storage • Models and spatial data structures • Basic editing digital geographical data and analysis • Mapping data • Applications of GIS

[ENVE 264] SOIL MECHANICS AND FOUNDATIONS

Soil Mechanics: Nature and properties of soils • Soil classification systems. Particle size distribution. Atterberg limits • 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. Deformation of soils • Shear strength of soils. Failure criteria. Mohr-Coulomb theory • Lateral soil pressures and retaining systems. Methods for calculating active and passive pressures • Slope stability. Landslides.

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 CONTROL

Lectures: Physical and chemical characteristics of water • Introduction to instrumental analysis • Sampling • Statistical evaluation of results • Introduction to spectrophotometry • Introduction to atomic spectroscopy • Introduction to chromatography • Gas Chromatography • Liquid Chromatography • Partitioning of organics in the environment • Determination of the physico-chemcial properties of organics.

Labs: Safety in the laboratory. Measurements (volume, weight, pH). Solution preparation and further dissolving. Buffers • Identify unknown acid with strong base (volumetric analysis) • Redox

titration. Determination H₂O₂ using potassium permanganate • Complexometric titration. Hardness measurements using titration with EDTA • Determination of TSS, TDS, pH, conductivity, salinity, turbidity • Determination of BOD, COD, TOC, TC, IC, NPOC: (Using samples from river and WWTP) • Determination of P-PO₄ N-NO₂⁻, N-NO₃⁻ Cl⁻ using UV-spectrophotometer • Determination of calibration curve in spectrophotometer • High-performance liquid chromatography: determination of octanol water partition coefficient (K_{ow}) of organic compounds • Theoretical calculation of octanol water partition coefficients (K_{ow}) and Henry (K_H).

[ENVE 229] ENVIRONMENTAL THERMODYNAMICS

Introduction to thermodynamics- basic concepts • Forms of energy and energy transfer • Properties of pure substances • Energy analysis of open and closed systems (first law of thermodynamics) • Second law of thermodynamics • Entropy • Air and steam thermodynamic cycles • Refrigeration cycles • Relations of thermodynamics properties

1 out of 2 foreign languages

[LANG 202] ENGLISH IV

Terminology for Environmental Engineering • Academic Word List • Grammatical features conducive to proper academic style in writing, reading, and spoken English • Exposure to academic talks in English • Autonomous language laboratory exercises • Teaching of text written for academic purposes • Examination of articles written on topics in Environmental Engineering

[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.

[ENVE 321] STRUCTURAL ANALYSIS AND REINFORCED CONCRETE

Basic principles of structural analysis. • Types of loads and supports. • Stiffness and transformation matrices • Formulation and solution of equilibrium equations • Evaluation of member actions. 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/Eurocodes norms • Computations for basic structural elements of reinforced concrete buildings • Code requirements and detailing provisions • Analytical and computational project

[ENVE 332] ENVIRONMENTAL METEOROLOGY AND AIR QUALITY MODELS

Introduction and the structure of the atmosphere • Heat and Radiation in the atmosphere • The role of Temperature-Stability-Sensors for monitoring • Moisture Evaporation and Transpiration • The water in the atmosphere. Precipitation • Thermodynamic diagrams • Wind and atmospheric pressure • Local winds and circulation • Air masses and fronts. Meteorological Prognosis • 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 and Recycle PFR reactors • Analysis of kinetic data from reactors • Catalysis and chemical catalysts • Reactions with free enzymes and Michaelis-Menten kinetics • Determination of kinetic parameters • Inhibition 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 agitation of bioreactors • Determination the optimal operating conditions.

[ENVE 345] AQUATIC CHEMISTRY

Global Biogeochemical Cycles • Determination of natural water pH • Carbon Equilibrium • Chemical species in 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

Hydrology. Hydrological cycle. Geomorphology. Watershed. Hydrographic network. Hydrometeorology • Precipitation. Rainfall measurement. Homogeneity data. Completion of

observations. Estimation of average rainfall in a watershed. Rainfall data analysis. Problems • Evapotranspiration. Practical importance of evapotranspiration. Factors affecting evapotranspiration. Methods for calculating evaporation. Problems • Infiltration. Penetration. Static and dynamic soil water. Percolation phenomenon description. Empirical infiltration equations. Problems • Excess rainfall. Methods of estimation of excess rainfall-SCS method. Surface runoff and estimation methods. Stage-Discharge curves. Cumulative discharge curve. Problems • Hydrographs. Unit hydrograph. Synthetic unit hydrograph. Snyder method. Empirical methods of estimating flood magnitude parameters. Rational method. Problems • Routing. Hydrologic river routing - Musking method. Hydrologic reservoir routing. Problems • Groundwater concepts and aquifer properties. Well Hydraulics. Problems

[ENVE 322] HEAT AND MASS TRANSFER

Basic concepts (Introduction to transport phenomena, Concentration, Similarities in momentum, heat and mass transfer) • Mass transport • Mass transfer mechanisms • Diffusion (Diffusion coefficient, Diffusion in liquids, Steady state diffusion, Transient diffusion, Diffusion with chemical reaction, Diffusion with chemical reaction in Porous media) • Mass balances • Control volume • Evaporation • Film theory • General transport equation • Analytical solutions • Applications • Forced convection • Mass transfer from non-aqueous phase • Heat transfer (Heat transfer mechanisms, Radiation, One-dimensional heat transfer, Heat transfer with simultaneous heat generation, Multidimensional heat transfer).

Elective Courses (2 out of 7 SSci available in the 5th and 6th semester)

[SSCI 101] SOCIOLOGY

Το μάθημα αποτελεί εισαγωγή στην Κοινωνιολογία, με αναλυτική και συνθετική μελέτη εννοιών που αφορούν βασικά στοιχεία του κοινωνικού πλαισίου μέσα στο οποίο πραγματοποιείται η παραγωγική δραστηριότητα του ανθρώπου. Εξετάζονται έννοιες όπως: κοινωνία, κοινωνικές θέσεις και ρόλοι, κοινωνική αλλαγή, κοινωνική διαστρωμάτωση και κινητικότητα, κοινωνικές κατηγορίες και τάξεις, κοινωνικο-πολιτικοί θεσμοί, κοινωνικο-οικονομικοί θεσμοί και μετασχηματισμοί.

[SSCI 203] PHILOSOPHY AND HISTORY OF SCIENCE

Science as: a cognitive acquisition of reality and a social cultural phenomenon. The Position and Role of Science in the Structure and Development of Society. Issues of theory of knowledge, logic and methodology in scientific research. Sciences in history. Diversification, integration of sciences and interdisciplinarity. Novelties and traditions, laws governing the development of science and technology. The subject of scientific activity. Theories, Directions, Trends and Approaches to the Philosophy of Science.The course is structured around two axes:

A) Important landmarks in the history of individual sciences (astronomy, logic, mathematics, physics, etc.); and related philosophical theories.

B) Basic theoretical trends and individual trends in philosophy and history of science, logical empiricism and then (study by R. Carnap, K. Popper, T.S. Kuhn, I. Lakatos, P. Feyerabend, A. Koyre, G. Bachelard, G. Canguilhem, L. Geymonat, E. Bitsakis).

[SSCI 301] ART AND TECHNOLOGY

Historical-sociological approach to the relationships between Technology and Art, Technology and Culture. In particular, the historical conditions in which the separation of Art and Technology took place are examined. Reflections are being made on the current possibilities of unification or harmonious cooperation • The development of new technologies in the context of the current socioeconomic formation, its impact on the art and culture sector, the needs in the know-how to better control (new) technologies are being explored • Technology and art as types of creative activity in the structure and development of society. Technology as: objectification, context of human action in nature and relations between people, anticipating conception-knowledge and instrument of action in nature • The aesthetic as form of consciousness and specialized occupation in the division of labor (art). Basic aesthetic categories. Social functions of art • Art and technology in the history of culture. The non-existence of metaphysical contradictory emotion and logic. • "Apollon" and "Dionysian" • The synthetic dimension of creativity.



Required courses

[ENVE 340] FIELD STUDIES I

In this course students are visiting wastewater treatment plants, solid waste treatment and recycling plants and/or wind parks in order to get practice on topics related to courses taught during the 2nd and 3rd year of the curriculum.

[ENVE 311] AIR POLLUTION

Atmospheric structure and composition of the Earth's atmosphere • Concentration and mixing volume of chemical species in the atmosphere • Radiation and atmosphere • Greenhouse effect, emissions of greenhouse gasses in the atmosphere • Atmospheric circulation, basic equations of transport • Characteristics of particulate matter • Chemical properties of gaseous pollutants and particulate matter in the atmosphere • Atmospheric dispersion – Methods of Euler and Lagrange • Gaussian models • Cell models • Human exposure and dose • Air quality legislation.

[ENVE 324] UNIT OPERATIONS FOR WATER AND WASTEWATER TREATMENT

Basic principles in water and wastewater treatment • Flow equalization • Screening • Sedimentation (Discrete solids sedimentation – Grid chamber design, Flocculants settling – Primary sedimentation tank design, Zone settling – Secondary sedimentation tank design) • Floatation • Deep-bed filtration • Surface filtration in (Filter-press – Belt Filter-press - Vacuum filters) • Membrane separation (Reverse Osmosis, Ultrafiltration)

[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 initialvalue and boundary-value problems for ordinary differential equations • Applications in environmental engineering.

[ENVE 326] HYDRAULICS I

Introduction, Control cross sections, Velocity distribution in open channels • Equations in open channel flow, Continuity equation, Bernoulli equation, Momentum equation, Energy equation - Total energy - Specific energy • Uniform flow, Manning equation, Steady flow in flood plain, Optimal cross section • Non uniform flow, Flow categorization, Hydraulic jump - stilling basins, Specific energy – critical depth, Non-uniform flow – Gradually varying flow, Flow profile classification, River flow • Control and measurement of open channel flow, Control cross sections • Spillways.

[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.

[ENVE 303] ENERGY AND ENVIRONMENTAL TECHNOLOGIES

Study and assessment of solar potential • Study and assessment of wind potential • Measurement of Emissions in a boiler • Calculation of energy footprint in the Environment • Basic Principles of Thermal Comfort and its Connection to Indoor Air Quality • Solar energy utilization technologies for the production of heat (solar water heater with flat solar collector, Calculation of efficiency of solar collector-water heater) • Technologies for the utilization of solar energy for the production of electricity (PV panel, Photovoltaic (PV) panel basic principles and operation, calculation of PV panel power efficiency)

Elective Courses (2 out of 7 SSci available in the 5th and 6th semester)

[SSCI 104] INTRODUCTION TO PHILOSOPHY

A brief look at the history of philosophy • From myth to speech • Basic philosophical concepts, categories and laws of dialectics in the areas of theory of knowledge, ontology and logic (formal and dialectical • Philosophy, science and technology • Elements of social philosophy: the structure of the development of society as an organic whole, its social connotations and its forms • The act of philosophy as a necessary element of the consciousness of personality, self-awareness and self-consciousness of the civilization of each time.

[SSCI 102] POLITICAL ECONOMY

[SSCI 202] HISTORY OF CIVILIZATION

The relationship between material and intellectual civilization: contradiction and unity • Types of civilization and modes of production • History of civilization: Antiquity, Middle Ages, Renaissance and transition to modernity • Theoretical Approaches: Sociology, Philosophy, Social Anthropology • Modernity and Post-Modernity • 21st Century Culture: 4th Industrial Revolution, "immaterial" labour and civilization.

[SSCI 302] INDUSTRIAL SOCIOLOGY

[ENVE 346] INTERNSHIP

The Internship offers students the opportunity to gain an initial professional experience as well as the connection of the School with enterprises and businesses. The Internship at Technical University of Crete is implemented within the framework of the funding project $E\Sigma\Pi A$ 2014-2020 and it is an elective course with 5 ECTS credits in the curriculum of the School of Environmental Engineering, but without any grade. ECTS of Internship are not included in the requirements for the Diploma in Environmental Engineering. It is offered in the third year of studies, at the 6th semester (Course ID: ENVE 346 INTERNSHIP) and its duration is 2 months. During Internship, students are employed in enterprises and businesses in Greece, while working positions abroad are not excluded. Nevertheless, the amount of payment remains the same in all cases and is defined by the budget of the funding project each year. Students, who conduct an Internship, have the opportunity to work at enterprises/businesses registered in the School website and/or in http://atlas.grnet.gr (interconnected companies). Furthermore, students have the potential to conduct Internship at a

company of their own choice. Further information regarding the implementation of Internship may be found in the School website (<u>www.enveng.tuc.gr</u>).

[ENVE 421] APPLICATIONS IN ENVIRONMENTAL MODELING

Introduction to the methodology of modeling environmental systems • Transport Phenomena (Advective, dispersive and advective-dispersive systems; Compartmentalization; Sediment Transport; Simple Transport Models; Parameters calculation) • Chemical Reaction Kinetics • Eutrophication • Ecosystem Models • Conventional Pollutants in Rivers and Lakes.

[ENVE 437] CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT

Basic principles for chemical equilibrium in water • Complexation and solubility • Precipitation • Coagulation - Flocculation • Floatation • Adsorption • Disinfection • Ion exchange.

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

Introduction to Integrated Solid Waste Management (Solid waste categories; Qualitative and quantitative analysis; Properties and generation; MSW composition studies in Greece and overseas; Current practices, problems and future trends) • Reduce, Reuse, Recycle, Recovery... The Rs of Solid Waste Management (Basic Principles; Recycling Performance Assessment; Recycling Materials; Recycling opportunities; Separation/processing unit operations) • Biological Treatment (Basic principles; Methods for biological treatment of municipal solid waste; Composting; Advantages and disadvantages of composting; The science of composting; Stages of Composting; Important factors in compost chemistry; Quality requirements; Anaerobic digestion; Low-solids (wet) anaerobic digestion; Dry anaerobic digestion; Anaerobic digestion facilities) • Thermal Treatment (Introduction; Incineration; Incineration facilities; Pyrolysis; Gasification; Hydrothermal; Air Pollution Control Systems) • Process balance (Mass balances; Pollutants; Energy yields; Summary) • Sanitary landfills (Disposal; Landfill; Production and composition of leachates; Biogas) • Liner Systems, Management and Collection of leachates (Leachate Production; Slope and collection of leachate/exhaust pipe installation; Hydraulic conductivity of the drainage zone; Selection and characteristics of the pipe; Blocking and filtering) • Biogas Collection and Control Systems (Estimate quantity of biogas; Passive monitoring of biogas; Active monitoring of biogas; Concentrates on biogas recovery systems; Biogas Management) • Design of landfills (Design of landfill; Compost cover; Closing a landfill) • Final cover and restoration.

[ENVE 435] PROJECT MANAGEMENT

Introduction: project characteristics, responsibilities of project managers, activities and life cycle of projects, conditions of success • Mathematics of financial transactions – Time value of money – annuities –perpetuities- loans • Project appraisal: investment appraisal, sensitivity analysis & Monte Carlo simulation • Life-cycle costing: Cost items and analysis, uncertainty, life-cycle cost model • Evaluation and project selection: cost-benefit and cost-effectiveness analysis, decision making under uncertainty – decision trees • Probabilities and risk: Subjective probability distributions, Expected value criterion. Bayes theorem and the value of information • Activity based approach: management, objective, time, cost, quality, human resources, risk, inputs, organizational model, work breakdown structure • Mathematical programming for project management: network and transport problems. • Project scheduling: GANTT graph, Critical Path Method, Crashing •

Program Evaluation and Review Technique (PERT) – simulation • Software hands-on: i.e. new product development, construction projects, R&D ventures • Budgeting and project monitoring: Design, management techniques, cash flow, cost monitoring and time scheduling.

[ENVE 433] HYDRAULICS II

A. Hydraulics and hydrology labs: • Hydraulic jump and stilling basins • Specific energy-critical depth
• Flow over rectangular, vee notch and broad crested weir

B. Growndwater flow labs: • Darcy law – demonstration of groundwater flow, calculation of hydraulic gradient and calculation of hydraulic conductivity • Demonstration of groundwater flow, and calculation of hydraulic conductivity in confined aquifer

C. Hydrometry labs: • Hydrometry - hydrology • Hydrometic networks – state of technology • Methods and equipment of flow measurements • H-q curves • Floods and flood peak discharge estimation • Hydraulic works and control cross-sections • Hydrometeorological measurements.

Elective Courses (1 out of the 5 courses available)

[ENVE 443] SUSTAINABLE DEVELOPMENT (ISO 14000 & LCA)

Economic system and environment. Sustainability. Examples. The concept of development • Income. Impact of growth rates. Level of development and country classification. Determinants of development. Development with and without technological progress • Productivity • Natural resources. Relationship of economic sphere and biosphere. Examples of energy and circular economy • Sustainable management. Economic Growth Standards. Unbalanced growth. Agricultural, industrial • International financial transactions and technology transfer • Redefining national income and well-being. Depreciation of national capital. Examples from the World Bank. • Indicators of Sustainable Economic Prosperity • Long-term growth and sustainability. Economics of ecology • Economics of Climate Change. External economies • Cost-benefit analysis. Environmental Management Systems -EMAS • Environmental taxes. Transition to sustainable production systems. Examples from energy • European sustainability policies. The European Framework Programs for Sustainable Development.

[ENVE 451] AGRICULTURAL ENGINEERING

Introductory concepts on soils (soil genesis, texture, structure) • Soil water concepts (soil water transport and storage, field capacity, permanent wilting point, irrigation dose) • Methods for calculating evapotranspiration • Irrigation scheduling • Irrigation methods and design of irrigation networks • Basic principles of soil drainage • Design of drainage networks • Irrigation water quality and soil salinity.

[ENVE 417] HEALTH AND SAFETY AT WORK

Introduction to Occupational Health and Safety • Regulatory framework on OHS • Safety, health, ergonomic hazards • Workplace requirements • Personal Protective Equipment • Safe chemicals handling • Chemicals labeling and classification (CLP – Regulation) • Registration, Evaluation, Authorization and Restriction of Chemicals (REACH Regulation) • Occupational safety and health risk assessment • Requirements of Occupational Safety Management System.

[ENVE 419] ENGINEERING SEISMOLOGY AND SEISMIC NORMS

Introduction to earthquake hazard and seismic risk 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 ways of dealing with noise emitted by various sources to the environment • Existing institutional adequacy and inadequacy of noise control in the country, and its obligations within the framework of European noise policy • Subjects: Introductory concepts of acoustic and noise; Impact of noise exposure; Recommended levels of noise for different areas; Noise measurements and evaluation; Environmental, industrial, traffic, air, social and occupational noise; Noise protection; Basic noise legislation; Noise prediction models.

[ENVE 430] FIELD STUDIES II

In this course students are visiting wastewater treatment plants, solid waste treatment and recycling plants and/or wind parks in order to get practice on topics related to courses taught during the 3rd and 4th year of the curriculum. Filed studies II include topics on: the management of gas, liquid and solid waste and the operation of associated collection, recycling, transport, treatment and disposal facilities; applications of fluid mechanics, hydraulics, groundwater, surface water, hydrology, soil and surface water pollutants; the management and operation of wind farms.

[ENVE 432] GROUNDWATER FLOW AND 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 • Flick'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

Properties and classification of hazardous waste based on their physical and chemical characteristics, treatment and disposal • Distribution of pollutants in the environment and effects in human health, materials, vegetation, air (hazardous waste in the geosphere, hydrosphere, atmosphere, biosphere) • Introduction (Hazardous waste history; Hazardous waste in Greece) • Hazardous waste (Definition of hazardous waste; Classification; Hazardous waste symbols; Current legal framework) • Risk Assessment and Toxicity (Basic concepts of toxicology; Basic principles of risk assessment) • Hazardous waste management (Reduction-minimization of waste production at the source; Reuse and recovery; Recycling; Storage; Transfer; Treatment; Final disposal; Life cycle analysis (LCA)) • Hazardous waste landfilling (Design of landfills for hazardous waste; Site selection; Identification and control of incoming waste; Construction; Operation; Monitoring; Security and emergency situations) • Physicochemical treatment processes (Flocculation and agglomeration; Sedimentation; Flotation; Filtration; Evaporation; Neutralization; Chemical oxidation/reduction; Sorption; Advanced oxidation processes (AOPs); Solidification/stabilization) • Thermal treatment processes (Incineration; Pyrolysis; Gasification; Mechanisms of formation and emissions of gaseous pollutants; Energy balance; Legislation) • Examples (Asbestos; Dioxins and furans; Polychlorinated Biphenyls; Radioactive Waste)

[ENVE 442] BIOLOGICAL PROCESSES IN WASTEWATER TREATMENT

The course is designed to provide undergraduate students in Environmental Engineering with the necessary background for a meaningful understanding of the general principles of wastewater treatment. The course provides a quick overview of the basic concepts of aqueous chemistry (concentration units, chemical equilibrium, reaction rate, chemical kinetics, chemical thermodynamics) and examines in depth: • Wastewater quality characteristics (Quality of untreated wastewater; Organic chemical characteristics; Theoretical determination of oxygen demand; Biochemical oxygen demand, BOD measurement methods) • Wastewater treatment processes (Basic processes; Selection of processes; Primary treatment; Sedimentation) • Biological treatment of wastewater (Principles of microbiology; Microorganisms growth; Activated sludge systems; Ventilation reservoirs; Oxygen mass transfer; Operational problems; Secondary sedimentation tank design) • Biofilm reactors (Trickling filters; Rotating biological contactors) • Disinfection of treated wastewater (disinfectants; chlorination; ozonation; UV).

[ENVE 531] DESIGN OF HYDRAULIC STRUCTURES

Introduction to hydraulic works (Water; Hydraulic installations; Water supply installations; Sewage installations; Drainage of rainwater; Sewage management; Pipes and assemblies) • Estimation of sewage water quantities (Volumes and flows; Requirements for housing units; Changes in daily water flows; Extinguishing flows) • Supply network design (Pipe systems and pump mains; serial and parallel pumps installations; network analysis using the Hardy - Cross method) • Design of urban sewage networks (Estimation of rainwater and wastewater flows; Hydraulics of sewers; Simulation of rainwater network operation)

[ENVE 444] RENEWABLE ENERGY SOURCES

Environment and energy • Fundamentals of Sustainable Energy Systems and Renewable Sources • Solar energy utilization systems - solar thermal systems • Photovoltaic systems • Solar thermal power generation systems • Biomass - Biofuels • Wind power • Small hydroelectric systems • Geothermal energy • Standard energy applications • Environmental impacts from renewable and conventional energy sources • Design of RES applications with examples • Assessment of energy systems

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

Basic Concepts on Environmental Licensing • Content of Environmental Impact Assessment Studies • Methodology for Writing Environmental Impact Assessment Studies • Estimation of design capacity of Environmental Facilities • Compilation of Flow Charts of Environmental Facilities / Technology Selection Criteria • Mass balances • Design of Environmental Systems

Elective Courses (1 out of the 5 courses available)

[ENVE 446] BIOLOGICAL METHODS FOR ENVIRONMENTAL REMEDIATION

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.

Introduction to bioremediation technologies • In-situ & ex-situ soil and underground water bioremediation technologies polluted with hydrocarbons • In-situ & ex-situ soil and underground water bioremediation technologies polluted with chlorinated organic compounds • Design of in situ reactive walls (subsurface barriers, funnel & gate systems) • Design and operation of slurry bioreactors and sequencing batch reactors (SBR) • Landfarming technique • Composting technique • Rehabilitation of marine ecosystems from oil spills • Environmental natural attenuation • Phytoremediation of soils and groundwater polluted with organic chemical substances • Phytoremediation of soils and groundwater polluted with heavy metals • Design of air biofilters for odor control and VOCs • Bioremediation mechanisms of organic substances: Alkanes, Alkenes, Cycloalkanes, Aromatic hydrocarbons (BTEX), Polycyclic aromatic hydrocarbons (PAHs), Polychlorinated biphenyls (PCBs), Asphaltenes and resins, Explosives (TNT, RMX, HMX) • Field applications.

[ENVE 450] ANALYSIS OF MUNICIPAL TRANSPORTATION SYSTEMS

Urban Transport and Sustainable Mobility: Basic concepts; Sustainable Urban Mobility Plans • Mobility Management Measures: Selection of a means of transport; Incentives to choose an alternative means of transport; Land use and mobility • Quantitative and qualitative parameters in urban transport: Quantitative and qualitative parameters; Basic dimensions and concepts in the urban transport system; Measurement and evaluation of urban transport systems • Urban Road Networks: Urban road network structure; Traffic flow; Level of Service (LoS) calculation • Pedestrian and Bicycle Networks: Definition and specific features of pedestrian movement and bicycle use; Traffic flow characteristics of pedestrians and cyclists; Pedestrian and bicycle traffic networks; Level of Service • Public Transport: Types and features; Offer-demand and services provided; Quality of public transport services; Transportation capacity • Integrated view of urban transport networks: Combined transport; Level of combined service calculation methodology; Transit stations; Environmental impacts (measurement and monitoring systems, emissions and noise) • Use of New Technologies: Present and new methods of data (loop detectors – GPS); Use of Large Data; Intelligent Transport Systems; Telematics; Alternative fuels

[ENVE 434] DECENTRALIZED WASTEWATER TREATMENT SYTEMS

General aspects of wastewater treatment • General aspects of Natural wastewater treatment systems • Slow rate treatment systems (type 1 and 2) • Soil infiltration systems • Constructed wetlands (surface and subsurface flow) • Oxidation and maturation ponds • General aspects of effluent reuse (drivers, current status, future trends) • Effluent reuse applications (irrigation, urban uses, groundwater recharge, environmental applications, indirect potable reuse) • Regulations and guidelines of effluent reuse.

[ENVE 436] WATER RESOURCES MANAGEMENT

Introduction to Environmental Systems Management - Pollution categories, legislation • Implementation of the Water Framework Directive - Region of Crete • Model of Water Resources Management - Hydrology • Water Resources Management Model: Sediment transport and nitrogen and phosphorus cycle analysis; Eutrophication Theory and Heavy Metals; Water Framework Directive and Management Criteria; Methodology for Management and Restoration; Ecological Impacts • Water Resources Management: Waste Load Allocation Methodology; Sensitivity Analysis; Uncertainty Analysis.

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

Small and Medium Enterprises • Organizing and Managing SMEs • SME Legislation • Business Initiatives • Creating New Businesses • Creating Business Plans • Managing Projects and Resources • SME Development Models • Accounting and Costing of SMEs • SME Financing • SME Sustainability • Leadership • SMEs and Innovation • Ideas • Creativity, Competition, Market Segmentation • New Product Design and Development; Sales Promotion; SME Evaluation; Investment Evaluation; Strategy Development and Evaluation; Financial investment analysis • Workshops.

[ENVE 545] BUILDINGS' ENERGY EFFICIENCY

Introduction. Energy regulations • Basic principles aims and benefits of energy audit • Energy analysis and the importance of energy pricing for energy costs • Energy audit of the building envelope and heating, cooling, air conditioning systems • Principles and instruments for inspection of boilers and heating systems • Calibration and energy certification of different types of buildings • Energy conservation measures for buildings • Simulation tools: EnergyPlus • Design and installation of energy monitoring, fault diagnosis and warning networks.

[ENVE 441] STRATEGIC MANAGEMENT AND 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, Bioeconomy, Circular Economy, Industrial Ecology • External Environment: Economy; Technology; Nature; Society; Institutions; Politics. Porter model and competition. Barriers to entry; buyers and sellers and market clearing • Internal Environment: 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: Business model canvas; Set-up & Implementation.

[SSCI 304] ENVIRONMENTAL AND 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. Harmonization 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 neighborhood") • 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 Act 1650/1986 on 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 organization for the environmental protection. Pro-ce-dures for environmental authorization – Approval of Environmental Terms. Historical evolution (L. 1650/1986, L. 3010/2002, L. 4014/2011). EU directives on Envi-ronmental Impact Assessment (EIA) and Strategic Environmental Asses-sment (SEA). Content, specifications and evaluation of envi-ron-mental studies. The case law of the Hellenic Council of State and of the EU Court of Justice for the environ-mental impact assessment.

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

Environmental risk assessment and methodology to address it • Methodology for composing Environmental Impact Assessment Studies • Mass and energy balances • Compilation of diagrams and charts: Flow, P & I, hydraulic sections and plant layouts • Calculation of the design parameters of environmental processes • Cost Assessment of environmental process.

Elective Courses (2 out of the courses offered)

[ENVE 501] FUNDAMENTAL PRINCIPLES AND APPLICATIONS OF AEROZOL SCIENCE

Basic principles of aerosol science and reference to technological applications • Aerosol dynamics, condensation, evaporation, agglomeration and nucleation mechanisms • Study of aerosol dynamics in atmospheric conditions • Optical properties of aerosols • Study of aerosols and their physicochemical characteristics in the indoor and the atmosphere • Methods of measuring aerosols in relation to sources and their concentration in the atmosphere • Aerosol deposition into the respiratory system and human exposure and dose issues • Radioactive aerosol dispensers.

[ENVE 537] INDOOR AIR QUALITY

Introduction to air quality indoors • Gaseous and particulate matter pollutants indoors • Radon, cigarette smoke, ozone, nitrogen dioxide, carbon monoxide, PAHs • Asbestos, heavy metals, formaldehyde • Bioaerosols • Emission sources of air pollutants indoors • Construction materials, odors • Human exposure and dose • Lighting, infiltration • Microenvironmental models • Methodology of air quality measurements • Protection of cultural heritage objects from air pollution • Indoor air quality in industry • Worker protection, human health effects.

[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 • Exercises – Tutorials.

[ENVE 541] RISK ANALYSIS

Elements of probability and statistics • 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 • Bayes Risk • Decision trees • Simulation • Environmental safety • Information on Risk and public perception • Environmental Impact Assessment • Risk assessment using spatial analysis • Methods and Examples in Environmental applications.

[ENVE 539] SOIL AND GROUNDWATER REMEDIATION TEHNOLOGIES

Hydrodynamic, physicochemical and biological underground processes • Transport and course of contaminants in soil: Hydrodynamic processes; Abiotic processes; Biotic processes • Soil Remediation Technologies: Physicochemical methods (Electrokinetic method; Stabilization – Solidification; Soil flushing; Soil washing; Soil vapor extraction), Biological treatment (Bioventing; Bioreactor Slurry; Land treatment; Composting; Phytoremediation), Thermal treatment (In-situ thermal treatment; Incineration; Pyrolysis; Thermal desorption) • Groundwater Remediation Technologies: Ex-situ Technologies (Pump-and-treat; Air stripping; Advanced Oxidation Processes (AOPs)) • In-situ Technologies (Permeable Reactive Barriers (PRB); Air Sparging; Bioslurping) • Examples of applications.

[ENVE 553] AGRO-INDUSTRIAL WASTE PROCESS TECHNOLOGIES

Introduction to agro-industrial waste and basic concepts (definitions, properties, pollutant load from agrochemicals, gases, solid and liquid waste). Organization and Environment (inputs, outputs, Life Cycle Analysis, ISO standards). Health Planning of Food Processing Plants (requirements, HACCP principles, general design principles, waste collection, equipment specifications, cleaning and disinfection, energy forms, CIP design). Food Industry, Environment and Recovery (waste generation stages at the supply chain, functional components to be recovered, recovery stages, conventional recovery technologies, modern non-thermal recovery technologies, comparison of conventional and modern technologies in energy efficiency and cost). The Universal Recovery Strategy from the

waste of the food industry (macroscopic processing, macromolecule - micromolecule separation, extraction, isolation and purification of valuable ingredients, final product encapsulation). Commercial applications of ingredients recovered from food industry waste (commercialization stages, legal issues, innovation problems, scale-up, marketing, real products).

Separation of functional macromolecules and micromoles using ultrafiltration and nanofiltration. Agriculture and the Environment (agrochemicals, insecticides, classification and mechanism of action, fungicides, herbicides and their classification, fertilizers, gases, solid and liquid pollutants, persistent organic pollutants, pesticide residues in food and its health effects the Poison Cycle, Organic Farming, Organic Control and trading). Field and Energy Management (greenhouse energy needs, heat pumps, heat & electricity cogeneration systems, use of recovered heat from industries, use of solar energy for heating, use of geothermal heat for greenhouse use, use of solid biomass for greenhouse heating), anaerobic treatment, use of biogas for greenhouse heating, production of Biodiesel, creation of pellets from oil-pruning and other agricultural residues, combustion gas treatment, anaerobic treatment, activated sludge treatment, secondary treatment, aerobic treatment, activated sludge treatment system selection, septic tank-sedimentation, septic tank scavenging unit, wetland feed well). Wastewater treatment (biological treatment, surface flow wetland, wetland vegetation, optimal treatment of wetland wastewater, chlorination system, artificial wetland yield, water reuse, environmental impact).

[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, et.c) • Particulate matter pollution and its control • Novel, alternative clean technologies for energy and chemicals production

[ENVE 511] DESIGN OF ENERGY SYSTEMS

Introduction and heat transfer in buildings • Calculation of heating and cooling loads • Methodologies for the calculation of the energy consumption for heating, cooling and lighting • Energy Plus simulation tool • Energy efficiency in buildings. Projects 'assignment • Case studies analysis • Energy systems' analysis • Use of virtual Lab • Specialised application of renewable energy sources • Desalination, autonomous energy systems • Integration of renewables in the built environment • Life cycle analysis • Revision of critical subjects.

10th Semester

Diploma thesis. No courses offered.

Further information regarding the implementation of Internship may be found in the School website:

https://www.enveng.tuc.gr/en/studies/undergraduate/curriculum/

V. CONTACT

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Gidarakos Evangelos	Emeritus Professor	37789
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<u>Xekoukoulotakis Nikos</u>	Faculty	37772
<u>Yentekakis Ioannis</u>	Faculty	37752
APPENDIX I

GUIDELINES FOR COMPLETING AND WRITING A DIPLOMA THESIS

DURATION

The diploma thesis project should be completed within a year after its undertaking. In case, the student fails to complete the research within one year, she/he should request to change the topic of the thesis and/or her/his supervisor.

STRUCTURE AND FORMAT

- 1. The thesis should be at least 10,000 words (around 70 pages), including Tables, Figures and References (excluding appendices).
- 2. The thesis should be written in formal English (either UK or US scientific language, without interchanging throughout the document) and checked for spelling errors.
- 3. The thesis must be typed on size A4 (210x297mm) paper. A conventional font (preferably Arial) size 11-point must be used for the body of the text, and size 12-point, bold for the chapter captions. Line spacing must be single (or multiple 1.15). Pagination must extend throughout the whole document except for the front page. Page numbers should be positioned at the bottom-centre of each page. Top, bottom and right hand margins must be 25 mm, and the left hand margin must be 30 mm.
- 4. The thesis should include:
 - 4.1. A front page mentioning the Technical University of Crete, School of Environmental Engineering, the thesis title, the name of the student and the submission date (the template is provided by the School).
 - 4.2. The second page must include the Copyright notice: "It is forbidden to copy, store and distribute this work, in whole or in part, for commercial purposes. Reproduction, storage and distribution are permitted for non-profit, educational or research purposes. The source of origin must be reported. Questions arising regarding the use of this work for other purposes should be addressed to the author.

The views and conclusions contained in this document express the author and should not be construed as the official positions of the Technical University of Crete"

- 4.3. Title page with the names of the examination committee (the template is provided by the School).
- 4.4. Abstract (300 words):

The abstract is written after the completion of the diploma thesis and should:

a) Address the problem researched and explain why it is being considered, and which question or questions are being studied.

- b) Cite the methods used.
- c) Present the significant results.
- d) Contribute to the reader's understanding of the problem.
- 4.5. Prologue and Acknowledgements.
- 4.6. Table of Contents.
- 4.7. List of Tables.
- 4.8. List of Figures.
- 5. The thesis body should have the following structure:
 - 5.1. **Introduction:** This chapter aims to introduce the reader as fully as possible to the subject of the diploma thesis and includes:
 - a) The subject of the study, the way it is approached and any relevant issues to the subject.
 - b) The purpose of the diploma thesis. The problem to be solved is specified.
 - c) The international scientific experience in the subject: Literature review pertaining to the analytical and critical presentation of the relevant bibliography.
 - 5.2. **Methodology:** This chapter analyzes the steps (phases or stages), techniques (e.g. experimental, computational) and any other means used (methodological) in order to solve the problem under consideration or to answer the questions raised.
 - 5.3. **Results:** The results (without any comment) are presented results obtained due to the methodology applied- in the form of Tables, Charts, etc.
 - 5.4. **Discussion:** The results of the dissertation are critically commented, the relationship between the findings of the work and bibliographic data is analyzed, the methodological weaknesses of the research are presented and suggestions are made for further use of the results.
 - 5.5. **Conclusions:** The main findings of the work are presented in a synthetic way and the methodology applied is evaluated weighted. Directions for future research are also briefly suggested.
 - 5.6. **List of References:** All references used and cited in the text must be listed in alphabetical order. They should be copied from a database e.g. Web of Science or Scopus or a source to which TUC has access.
 - 5.7. **Appendices:** Appendices include data that have been used directly in the diploma thesis.
- 6. When writing the thesis, it is <u>essential</u> to take into account:
 - 6.1. Tables and Charts are embedded in the text, with a title below the table or the chart, and a separate numbering system is used, e.g. Table (Chapter number. Picture number in chapter), Chart (Chapter number. Chart number in chapter). For example:
 - Table 3.4 Specifications of catalysts for biofuel production [EUBIA, 2016]. (*This is the 4th table in Chapter 3*),
 - Figure 4.2. Effect of temperature on the performance of the photovoltaic system [IEA, 2017]. (*This is the 2nd chart in Chapter 4*).

The same rule applies for equations (e.g. Equation 1.7 *is the 7th equation in Chapter 1*). Tables and Charts are placed in the document <u>only</u> following their relevant reference in the text. No title is inserted in tables and/or charts. All relevant information is written after the table/chart number.

- 6.2. Within the text of the diploma thesis, the bibliographic references must have the following form: [Surname of the author, date], e.g. [Papadopoulos, 1997] when there is one or two authors, while when there are three or more authors the reference must have the form [surname of the first author, et al., date] e.g. [Papadopoulos et al., 1998]
- 6.3. When an unaltered piece of text is quoted, it should be enclosed in quotation marks and at the end the author is quoted as above with additional reference to the pages of the book, in which the extract can be found e.g. [Papadopoulos, 1999]. ATTENTION: When writing the thesis, no original or slightly modified texts from other works, or texts resulting from a mere translation of extracts in another language, should be used. This practice is called PLAGIARISM and can, even after many years, lead to revoking the degree obtained.
- 6.4. In the text, a common form of symbol notations should be adopted (e.g. everywhere NO_x, not somewhere NO_x, and elsewhere Nitrogen oxides, etc.)
- 6.5. Superscripts and subscripts should be used correctly, e.g. it is wrong to write CO2, m3/h, NH4NO3, NO3-, instead of the correct form CO₂, m³/h or m³ h⁻¹, NH₄NO₃, NO₃⁻,
- 6.6. Chapter numbering is done according to the model "CHAPTER 3. WIND ENERGY ... 3.1. Wind characteristics 3.1.1». Avoid using 4-digit numbering (e.g. 3.1.1.1), because there is chaos in terms of the hierarchy of sections. If you need additional subsection number it as (i), (ii),...
- 6.7. In the **List of References** chapter, the references are listed as follows:

Books: Author name, year of publication, book title, publishing house and reference to the edition of the book if it is 2nd, 3rd and so on, edition of the book.

Chapters in collective volumes: Author name, year of publication, chapter title, book (editors, title, edition), chapter pages.

Journal articles: Author name, year of publication, article title, journal title, volume (issue), pages.

Websites: author / institution / various (if not clear), website address [visit month] (e.g. various, www.fao.org [04/2015]

Book and Journal titles should be presented either in italics or underlined.

- 7. Writing the diploma thesis will be easier and the result optimal if you follow the general guidelines below:
 - Selection and use of appropriate methodology,
 - Essential use of the literature,
 - Critical analysis of the results,
 - Coherence in the development of the issue in the final report,
 - Balanced distribution of material between the main body of the thesis,
 - Careful use of concepts and correct use of the English language,
 - Utilization of the bibliography and previous relevant works.

SUBMISSION OF THE THESIS

The thesis should be submitted to the committee at least 3 weeks before the presentation (defense). The committee should reply to the author, with comments and or corrections, within two weeks after submission.

The final text of the diploma thesis is submitted at least 1 (one) week prior to the defence day.

The PowerPoint presentation should be submitted to the supervisor at least one week before the final presentation.

THESIS DEFENSE

- 1. The date of the examination is first discussed with the supervisor and then dates are sought based on the availability of the other two members of the committee
- 2. An announcement is prepared by the candidate (see model on the page of the School: Studies> Undergraduate> Useful Forms)
- 3. Undergraduate students can present their diploma thesis, regardless of how many courses they have not completed and throughout the year (except public holidays and vacations).
- 4. The potential supervisor decides whether a student has acquired the appropriate knowledge and is able to undertake a thesis work, depending on the courses successfully taken.
- 5. The Academic Announcement for the presentation is posted by the secretariat (1) one week before the defense.
- 6. The candidate books the examination room, at the secretariat.
- 7. At least 15 minutes before the presentation, the candidate should be in the room to do the necessary tests (laptop, projectors, power point version compatibility)
- 8. The evaluation form of the diploma thesis lists the grades given by all examiners, per criterion, without though mentioning the name of the examiner.