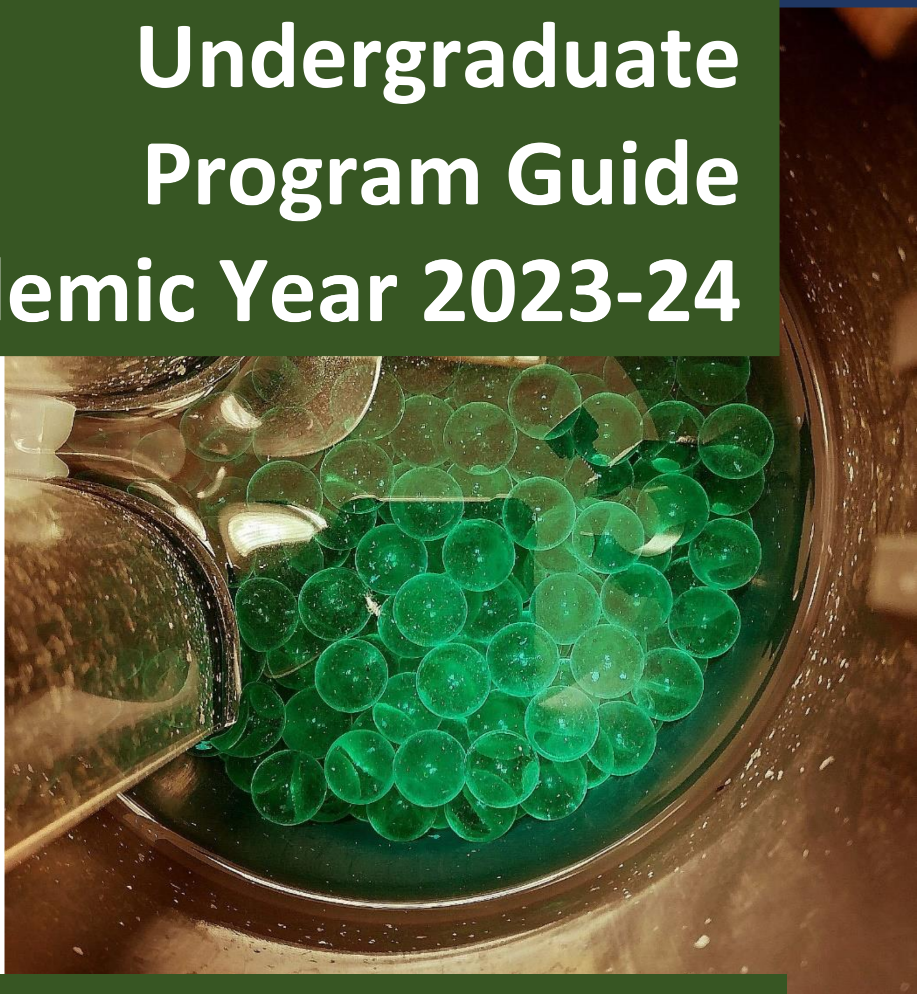
June 2023

Undergraduate Program Guide Academic Year 2023-24



School of Chemical and Environmental Engineering, Technical University of Crete

Students who are admitted to the School of[1], will receive - upon completion of their studies - a Diploma of the School of Chemical and Environmental Engineering in the direction of either "Chemical Engineering" or "Environmental Engineering" depending on the direction they will follow at the end of their 2nd year of study[2]. The choice of direction is based on the students' statements of direction at the 2nd year of study and if required (i.e., in the case that more than 2/3 of the students choose one of the two directions), and with performance criteria set by the University Senate.

Current students in the School of Environmental Engineering (ENVENG) of the Technical University of Crete are registered in the new School of Chemical Engineering and Environmental Engineering in the direction of Advanced Semester "Environmental Engineering".

It is worth noting that the two diplomas offered are a single and inseparable degree of Integrated Master. In addition, they are equal and equivalent to the diplomas of Chemical Engineering and Environmental Engineering offered by other universities in the country and therefore have the corresponding specialization of professional rights of engineers[3].

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

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

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[1] G.G. 2348/03-06-2021/vol. B'
[2] article 75, §1, Law 4589/2019
[3] P. D. 19/2018

- Elaboration or control of management programmes for natural or man-made environmental impacts, technical projects or other activities.

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

Contents

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 Chemical & Environmental Engineering
- School of Architecture

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

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

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

II. SCHOOL OF CHEMICAL & ENVIRONMENTAL ENGINEERING

II.1 General Information

The Department of Environmental Engineering was established[4] at the Technical University of Crete and admitted its first students in Academic Year 1997-1998. The School of Environmental Engineering[5], which incorporated the former Department, was established in May 2013.

In June 2021 the School of Environmental Engineering was renamed "School of Chemical and Environmental Engineering"[6]

II.2 School Objectives

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

- Provide high quality education at undergraduate and postgraduate level and a strong scientific background, know-how and skills to its graduates in two basic and distinct areas: (a) in the science of Modern Chemical Engineering, and (b) in Environmental Engineering.
- Prepare well-trained Chemical Engineers and Environmental Engineers, who will be able to evaluate, design and implement decisions, and constantly evolve into a wide range of activities

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

to compete in current and future challenges within a rapidly technological and scientifically developing society.

- Promote research and innovation via the knowledge transfer to cutting-edge areas, the evolution of the science of chemical engineering and environmental engineering and the expansion of their fields of application.
- Seek and acknowledge excellence, through encouraging, enhancing and rewarding the achievements of members of the academic community in teaching and research.
- Enhance openness through the promotion of collaborations and actions to publicize the achievements of the School at local, national and international level.

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

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

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

Objectives of the Undergraduate Program

The objectives of the Undergraduate Program of the School of Chemical Engineering and Environmental Engineering are the training of Certified Engineer scientists with high qualifications, skills and background to serve the modern scientific research and production process in cutting-edge issues related to the fields of Chemical Engineering and Environmental Engineering.

Educational Objectives of the Undergraduate Program

The educational objectives of the Undergraduate Program are:

- To offer courses related to environmental engineering and chemical 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 Professional Certification of Chemical Engineers & Environmental Engineers

Professional Certification of Chemical Engineers

The profession of Chemical Engineer has now matured and is no longer limited to the borders of a classical chemical industry, but is constantly expanding and penetrating dynamically in a number of fields in response to the recognition that Chemical Engineering plays a key role in meeting the needs of society, prosperity, health, safety and environmental protection. The curriculum of the School is designed to give the engineer a complete knowledge, so that he/she is able to take a leading position and collaborate with other Engineers, Chemists, Biologists and Toxicologists.

The graduate of the School of Chemical and Environmental Engineering in the direction of Chemical Engineering, has as main activity the development and design of processes and industrial facilities for the production and optimization of products, the conversion of raw materials into high value-added products, materials technology , environmental management, protection and exploitation of natural and mineral resources, food technology as well as energy production and storage, covering a wide range of activities with applications in sectors such as industry, environment, energy, biotechnology, nanotechnology , biomedicine and sustainability.

The Chemical Engineer is employed in public and private sector institutions independently or in collaboration with other specialties of Engineers, in subjects of his/her science, as well as in the training for the teaching of environmental education courses, as the professional rights of the Chemical Engineers are constantly expanding.

Given that today's society is characterized by an unstoppable appetite for technological progress, the skills and knowledge of the Chemical Engineer will be constantly needed and will always be in great demand in Greece and the rest of the world.

The Professional Rights of the Chemical Engineer have been regulated as follows:

Chemical Engineer is the engineer who deals with the development and improvement of products and production process methods, with the design, construction and operation of equipment and plant installations of the chemical and related industry with the accompanying technical and building projects, in terms of sustainability, plant health and safety and the management of resources and energy in order to provide useful goods for society as a whole, and applies the natural sciences (physics, chemistry), life sciences (biochemistry, biology), applied mathematics , Classical Engineering, Economics and Informatics.

The Chemical Engineer has the following professional rights:

- Preparation of studies for the location of process facilities and special uses.
- Management and assessment (plant and equipment values, vulnerability, risk).
- Preparation of seismic shielding studies of networks, installations and devices for which they are responsible.
- Preparation of studies in the industries of processing and molding of metals and alloys.
- Preparation of studies for the industries of production and processing of metallurgical powders, composites and other materials.

- Preparation of studies for the industries of production of refractory materials, ceramic products and glass products, production of cement, insulation and fillers, mortars, etc ..
- Preparation of studies for the installation of basic and useful process equipment.
- Capture of existing process installations.
- Design of devices and process reactors. Examples include settling tanks, bag filters, gas washing towers, dryers, biofilters, beds, cyclones, hydrocyclones, heat exchangers, membrane bioreactors.
- Training and analysis of user requirements, adaptation, configuration and operation supervision of hardware / software systems in process installations.
- Development, design and quality control of materials.
- Characterization and standardization of materials.
- Selection and application of materials in plant equipment.
- Diagnosis and treatment of damage, maintenance and protection of Cultural Heritage monuments.
- Exercising the duties of a Shipping Chemist.
- Preparation of Chemical Studies and Research.
- Preparation of Chemical and Chemical Technical Studies in projects, facilities and products. r. Preparation of studies and issuance of certificates of control of disinfections and insecticides in public and private areas.
- Carrying out physicochemical and microbiological analyzes and Management of control laboratories.
- Preparation of studies of anti-pollution technology installations for installations and activities of production, management and energy saving.
- Preparation of studies in crude oil and natural gas pumping facilities, except for electrical, mechanical and shipbuilding studies.
- Preparation of studies of fossil fuel processing plants, indicative of crude oil and natural gas, for each use.
- Preparation of studies in facilities of building service networks.
- Liquid and gaseous fuel combustion plants.
- Preparation of studies in water collection, treatment and supply facilities.
- Preparation of studies in wastewater treatment plants.
- Preparation of studies in facilities for collection, treatment and disposal of waste, waste and material recovery.
- Preparation of studies in storage facilities for hazardous materials as well as freezing or storage facilities for vulnerable products.
- Preparation of studies for the selection of suitability of metals, alloys, materials for demanding uses and adverse conditions (eg exposure to high pressure, high or extremely

low temperatures, dynamic stresses, resistance to earthquakes, malicious acts, terrorist acts, etc.). etc., alloys with ultra-high strength, with abrasion resistance or strongly anti-corrosion action, etc.).

- Preparation of studies for storage, production and distribution of flammable, toxic and explosive.
- Preparation of energy efficiency studies, upgrading and energy saving of building shells
- Preparation of energy efficiency studies, upgrades and energy savings of industrial / building installations.
- Energy audits / inspections.
- Management of energy resources and utilization of renewable energy sources.
- Development and Management of energy systems and energy saving systems.
- Preparation of studies of sanitary, safety and protection installations against fires and explosions (such as SEVESO, BAME, ATEX).
- Preparation of studies of installations and networks of Active Fire Safety and Fire Protection.
- Preparation of restoration studies after industrial accidents and related disasters (eg decontamination of soils, groundwater, etc.).
- Preparation of environmental restoration studies in abandoned mining, metallurgical and other industrial sites.
- Preparation of Environmental Rehabilitation studies.
- Development and design of environmental management and quality systems.
- Preparation of Environmental Studies and Environmental Impact Studies and Strategic Environmental Assessment.
- Development of environmental control systems (Eco audit).

Regarding the **Studies and Projects of the State**, in the present phase, the Certified Chemical Engineer can be registered as a designer in the categories of Studies of the Ministry of Infrastructure and Transport:

5 Organizational and operational research studies

14 Energy studies

15 Industrial studies

17 Chemical studies and research

18 Chemical engineering & chemical plant studies

27 Environmental studies

He can also be registered as a contractor in the Register of Manufacturers' Experience (MEK) of the same Ministry. The Certified Environmental Engineer can be registered in the following categories of MEK for Chemical Engineers:

Industrial Energy Projects

Water, Liquid, Solid & Gaseous Waste Cleaning and Treatment & Treatment Projects

Green Works

Professional Certification of Environmental Engineers

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.

Professional Rights of the Environmental Engineer[7] have been defined as follows:

The Environmental Engineer is the engineer who deals with the protection and promotion of the environment, the environmental management of technical projects, the management of gaseous pollutants, liquid and solid waste, the remediation of polluted areas, the development of renewable energy technologies, the management of water resources and of hydraulic works.

The Environmental Engineer has the following professional rights:

- Building's surveying (excluding special purpose buildings, monuments, etc.).
- Studies of buildings location, including special facilities and development of Master Plans.
- Spatial development studies (local and regional) and operational programmes.
- Studies for Hydraulic Work (land reclamation projects, dams, water supply, sewerage) and Water Resources Management.
- Hydrogeologic and Groundwater studies.
- Management and assessment (land values and other real estate, vulnerability, risk).
- Chemical studies and research.
- Chemical studies in projects, facilities and products.
- Physicochemical and microbiological analyses and management of control laboratories.
- Preparation of hydraulic works for buildings.
- Studies for water collection, treatment and supply facilities.
- Wastewater treatment plants studies.
- Studies for collection, treatment and disposal/recovery facilities.

[7] G.G. 187/05-11-2018/vol. A'

- Studies of storage facilities for hazardous materials and for the maintenance of vulnerable products.
- Energy efficiency studies, energy upgrade and energy saving studies of buildings.
- Energy audits / inspections.
- Management of energy resources and utilization of renewable energy sources.
- Management of energy systems and energy saving systems.
- Environmental Impact Studies and Strategic Environmental Assessment.
- Environmental restoration studies in abandoned mining, metallurgical and other industrial sites.
- Environmental monitoring programmes in accordance with the Environmental terms of projects and activities.
- Environmental Rehabilitation studies.
- Development and design of environmental and energy management systems.
- Management of environmentally sensitive or of special ecological interest and aesthetic beauty areas.
- Development of environmental control systems (Eco-audit).
- Development of environmental monitoring models.
- Preparation of Phytotechnical Landscaping studies.
- Implementation of industrial/energy project studies.
- Forest Studies.
- Studies and certificates of control of disinfections and insecticides in public and private areas.
- Restoration studies after industrial accidents and related disasters (e.g. decontamination of soils, groundwater, etc.).
- Management of energy resources and utilization of renewable energy sources.
- Management of energy systems and energy saving systems.

Regarding Studies and Public Works, the Certified Environmental Engineer can be currently registered as a designer in the Design categories of the Ministry of Infrastructure and Transport:

5 Organizational and operational research studies

13 Hydraulic works studies

17 Chemical studies and research

18 Chemical engineering & chemical plant studies

24 Forest studies

25 Phytotechnical landscaping studies & green works

27 Environmental studies

The Environmental Engineer can also be registered as a contractor of the same Ministry in the following categories for Chemical Engineers:

Industrial Energy Projects

Water, Liquid, Solid & Gaseous Waste Cleaning and Treatment & Treatment Projects

Green Works

or in the following categories for Civil Engineers:

Hydraulic Work Projects

Water, Liquid, Solid & Gaseous Waste Cleaning & Treatment Projects

Green Works

or in the following categories for Mechanical Engineers:

Hydraulic works including systems under pressure

Water, Liquid, Solid & Gaseous Waste Cleaning & Treatment Projects

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

Deanery of the School

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

The Faculty members:

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

Upon their appointment by the respective associations:

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

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 (2022-2023) as committee members:

1. Undergraduate Studies Committee
   - I. Yentekakis, Professor
   - A. Giannis, Assistant Professor
   - A. Manousakis, Associate Professor
   - N. Paranychianakis, Associate Professor
   - T. Tsoutsos, Professor
   - P. Panagiotopoulou, Associate Professor
   - (One student representing the Undergraduate Students' Association)
2. Postgraduate Studies Steering Committee
   - A. Voulgarakis, Associate Professor (Coordinator – Head of Postgraduate Studies)
   - D. Kolokotsa, Professor (Dean)

- M. Lazaridis, Professor
- P. Gikas, Professor
- G. Karatzas, Professor
- T. Tsoutsos, Professor

3. Committee for the Evaluation of Applications for Postgraduate and Doctoral Studies
   - A. Voulgarakis, Associate Professor (Coordinator – Head of Postgraduate Studies)
   - C. Chrysikopoulos, Professor
   - N. Nikolaidis, Professor
   - G. Karatzas, Professor (deputy)
4. Advising Committee for Undergraduate Students
   - P. Panagiotopoulou, Associate Professor (for Chemical Engineers)
   - N. Nikolaidis, Professor (for Environmental Engineers)
5. Internship
   - D. Venieri, Associate Professor
6. ERASMUS+
   - S. Rozakis, Professor
   - T. Daras, Associate Professor
7. TUC Library Committee
   - N. Xekoukoulotakis, Assistant Professor
   - S. Rozakis, Professor (deputy)
8. Energy Committee
   - T. Tsoutsos, Professor
   - D. Kolokotsa, Professor
   - E. Baradakis, STLS
9. Health and Safety Committee
   - I. Yentekakis, Professor
   - E. Koukouraki, LTS
   - R. Sarika, LTS
   - I. Gounaki, LTS
10. Fire Safety Committee
    - A. Giannis, Assistant Professor
    - A. Pantidou, STLS
    - K. Antelli, LTS
    - I. Kanakis, LTS
    - A. Spyridaki, LTS
11. Students' Records Supervisor
    - A. Manousakis, Professor
12. Financial Records
    - I. Gounaki, LTS
13. Quality Assurance IT System and Students' Evaluation monitoring
    - A. Koutroulis, Associate Professor
    - T. Glytsos, LTS
    - G. Botzolaki, LTS
    - A. Malandrakis, LTS
    - D. Venieri, Associate Professor
    - N. Xekoukoulotakis, Assistant Professor
    - N. Paranychianakis, Associate Professor

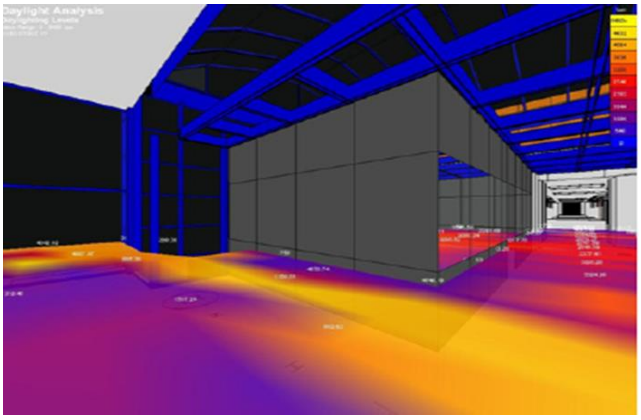
- A. Giannis, Assistant Professor

14. Web site Content Management
    - N. Vakakis, LTS
    - A. Spiridaki, LTS
    - L. Manaroli, Secretary
15. Undergraduate and Postgraduate Studies Guide
    - I. Koutsogiannaki, LTS
    - A. Koutroulis, LTS
    - L. Manaroli, Secretary
    - Secretary
16. High Schools’ visits planning
    - A. Pantidou, STLS
    - A. Spyridaki, LTS
17. TUC Special Research Funds Unit (School representative)
    - T. Tsoutsos, Professor (member)
    - P. Gikas, Professor (alternate member)
18. Outreach Committee
    - T. Tsoutsos, Professor
    - P. Gikas, Professor
    - S. Rozakis, Professor
    - A. Stefanakis, Assistant Professor
    - A. Papadopoulou, LTS
19. TUC Quality Assurance Unit
    - D. Venieri, Associate Professor
    - A. Giannis, Assistant Professor (alternate member)
20. TUC Strategic Planning Committee
    - D. Venieri, Associate Professor
    - D. Kolokotsa, Professor (Dean)
21. TUC Lifelong Learning Center Committee
    - D. Kolokotsa, Professor (Dean)
    - T. Tsoutsos, Professor

II.6 Divisions

The School of Chemical and Environmental Engineering is organized into four Divisions, each including a number of laboratories on various subjects.

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



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

PROCESS DEVELOPMENT, ANALYSIS AND DESIGN (DIVISION II):

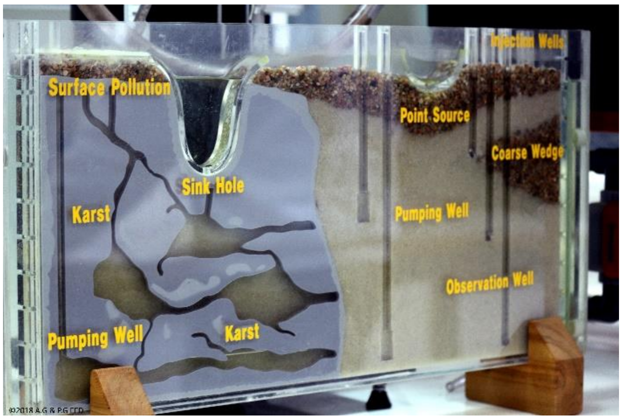
Division II is engaged in the field of sciences / areas of specialization: Chemical, biochemical and Environmental Process Design and Analysis; Thermodynamics; Calculus, Mathematics and Statistics; Numerical Analysis and Programming; Environmental Engineering; Unit Operations; Process Control; Physical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

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

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

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

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



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.

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

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.

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.

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

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

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

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

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

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

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

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

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

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

Associate Professors

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

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

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

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

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.

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

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

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

Engineering (2003), Technical University of Crete, PhD, Department of Environmental Engineering (2008), Technical University of Crete.

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

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

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

Emeritus Professors

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

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

Laboratory Teaching Staff (LTS)

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

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

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

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

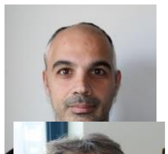
Kanakis, Ioannis: Physics, Degree in Physics (1991) National and Kapodistrian University of Athens, M.Sc. “History and Philosophy of Science and Technology” (2000) National Technical University of Athens.

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

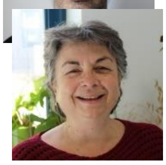
Koukouraki, Elissavet: Water and wastewater treatment, Degree in Chemistry (1992) University of Crete, M.Sc. “Quality Control & Environmental Management” (2002) Technical University of Crete.

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

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



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



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

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

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

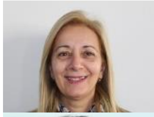
Vakakis, Nikolaos: Materials and Catalytic Procedures, Degree in Physics (1997) University of Crete, M.Sc. “Materials science and technology” (2001), National Technical University of Athens.

Specialized Technical Laboratory Staff (STLS)

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

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

Administration



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

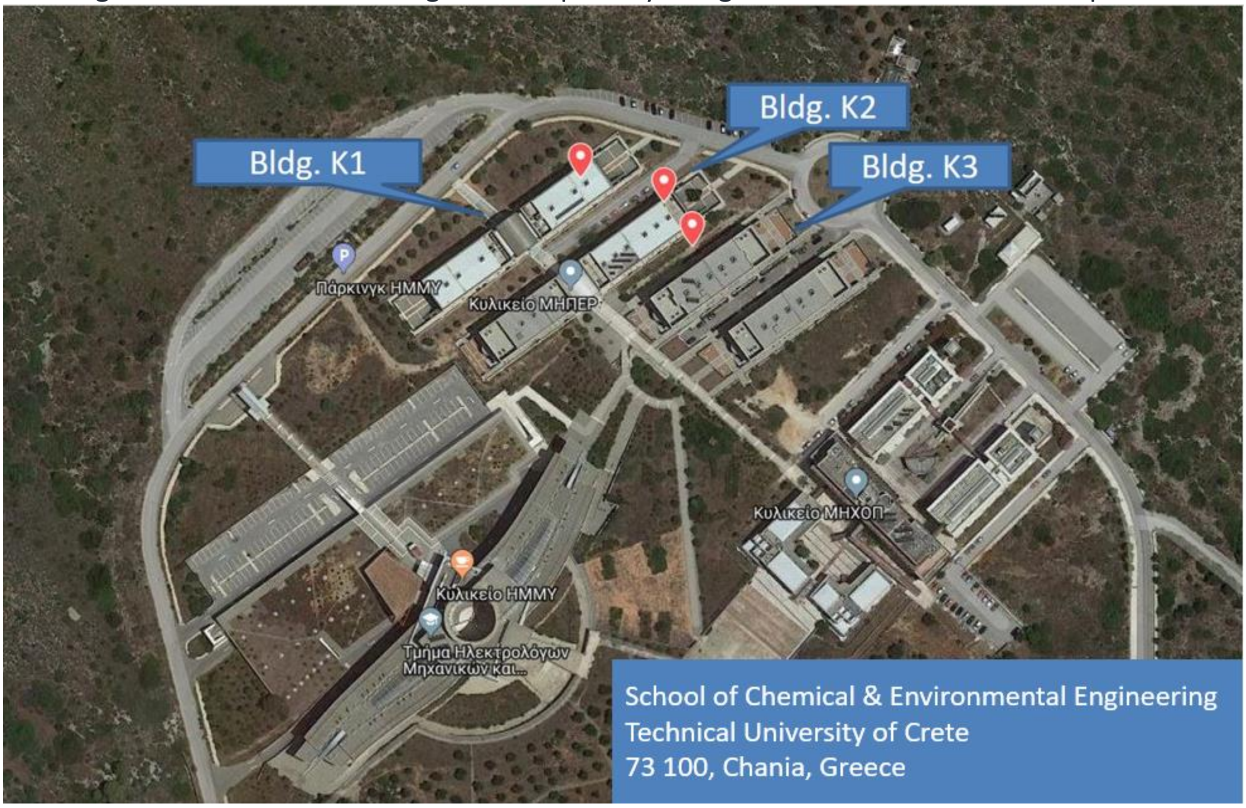
Pateraki, Dimitra: Permanent employee, coordinator of undergraduate and postgraduate studies (diplomas, registrations, certificates).

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

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 m^2. The first floor of building K2 houses the Secretariat. Laboratories are located on the ground floor of all buildings and in specially designed establishments on campus.






Laboratory Facilities

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

Agricultural Engineering Laboratory

DIVISION IV - Head: Paranychianakis Nikolaos, Associate Professor

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

Aquatic Chemistry Laboratory

DIVISION I - Head: Psillakis Elia, Professor

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

Atmospheric Aerosols Laboratory

DIVISION I - Head: Mihalis Lazaridis, Professor

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

Atmospheric Environment and Climate Change Laboratory

DIVISION I - Head: Voulgarakis Apostolos, Associate Professor

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

Biochemical Engineering & Environmental Biotechnology Laboratory

DIVISION II - Head: Vlysidis Anestis, Associate Professor

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

Bioeconomy and Biosystems economics Laboratory

DIVISION II - Head: Stelios Rozakis, Professor

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

Computational Dynamics & Energy Laboratory (CODEN)

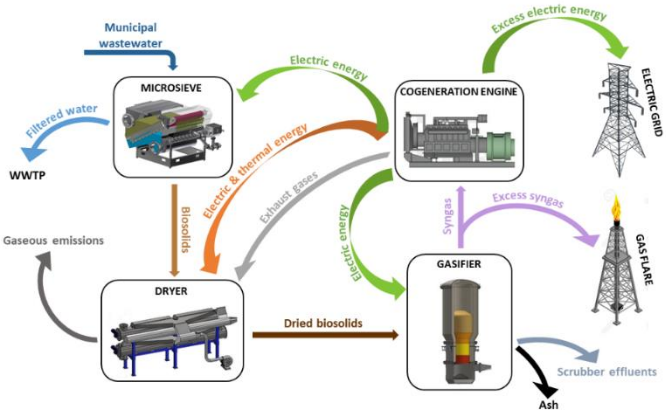
DIVISION IV- Head: Tsompanakis Yiannis, Professor

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

Design of Environmental Processes Laboratory

DIVISION II - Head: Gikas Petros, Professor

The major research activities of the Design of Environmental Processes Laboratory (www.deplab.tuc.gr) is the scale-up of Environmental Engineering processes. Focus is on novel processes for wastewater treatment and water reclamation and reuse, as well as processes for the management and valorization of solid wastes and sludges. Special attention is given to bioprocesses of immobilized biomass, to nitrogen removal from wastewaters using the "anammox" process, to the effects of heavy metals on microbial behavior and to disinfection processes. Integrated water resources management with emphasis on non-conventional water sources. Optimization of environmental process, cost analysis and environmental impact assessment. Research is carried out in laboratory, and at the field, with large scale pilot applications, with combination of experimental, informatics and design processes. The Research Unit has established collaboration with international and Greek universities, research centers and private enterprises, which are active on environmental engineering.



Energy Management in the Built Environment Laboratory

DIVISION I - Head: Kolokotsa Dionysia, Professor

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

Environmental Catalysis Laboratory

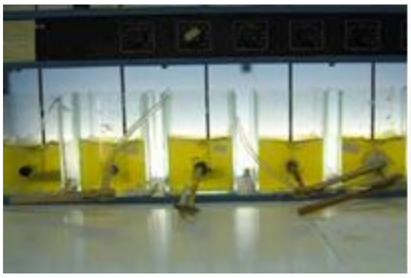
DIVISION III - Head: Panagiotopoulou Paraskevi, Associate Professor

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

Environmental Engineering and Management Laboratory

DIVISION II - Head: Diamadopoulos Evan, Professor

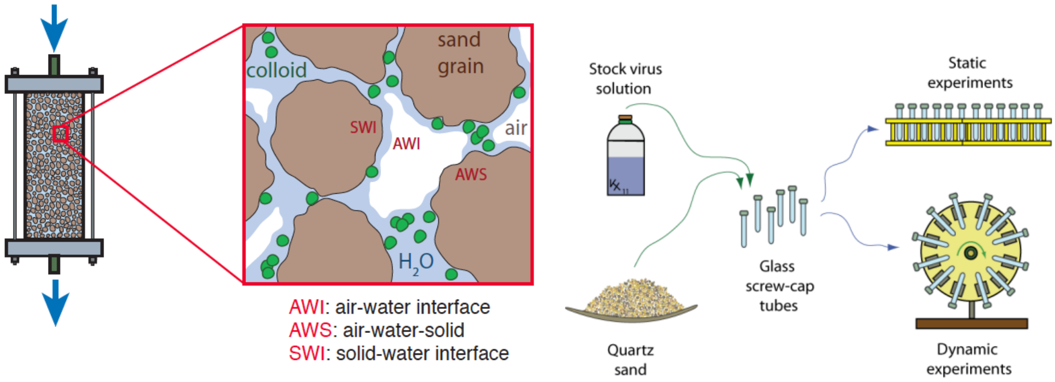
The Laboratory of Environmental Engineering and Management of the Technical University of Crete is involved (in terms of teaching and research activities) with the development and application of technologies for the appropriate management and treatment of water, wastewater and solid wastes. The Laboratory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



Environmental Engineering Laboratory (TUCeeL)

DIVISION II - Head: Chrysikopoulos Constantinos, Professor

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



Environmental Law and Governance Laboratory

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

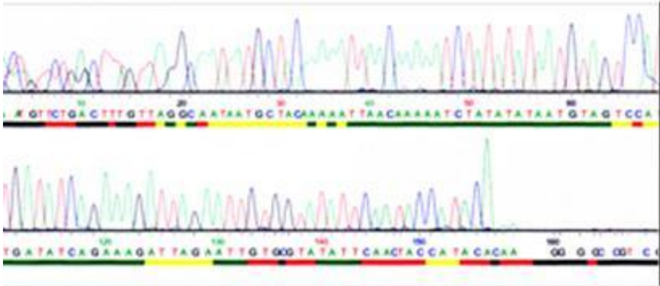
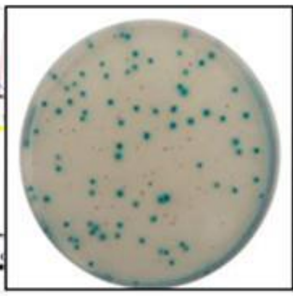
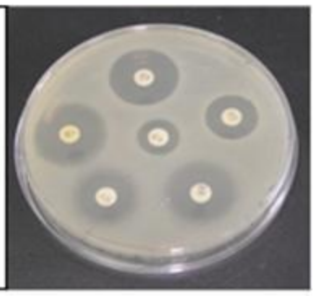
The laboratory is active in the following research areas: legal protection of forest ecosystems, legal protection of landscape, legal protection of biodiversity, agrobiodiversity, plant genetic resources, Genetic Material & Seed Banks, Botanical Gardens, garden and civil law legal issues of renewable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

Environmental Microbiology Laboratory

DIVISION II - Head: Venieri Danae, 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 III - Head: Xekoukoulotakis Nikolaos, Assistant Professor

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

Geodesy and Geographic Information Systems Research Unit

DIVISION IV - Head: Tsouchlaraki Androniki, Assistant Professor

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


Geoenvironmental Engineering Laboratory

DIVISION IV – Head: Karatzas George, Professor

Environmental fluid mechanics, environmental geology and hydrogeology, flow in porous media, contamination of soils and ground water remediation techniques for contaminated soils and ground waters, water intake structures, simulation of groundwater flow and mass transport, optimization methods for environmental systems, optimal groundwater management, saltwater intrusion, development and applications of geo-environmental software packages.

Hydrogeochemical Engineering and Soil Remediation Laboratory

DIVISION IV – Head: Nikolaidis Nikolaos, Professor

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

Mathematics Laboratory

DIVISION I – Head: Manousakis Antonis, Professor

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

Physical Chemistry & Chemical Processes Laboratory

DIVISION III – Head: Yentekakis Ioannis, Professor

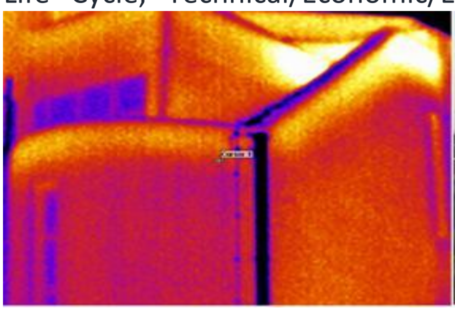
The laboratory of Physical Chemistry and Chemical Process (www.pccplab.tuc.gr) has excellent scientific equipment, active and productive faculty members, young and older researchers, postgraduate students and international collaborations thus, ensuring high quality education and research work.

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

Renewable and Sustainable Energy Systems Laboratory

DIVISION I – Head: Theocharis Tsoutsos, Professor

The Unit of Renewable and Sustainable Energy Systems covers a wide range of Applied Research and Technological Development, Energy Planning and Sustainable Energy Management on the following groups of activities: Management Systems Renewable Energy and Energy Conservation (regional-local energy planning, sustainable management of natural resources, technology transfer, Life Cycle, Technical/Economic/Environmental evaluation), biofuels (use of agricultural and



stockbreeding residues, production of liquid biofuels, biofuels for buildings heating, assessment of technical and financial resources available), Solar Air Conditioning (design active solar air conditioning systems, technical and financial evaluation), sustainable energy systems

(Environmental Impact analysis using energy Systems, Renewable energy and Environment, Assessment of Renewable Sources of Energy under uncertainty, development of sustainable energy systems, renewable energy industry analysis).

Stochastic models Laboratory

DIVISION II – Head: Daras Tryfon, Associate Professor

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

Toxic and Hazardous Waste Management Laboratory

DIVISION I – Head: Giannis Apostolos, Assistant Professor

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


Hydrologic and Hydraulic Engineering Laboratory

DIVISION IV – Head: Koutroulis Aristeidis, Associate Professor

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

III. Undergraduate Program Regulation

III.1 Registration

The Ministry of Education and Religious Affairs every year determines the selection criteria, the number of new undergraduate students and the registration dates. (https://www.minedu.gov.gr/)

The website of the Technical University of Crete (www.tuc.gr) provides detailed information for new students and their registration. Further details, i.e. documents required for registration, can be found on the CheEnvEng School web page.

New students should then visit the Secretariat of the School of Chemical and Environmental Engineering for the finalization of their registration by submitting the supporting documents which are posted on the website of the School.

As an alternative to the physical presence at the Secretariat of the School, the supporting documents can be sent by post to the address of the secretariat of the School. **In this case, the printed application for registration must be certified with the original signature by the Citizen Service Center.**

Upon completion of registration, new students obtain their personal accounts from the Computer Center of TUC (username, password) and thus gain access to all online services (academic identity, selection of texts on the Eudoxus 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 [https://academicid.minedu.gov.gr/]. In order to apply, it is necessary for the student to have access to the online services of the Technical University of Crete. The AIC allows for a reduced (student) ticket to public transport as well as to various social events (cinemas, theatres, concerts, etc.)

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

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

At the suggestion of faculty members, books and notes are distributed free of charge (Eudoxus system) to meet teaching needs.

III.3 Student Status

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

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

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 [https://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 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 as 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 Erasmus+ site. The Professor S. Rozakis (tel.: +30-28210-06160, office K3.A6, e-mail: srozakis@chenveng.tuc.gr) is the Academic Coordinator for the ERASMUS + program in connection to students of the School of Chemical and Environmental Engineering.

III.5 Qualification Exams

Graduates of other Higher Educational Institutes, 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, which are 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.

Admittance to the School via Qualifying Exams depends on the candidates' previous degree. That is,

A. Non ChEnvEng School Graduates: They should take qualifying exams on the following courses:

- Differential and Integral Calculus I ***(1st semester)***
- Physical Chemistry I ***(2nd semester)***
- Fluid Mechanics ***(3rd semester)***

Successful candidates register in the ***1st year of studies,*** and they may proceed to university course credit transfer (in addition to the three courses above) .

B. ChEnvEng School Graduates, with **Diploma in Chemical Engineering**, (hence they have successfully completed all 1st and 2nd year courses of the Undergraduate Studies Program) who may wish to follow the advanced semester **Direction of Environmental Engineering:** They should take qualifying exams on the following courses:

- Hydraulics I ***(5th semester)***
- Aquatic Chemistry ***(5th semester)***
- Meteorology and Air Quality Models ***(5th semester)***

Successful candidates register in the ***3rd year of studies, Direction of Environmental Engineering,*** and they may proceed to university course credit transfer (in addition to the three courses above).

Γ. ChEnvEng School Graduates, with **Diploma in Environmental Engineering**, (hence they have successfully completed all 1st and 2nd year courses of the Undergraduate Studies Program) who may wish to follow the advanced semester **Direction of Chemical Engineering:** They should take qualifying exams on the following courses:

- Transport Phenomena II ***(5th semester)***
- Unit Operations ***(5th semester)***
- Material Science and Technology ***(5th semester)***

Successful candidates register in the ***3rd year of studies, Direction of*** **Chemical** ***Engineering,*** and they may proceed to university course credit transfer (in addition to the three courses above).

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 Chemical and 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 Chemical Engineers and 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.

The maximum duration of study is set to the minimum study time, increased by six (6) semesters.

After completing the maximum period of study, subject to the regulations of the following paragraphs, the Dean of the School issues a deed of expulsion for the student.

Students may, upon request to the Dean of the School, postpone their studies for a period not exceeding two (2) years. Student status does not apply during the suspension of studies.

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 each 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 organization 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 School of Chemical and Environmental Engineering.

The students who are admitted to the School of Chemical and Environmental Engineering after the academic year 2021-2022, will receive upon completion of their studies a Diploma of the School of Chemical and Environmental Engineering in the direction of advanced semester either "Chemical Engineers" or "Environmental Engineers" depending on the direction they will follow at the end of their 2nd year of study. The choice of direction will be determined based on the direction statements in the 2nd year and if required (i.e., more than 2/3 of the students choose one of the two directions), based on the performance criteria set by the Senate of the Institution.

Specifically, the students at the School of Chemical and Environmental Engineering by the end of the 4th semester (June), state the direction they wish to follow. Direction selection criteria are performance criteria. No more than 2/3 of the students of each year can follow a single direction. In September of the 2nd year, after the completion of the examination period, we calculate the average (A15) of the grades in courses of the 2nd, 3rd and 4th semester (19 courses) of each student, subtracting his/her 4 worst grades. Therefore, the A15 is derived from grades in 15 courses while any non-transferable grades (0-4) are included (if they are in the top 15). Courses of the 1st semester are not considered, since this is a semester of adaptation (change of place of residence, new way of life, etc.). On the grounds of A15 ranking, students with the best performance are led in the direction they had apply for until the positions of each direction are filled.

The current students in the former School of Environmental Engineering of the Technical University of Crete are registered in the new School of Chemical and Environmental Engineering in the direction of Advanced Semester "Environmental Engineering".

It is worth noting that the two diplomas offered are a single and inseparable degree of integrated master's degree. In addition, they are equal and equivalent to the diplomas of Chemical Engineering and Environmental Engineering offered by other universities in the country and therefore have the corresponding professional rights.

Course Registration and Attendance

At the beginning of each semester, course registration is conducted electronically via the special Students Information System of the Technical University of Crete http://websrv.stdnet.tuc.gr/unistudent. Students are required to have an E-services account which is created at the Computer Centre of the University. Otherwise, they should create one and properly notify the Secretariat of the School of Chemical and 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 ChEnvEng websites. Students cannot be examined nor obtain 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 9^{th} 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. 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.

Course Grading

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 diploma grade for those admitted to the Acad. Year 2021-22 and later (and not retrospectively) is calculated according to the equation (Departmental Assembly#2 / 29-9-2021 and DA#7 / 16-2-2022):

Diploma Grade=

$$\frac{\text{Course 1 Grade x ECTS Course 1 + Course 2 Grade x ECTS Course 2 + …. …+ Course N Grade x ECTS Course N + Diploma Thesis Grade x ECTS Diploma Thesis}}{\text{Total ECTS (=300)}}$$

For students admitted to the School prior to the Academic Year 2021-22, 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 Chemical and Environmental Engineering, 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, 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 Chemical and Environmental Engineering School.
- In the case of equivalence, the student is credited with the ECTS 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 ECTS 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 Departmental 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.

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

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 Chemical and 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/organizations 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 Chemical and 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 Departmental Assembly. For the approval of the Diploma Thesis topic by the DA the student is required to write a summary of the Diploma Thesis according to the template posted on the Website of the School. The progress of the Diploma Thesis is monitored at regular intervals in collaboration with the Supervising Professor, faculty member of the School, and the three-member committee. The student should prepare the summary plan within a time limit determined by the Supervising Professor in collaboration with the three-member committee. This time limit may not exceed three months from the date of undertaking the Diploma Thesis.

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. The text of the Diploma Thesis must have been checked with appropriate plagiarism software, before its submission to the Three-member examination committee.

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.

Regarding the number of courses that the student must have successfully completed in order to start the elaboration of the diploma thesis, it is up to the supervisor who will choose, to give or not a topic to someone, if he/she deems that the courses passed are so few that they do not provide the student with sufficient knowledge of the subject. Undergraduate students may present their thesis throughout the year (excluding public holidays), regardless of how many courses they have not successfully completed.

The exact date and time of the examination is set after consultation with the Examination Committee.

Diploma Thesis Grade

Each one 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 10% to the final diploma grade, that is the diploma thesis accounts for 30 ECTS. 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 Chemical Engineering or Environmental Engineering

The requirements for the Diploma are the following:

Enrollment in the School of Chemical and Environmental Engineering and registration for courses for at least ten (10) semesters, for regularly enrolled students. Students who have been selected in the advanced semester direction of "Chemical Engineering" or "Environmental Engineering" receive the corresponding diplomas of the School, i.e. **Diploma of Chemical Engineer of the School of Chemical Engineering and Environmental Engineering or Diploma of Environmental Engineering of the School of Chemical Engineering and Environmental Engineering.**

The required number of courses leading to the Diploma is that described by the curriculum in force during the student's first enrollment in the Undergraduate Program, i.e. first two years of study and advanced semester direction studies. However, students may have to take additional courses depending on changes in the undergraduate program of studies, included in amendments to the Undergraduate Program Guide, during the period of their studies.

The total number of the ECTS of Undergraduate Program is 300 for each direction, of which 30 correspond to the diploma thesis.

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 10% to the final Diploma grade.

For the calculation of the diploma grade, for students first enrolled in the School in the academic year 2021-22 onwards, the grade of each course is multiplied by the ECTS of the course. The sum of the individual products is divided by the sum of the ECTS of all the courses and the average grade of the courses is obtained. The diploma grade is calculated from the average of the grades of the courses with a weighting factor of 90% and from the diploma thesis grade with a weighting factor of 10%.

For the calculation of the diploma grade, for students first enrolled in the School prior to the academic year 2021-22, the grade for each 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

Tables below list 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), total teaching hours (H) and credits according to the European Credit Transfer and Accumulation System (ECTS) are noted. At the end of each table, there is a list of all the elective courses that students can choose during their studies, as well as some restrictions regarding their choice.

1st Semester courses (CHENVENG)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
ENVE 113	Introduction to Chemical and Environmental Engineering	(2-1-0)	3	4
MATH 101	Differential and Integral Calculus I	(4-1-0)	5	4
PHYS 101	Physics	(2-1-2)	5	4
MATH 105	Introduction to Computer Programming I	(3-0-2)	5	5
ENVE 132	General Chemistry	(2-1-3)	6	5
ENVE 100	Geology	(2-2 -0)	4	4
ENVE 112	Ecology and Introduction to Technical Ecology	(2-0-2)	4	4
Furthermore, the following language courses are offered				
	English I (Seminars)			
	German I (Seminars)			
CHIN 101	Chinese I (not included in the final Diploma Grade)	(2-0-2)	4	3
ECTS Total				**30**

2nd Semester courses (CHENVENG)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
MATH 102	Differential and Integral Calculus II	(4-1-0)	5	4
ENVE 126	Microbiology	(2-0-2)	4	4
MECH 102	Technical Mechanics - Statics	(2-1-0)	3	4
CHENVE 101	Organic Chemistry	(2-1-3)	6	5
CHENVE 102	Mass and Energy Balances	(3-1-0)	4	4
CHEM 201	Physical Chemistry I	(3-1-0)	4	4
MATH 106	Introduction to Computer Programming II	(3-0-2)	5	5
Furthermore, the following language courses are offered				
	English II (Seminars)			
	German II (Seminars)			
CHIN 102	Chinese II (not included in the final Diploma Grade)	(2-0-2)	4	3
ECTS Total				**30**

3rd Semester courses (CHENVENG)

ID	Required Courses	(T-E-L)	H	ECTS
MATH 201	Linear Algebra	(4-1-0)	5	4
MECH 201	Engineering Mechanics-Strength of Materials	(3-1-1)	5	4
MATH 203	Ordinary Differential Equations	(3-0-1)	4	4
ENVE 221	Fluid Mechanics	(3-1-2)	6	5
ENVE 133	Computer Aided Design	(2-0-3)	5	4
CHENVE201	Environmental Law I	(3-0-0)	3	4

Required Course (English/German)

ID	Elective Courses	(T-E-L)	H	ECTS
LANG 201	English III	(2-0-2)	4	3
LANG 203	German III	(2-0-2)	4	3
CHIN 103	Chinese III (not included in the final Diploma Grade)	(2-0-2)	4	3

Elective Courses (1 out of 4 Social Sciences Courses)

ID	Elective Courses	(T-E-L)	H	ECTS
SSCI 101	Sociology	(3-0-0)	3	3
SSCI 203	Philosophy and History of Science	(3-0-0)	3	3
SSCI 301	Art and Technology	(3-0-0)	3	3
SSCI 201	Micro-Macro Economic Analysis	(3-0-0)	3	3
ECTS Total				**30**

4th Semester courses (CHENVENG)

ID	Required Courses	(T-E-L)	H	ECTS
ENVE 229	Thermodynamics	(3-1-0)	4	4
ENVE 336	Numerical Analysis	(4-0-2)	6	4
MATH 204	Probability and Statistics	(3-0-0)	3	3
ENVE 212	Instrumental Chemical Analysis	(3-1-2)	6	5
CHENVE 202	Transport Phenomena I	(2-1-0)	3	4
ENVE 224	Geographical Information Systems	(1-0-3)	4	4

One of the two languages required (English/German)

ID	Elective Courses	(T-E-L)	H	ECTS
LANG 202	English IV	(2-0-2)	4	3
LANG 204	German IV	(2-0-2)	4	3
CHIN 104	Chinese II (not included in the final Diploma Grade)	(2-0-2)	4	3

Elective Courses (1 out of 4 Social Sciences Courses)

ID	Elective Courses	(T-E-L)	H	ECTS
SSCI 104	Introduction to Philosophy	(3-0-0)	3	4
SSCI 102	Political Economy	(3-0-0)	3	4
SSCI 202	History of Civilization	(3-0-0)	3	4
SSCI 302	Industrial Sociology	(3-0-0)	3	4
ECTS Total				**30**

COURSES OF ADVANCED SEMESTER DIRECTION

ADVANCED SEMESTER DIRECTION: CHEMICAL ENGEERING

5th Semester course (ChE)

ID	Required Courses	(T-E-L)	H	ECTS
CHENVE 301	Chemical Process Analysis and Design I	(3-1-0)	4	5
ENVE 435	Project Management	(3-0-1)	4	4
ENVE 443	Sustainable Development & LCA	(2-1-0)	3	4
CHE 310	Transport Phenomena II	(3-1-0)	4	4
CHE 311	Unit Operations	(3-1-2)	6	6
CHE 315	Process Dynamics and Control	(3-1-0)	4	4

Elective Courses (1 out of 2)

ID	Elective Courses	(T-E-L)	H	ECTS
CHE 313	Advanced Technologies for Energy Production and Storage & Energy Cycles	(3-1-0)	4	3
CHE 314	Polymers and Macromolecules Science and Technology	(3-1-0)	4	3
ENVE 332	Meteorology and Climate Change	(2-1-0)	3	3
ECTS Total				**30**

6th Semester courses (ChE)

ID	Required Courses	(T-E-L)	H	ECTS
CHENVE302	Biochemical Process Analysis and Design	(3-1-2)	6	5
ENVE 335	Optimization of Environmental and Energy Systems	(3-1-0)	4	4
ENVE 303	Energy and Environmental Technologies	(1-0-3)	4	4
CHE 312	Material Science and Technology I	(3-1-0)	4	4
CHE 316	Wastewater treatment	(3-1-0)	4	4
CHE 402	Physical Chemistry II	(3-1-2)	6	5
CHE 318	Chemical and Technical Thermodynamics	(3-1-0)	4	4
ENVE 340	Field Studies I	-	-	-
ENVE 346	Internship*			5
ECTS Total				**30**

* The ECTS are not accounted for in the final grade.

7th Semester courses (ChE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
ENVE 417	Health and Safety at Work	(3-0-0)	3	4
CHENVE 401	Environmental Catalysis	(3-1-0)	4	4
CHE 317	Chemical Process Design and Analysis II	(2-1-3)	6	6
CHE 403	Nano-materials and nano-technology	(4-0-0)	4	6
Elective Courses (2 out of 3 available)				
ID	**Elective Courses**	**(T-E-L)**	**H**	**ECTS**
CHE 404	Biomedical Technology I	(3-0-0)	3	5
CHE 405	Food Technology	(3-0-0)	3	5
CHE 406	Environmental Chemistry	(3-0-0)	3	5
ECTS Total				**30**

8th Semester courses (ChE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
ENVE 554	Design of Chemical and Environmental Plants and Environmental Impact Assessment I	(2-2-1)	5	6
ENVE 444	Renewable Energy Sources	(3-1-0)	4	5
ENVE 452	Gas-emissions Treatment Technology	(3-0-0)	3	5
CHE 407	Technical and Economic Process Feasibility Study	(3-1-0)	4	5
ENVE 430	Field Studies II	-	-	-
Elective Courses (3 out of 6 available)				
ID	**Elective Courses**	**(T-E-L)**	**H**	**ECTS**
ENVE 441	Strategic Management and Innovative Entrepreneurship	(2-2-0)	4	3
DPEM 433	Small & Medium Enterprises (SMEs) and Innovation	(2-0-2)	4	3
ENVE 311	Air Pollution	(2-1-0)	3	3
CHE 408	Biomaterials - Bioplastics	(3-0-0)	3	3
CHE 409	Solid State Physics and Surface Science	(3-1-0)	4	3
CHE 410	Biomedical Technology II	(3-1-0)	4	3
ECTS Total				**>=30**

9th Semester courses (ChE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
CHENVE 501	Environmental Legislation II - Introduction to Public works Law	(3-0-0)	3	5
ENVE 555	Design of Chemical and Environmental Plants and Environmental Impact Assessment II	(2-2-1)	5	15
CHE 501	Fuel and Lubricants Tecnology	(3-0-0)	3	5
Elective Courses (1 out of 4 available)				
ID	**Elective Courses**	**(T-E-L)**	**H**	**ECTS**
CHE 503	Biorefineries and Circular Economy	(3-1-0)	4	5
CHE 504	Natural Gas – Biogas -Hydrogen Technologies	(3-1-0)	4	5
CHE 410	Metallurgical Processes	(2-1-0)	3	5
ENVE 541	Risk Analysis	(2-1-0)	3	5
ECTS Total				**30**

10th Semester courses (ChE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
	DIPLOMA THESIS			30
ECTS Total				**30**

COURSES OF ADVANCED SEMESTER DIRECTION

ADVANCED SEMESTER DIRECTION: ENVIRONMENTAL ENGEERING

5th Semester courses (EnvE)

ID	Required Courses	(T-E-L)	H	ECTS
CHENVE 301	Chemical Process Analysis and Design I	(3-1-0)	4	5
ENVE 435	Project Management	(3-0-1)	4	4
ENVE 443	Sustainable Development & LCA	(2-1-0)	3	4
ENVE 326	Hydraulics I	(3-1-0)	4	5
ENVE 345	Aquatic Chemistry	(2-1-0)	3	4
ENVE 332	Meteorology and Climate Change	(2-1-0)	3	3
ENVE 321	Structural Analysis and Reinforced Concrete	(3-1-0)	4	5
ECTS Total				**30**

6th Semester courses (EnvE)

ID	Required Courses	(T-E-L)	H	ECTS
CHENVE 302	Biochemical Process Analysis and Design	(3-1-2)	6	5
ENVE 335	Optimization of Environmental and Energy Systems	(3-1-0)	4	4
ENVE 303	Energy and Environmental Technologies	(1-0-3)	4	4
ENVE 311	Air Pollution	(2-1-0)	3	4
ENVE 324	Unit Operations for Water and Wastewater Treatment	(2-1-4/2)	5	4
ENVE 331	Hydrology	(2-1-0)	3	4
ENVE 162	Geodesy	(1-0-3/2)	3	5
ENVE 340	Field Studies I	-	-	-
ENVE 346	Internship*			5
ECTS Total				**30**

* The ECTS are not accounted for in the final grade.

7th Semester courses (EnvE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
ENVE 338	Municipal Solid Waste: System Management and Design	(3-1-2/2)	5	5
ENVE 437	Chemical Processes for Water and Wastewater Treatment	(2-1-4/2)	5	6
ENVE 421	Applications in Environmental Modelling	(2-1-0)	3	5
ENVE 442	Biological Processes in Wastewater Treatment	(3-0-2/2)	4	5
ENVE 433	Hydraulics II	(0-0-3)	3	5

Elective Courses (1 out of 4 available)

ID	Elective Courses	(T-E-L)	H	ECTS
CHENVE 401	Environmental Catalysis	(2-1-0)	3	4
ENVE 417	Health and Safety at Work	(3-0-0)	3	4
ENVE 451	Agricultural Engineering Systems	(2-1-0)	3	4
ENVE 419	Engineering Seismology and Seismic Norms	(3-0-0)	3	4
ECTS Total				**30**

8th Semester courses (EnvE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
ENVE 554	Design of Chemical and Environmental Plants and Environmental Impact Assessment I	(2-2-1)	5	6
ENVE 444	Renewable Energy Sources	(3-1-0)	5	5
ENVE 432	Groundwater flow and Contaminant Transport	(3-1-2/2)	5	5
ENVE 338	Treatment and Management of Toxic and Hazardous Waste	(3-1-2/2)	5	5
ENVE 531	Design of Hydraulic Structures	(2-1-0)	3	3
ENVE 430	Field Studies II	-	-	-

Elective Courses (2 out of 5 available)

ID	Elective Courses	(T-E-L)	H	ECTS
ENVE 441	Strategic Management and Innovative Entrepreneurship	(2-2-0)	4	3
PEM 433	Small & Medium Enterprises (SMEs) and Innovation	(3-0-0)	3	3
ENVE 452	Gas-emissions Treatment Technology	(3-0-0)	3	5
ENVE 436	Water Resources Management	(2-0-2/2)	3	3
ENVE 545	Buildings' Energy Efficiency	(2-1-0)	3	3
ECTS Total				**>=30**

9th Semester courses (EnvE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
CHENVE 501	Environmental Legislation II - Introduction to Public Works Law	(3-0-0)	3	5
ENVE 555	Design of Chemical and Environmental Plants and Environmental Impact Assessment II	(2-2-1)	5	15
ENVE 512	Ecological Engineering and Circular Economy	(2-1-0)	3	5

Elective Courses (1 out of 6 available)

ID	Elective Courses	(T-E-L)	H	ECTS
ENVE 501	Fundamental Principles and Applications of Aerozol science	(2-1-0)	3	5
ENVE 446	Biological Methods for Environmental Remediation	(2-1-0)	3	5
ENVE 537	Indoor Air Quality	(2-1-0)	3	5
ENVE 535	Coastal Engineering	(2-1-0)	3	5
ENVE 541	Risk Analysis	(2-1-0)	3	5
ENVE 511	Design of Energy Systems	(2-1-0)	3	5
ECTS Total				**30**

10th Semester courses (EnvE)				
ID	**Required Courses**	**(T-E-L)**	**H**	**ECTS**
	DIPLOMA THESIS			30
ECTS Total				**30**

IV.1 Course description

1st Semester

Required Courses

[ENVE 113] INTRODUCTION TO CHEMICAL AND ENVIRONMENTAL ENGINEERING

•Definition of the Science of Chemical Engineering. Knowledge and skills, activities and professional rights. The Chemical and Energy Industry in the light of sustainability and a clean environment: Development of non-polluting industrial processes and technologies, energy saving technologies, minimal carbon footprint and materials recycling technologies. •Methodology of modeling physicochemical phenomena, the concepts of physicochemical and mathematical models, Sources of mathematical model equations (conservation equations of mass, energy, momentum, electric charge and state equations). Integral and differential methods for experimental measurements processing. •Mass balances of chemical components in simple reactors. The concepts of chemical equilibrium and steady-state. Steady-state and dynamic behavior of a simple system. The Scale-Up concept in industrial processes. •Dimensional Analysis Methodology. Basic dimensionless numbers in Chemical Engineering (Reynolds, Froude, Sherwood, Thiele, Damköhler, Biot, Arrhenius). Procedure for extracting semi-empirical state equations (Bunkinham theorem). •Introduction to Environmental Engineering Science. Historical data, knowledge and skills, subject of work, professional rights. Environmental problems and causes. Sustainable development. Environmental legislation. Environmental ethics. European Environment Agenda. Nature-based solutions. •Overview of environmental systems - ecosystems - biodiversity. Conservation of natural resources. Hydrological cycle. Water resources, watersheds, least squares method. Water pollution. Water and wastewater treatment technologies. Reuse of processed outputs. •Climate change and air pollution. Greenhouse effect. Particulate pollutants and technologies for the treatment of gaseous pollutants. Renewable energy sources. Carbon footprint. •Solid and hazardous waste: collection, recycling, composting, landfill, incineration, energy production. Environmental Economics, Environmental Policy, Circular Economy. •Metric systems, units of measurement and unit conversions. Writing scientific reports: structure and organization, use of Word-Excel-Powerpoint. Scientific information: search of scientific literature, ways of referring bibliography. •Short Presentation Seminars for the research of the faculty members / laboratories of the School. •Short Seminars for the presentation of the research of the faculty members / laboratories of the School. •Short Seminars for the presentation of the research of the faculty members / laboratories of the School. •Short Seminars for the presentation of the research of the faculty members / laboratories of the School.

[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.

[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 132] GENERAL CHEMISTRY

A. Theory: •Introduction to Chemistry •Atoms, molecules and ions •The quantum-mechanical model of the atom •Periodic table and periodic properties of the elements •Chemical bonding and molecular geometry •Stoichiometry and chemical reactions •Energy and thermochemistry •States of matter and intermolecular forces •Chemical kinetics •Chemical equilibrium •Acids, bases, and acid-base equilibria •Solubility and complex-ion equilibria •Chemical thermodynamics, entropy, and free energy •Electrochemistry

B. Laboratory experiments: •Measurements and calculations in Chemistry: measurements and significant figures, SI units, experimental errors, precision and accuracy •Safety in the chemical laboratory, safety of the chemical reagents, laboratory apparatuses and instruments. Measurement of mass and volume, calculation of the density of metals and alloys •Determination of the average atomic mass of an element •Solutions: expressing solution concentration, preparation of solutions of a certain concentration by weighing and dilution •Molecular geometry of covalent molecules •Stoichiometry of chemical reactions •Thermochemistry •Methods for the separation of mixtures: distillation, filtration, centrifugation, drying, crystallization, thin layer chromatography •Chemical kinetics •Chemical equilibrium •Measurement of the pH of aqueous solutions, determination of the ionization constant of a weak acid, titration of a strong acid with a strong base •Buffers: preparation of aqueous buffer solutions and study of their buffer capacity •Redox reactions and electrolysis of water

[ENVE 100] 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 112] ECOLOGY AND INTRODUCTION TO TECHNICAL 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)

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

Required Courses

[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 126] 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.

[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.

[CHENVE 101] O

RGANIC CHEMISTRY

A. Theory: Introduction to Organic Chemistry: structure and bonding of organic compounds •Alkanes and cycloalkanes •Stereochemistry at tetrahedral centers •An overview of organic reactions •Alkenes: structure, and reactivity •Alkynes: structure, preparation and reactivity •Alkyl halides: structure, preparation and reactivity with emphasis on substitution and elimination reactions •Structure determination of organic compounds: mass spectrometry, infrared spectroscopy, nuclear magnetic resonance spectroscopy and ultraviolet spectroscopy •Benzene and aromatic compounds: structure, aromaticity and electrophilic aromatic substitution reactions •Alcohols, phenols, ethers, epoxies, thiols and sulfides: structure, properties, preparations and reactivity •Aldehydes and ketones: structure, preparations and nucleophilic addition reactions •Carboxylic acids and their derivatives: structure, preparations and nucleophilic acyl substitution, alpha-substitution and carbonyl condensation reactions •Amines and heterocyclic compounds:

structure, basicity and reactivity •Biomolecules: carbohydrates, amino acids, peptides, proteins, lipids and nucleic acids •Synthetic polymers

B. Laboratory experiments: •Isolation of caffeine from coffee beans and tea leaves •Preparation of aspirin (acetylsalicylic acid) •Isolation of the active ingredient in an analgesic drug •Esterification: Preparation of esters with fruit aromas (aroma of orange, apple, banana, peach, pear and pineapple) •Essential oils: extraction of oil of cloves by steam distillation •Isolation of chlorophyll and carotenoid pigments from spinach. Column chromatography and thin layer chromatography •Alcoholic fermentation: preparation of ethanol by fermentation of sugars and purification by fractional distillation •Saponification: preparation of soap from vegetable oils •Alkyl halide reactivity in nucleophilic substitution reactions •Preparation of biodiesel from vegetable oils •Synthetic dyes: preparation of methyl orange and indigo blue. Dyeing of fabrics and formulation of a paint suitable for painting •Synthetic polymers and plastics: preparation of a polyester and a polyamide (nylon).

[CHENVE 102]

MASS AND ENERGY BALANCES

•Introductory concepts and definitions. •Material balances without reaction. •Material balances involving reactions and material balances for multi-unit systems. •Ideal and real gases, vapors and liquids and multiphase equilibrium. •Energy and energy balances – energy balances in systems involving chemical reactions. •Humidity (psychrometric) charts and their use •Analysis of the degree of freedom in steady-state processes. •Heats of solution and mixing. •The mechanical energy balance. •Material and energy balances. •Unsteady-state material and energy balances.

[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.

[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.

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.

3^{nd} Semester

Required Courses

[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 DIFFERANTIAL 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

[MECH 201] ENGINEERING MECHANICS-STRENGTH OF MATERIALS

Theory: 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.

Laboratories: 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.

[ENVE 133] 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 (Erase, Copy, offset, Fillet, Chamfer, move, Trim, Extend, Lengthen) • Object editing commands (Scale, Stretch, Rotate, array, mirror, explode) • Grips (controls) • Dimensions • Marking • Insert text • Layers • Insert Block

[CHENVE 201] ENVIRONMENTAL LAW I

Introduction to Law. Basic categories of Law. Basic notions of public and private law, of public international law and of European Union (EU) Law. Legislation and case law. Legal research databases (legislation and case law) [1st and 2nd lectures] • Objectives, main purpose, characteristics and branches of Environmental Law (International, EU, national). Sources and historical development of Environmental Law [3rd lecture] • Tools and mechanisms of direct and indirect State intervention in the field of Environmental Law. Hard law and soft law environmental regulation. Examples of indirect State intervention (environmental agreements, environmental taxes and fees, environmental liability, eco-label, EU eco-management and audit system (EMAS), environmental inspections) [4th-6th lectures] • The concept of environmental risk - risk assessment tools – risk management examples: genetically modified organisms, exposure to electromagnetic radiation, exposure to chemicals [lecture 7] • International environmental law. General principles and international agreements. Key international environmental conventions, focusing on the issues of Biological Diversity, climate change and landscape [8th and 9th lectures] • Environmental protection in EU law. Historical evolution. Sources and principles of EU environmental law. The role of European Court of Justice (ECJ) in the protection of the environment – Highlights of ECJ Judgments [10th lecture] • Horizontal environmental EU directives (right to information - integrated pollution prevention and control - environmental liability) [11th lecture] • Major areas of environmental policy (climate change - industrial emissions and accidents - environmental impact assessment - waste management – Habitats conservation, Natura 2000 network - Water Framework Directive

2000/60) [12th lecture] • Sustainable development (historical evolution - sustainable development in international and EU legal documents) [13th lecture]

1 out of 2 foreign languages

[LANG 201] ENGLISH III

Terminology for Chemical and 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 202] 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.

Elective Courses (1 out of 4 Social Sciences Courses)

[SSCI 101] SOCIOLOGY

The course is an introduction to Sociology, with a detailed and synthetic study of concepts that relate to key elements of the social context in which the productive activity of man takes place. Concepts such as: society, social positions and roles, social change, social stratification and mobility, social categories and classes, socio-political institutions, socio-economic institutions and transformations are examined.

[SSCI 203] PHILOSHOPHY AND HISTORY OF SCIENCE

Science as: intellectual acquisition of reality and social cultural phenomenon • The place and role of science in the structure and development of society • Issues of theory of knowledge, logic and methodology in scientific research • Science in history • Differentiation, integration of sciences and interdisciplinarity • Innovations 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 milestones in the history of the individual sciences (astronomy, logic, mathematics, physics, etc.) and related philosophical theories. B) Basic theoretical currents and individual trends in the philosophy and history of science, from logical empiricism onwards (R. Carnap, K. Popper, T.S. Kuhn, I. Lakatos, P. Feyerabend, A. Koyre, G. Bachelard, G. Canguilhem, L. Geymonat, E. Bitsaki).

[SSCI 301] ART AND TECHNOLOGY

Historical-sociological approach to the relationship between Technology and Art, Technology and Culture. In particular, the historical conditions in which the separation of Art and Technology took place are examined. Concerns are being raised about the current possibilities for their unification or harmonious cooperation. The development of new technologies in the context of the current socio-economic formation, its implications in the field of art and culture, the needs that are deleted in the field of know-how for the better control of (new) technologies are examined.

Technology and art, as types of creative activity, in the structure and development of society. Technology as: objectification, framework of human influence in nature and relations between people, pre-conception-knowledge and instrument of influence in nature. The aesthetic as: a form of consciousness and specialized engagement in the division of labor (art). Basic aesthetic categories. Social functions of art. Art and technology in the history of civilization. The non-existence of the metaphysical contrast of emotion and logic, "Apollonian" and "Dionysian". The synthetic dimension of creativity.

[SSCI 201] MICRO-MACRO ECONOMIC ANALYSIS

Introduction to Economics - Historical evolution, markets • Demand and Supply Analysis, Consumer Theory • Production cost and Theory of the firm • Pricing and market organization • Consumer and producer surplus, economic welfare. External economies and diseconomies • Alternative approaches to the economic science • Macro-economics, income and employment, Consumption, Savings, investments • Monetary markets

4nd Semester

Required Courses

[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

[ENVE 336] NUMERICAL ANALYSIS

Errors • Numerical solution of non-linear equations • Interpolation and polynomial approximation • Numerical differentiation and integration • Approximation theory • Numerical methods for initial-value and boundary-value problems for ordinary differential equations • Applications in environmental engineering.

[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.

[ENVE 212] INSTRUMENTAL CHEMICAL ANALYSIS

Lectures: •Introduction to instrumental chemical analysis. •Chemical Characteristics of Samples. •Principles of Green Analytical Chemistry •Statistics and data management. Quality assurance and method validation •Calibration of instruments •Spectrochemical Methods •Atomic Spectrometry Methods •Sampling strategies. Sample preparation methods •Chromatography: Basic Principles and Theory •Gas Chromatography •Liquid Chromatography and Electrophoresis •Mass spectrometry •Automation in measurements

Laboratory exercises: •Laboratory safety, basic measurements, preparation of solutions •Determination of TSS, TDS, conductivity, salinity, BOD, COD •Generation of a spectrophotometer calibration curve. •Determination of trace amounts of polycyclic aromatic hydrocarbons in liquid samples using gas chromatography •Determination of water octanol distribution coefficients using liquid chromatography •Determination of metals in solid samples using ICP / MS

[CHENVE 202] TRANSPORT PHENOMENA I

•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.

[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

1 out of 2 foreign languages

[LANG 202] ENGLISH IV

Terminology • 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-Chemical 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.

Elective Courses (1 out of 4 Social Sciences Courses)

[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

Economics is of great interest because it can provide valuable answers to how basic socio-economic problems should be addressed. It essentially helps us to understand capitalism.

It is distinguished in two basic schools of economic thought, the "Political Economy" or otherwise the "Three-Dimensional Approach to Economics" and the "Neoclassical Economics". The "three-dimensional approach to economics" focuses not only on market competition, like the second, but also on the concepts of mandate, power and historical change. This is an interdisciplinary approach.

The contrast between these two schools of economic thought, the description of the past and present of "Political Economy" (Adam Smith, Karl Marx, Joseph Schumpeter, John Maynard Keynes, Ronald Coase, Amartya Sen, etc.) the thorough development of its economic perceptions and its correlation with basic economic terminology, which relate to modern reality (GDP, public debt, international trade, inflation, money, economic fluctuations, economic growth and development, investment, trade, etc.).), is the dominant spirit of the course. This is an introductory approach to the subsequent teaching of microeconomic and macroeconomic theory courses.

Indicative concepts to be examined are the labor theory of value, surplus value and prices, the relationship between competition and distribution, the fundamental trends and contradictions of growth, the phenomena of economic crisis, classes and class relations, the "surplus" of production and profits, accumulation and change in American capitalism, wealth inequality and the future of capitalism.

[SSCI 202] HISTORY OF CIVILIZATION

Introductory remarks-methodological / etymological clarifications • Culture as a production of material values and spiritual values • The relationship between material-spiritual culture: contradiction and unity • The historicity of types of culture as a succession of ways of production • Transformations of family, state and society • Criteria Periodization • A Brief History of Culture: Antiquity, the Middle Ages, the Renaissance and the Transition to Modernity • Theoretical approaches to the History of Civilization: sociology, philosophy, social anthropology • Culture in modernity and postmodernity: the culture of civil society • Culture of the 21st century: 4th industrial revolution and cultural production, labor transformations and art-technology relationship.

[SSCI 302] INDUSTRIAL SOCIOLOGY

Industrial sociology is part of the Sociology of Labor and Development. This field of sociology appeared in its organized form in the 13th century and took off in the second half of the 19th century. The central core are the changes of the production systems and the branch of processing (handicrafts, industry), in combination with related branches of the productive as well as the scientific activity. It deals with the relations of people in industrial production and specifically in factories and companies.

The general objective of the course is the study of the operation, structure and evolution of industry, while giving special weight to the human relationships that develop in industrial units between employers, employees, managers, etc.

It raises questions about how the future of the labor phenomenon is being erased in view of the widespread use of new technology automation, whether the latter defines work and society or vice versa, whether the modern labor movement can influence developments and certainly for the role that sociology itself can play in the direction of explaining, analyzing and understanding the phenomena produced by the broader contemporary changes.

In summary, we would say that the course studies all social phenomena in an industrialized society.

Indicative concepts to be studied are: a) the historical evolution of work and its modern historical role, b) the concept of industrial sociology, c) the general theories of classical sociologists about work and organization, d) the scientific administration in human relations, e) modern theories of work and organization, f) metaphorism as an organizational and work model, g) work and social protection, h) work and organization in a potential environment.

5^{th} Semester (Chemical Engineering)

Required Courses

[CHENVE 301] CHEMICAL PROCESS ANALYSIS AND DESIGN I

Stoichiometry and kinetics of chemical reactions • Thermodynamics analysis of chemical reactions • The Arrhenius equation • Design of isothermal homogeneous chemical reactors (batch, CSTR, PFR) • CSTR reactors in series • Recycle PFR reactors • Design of non-isothermal homogeneous reactors • Non-ideal chemical reactors • Dynamic reactor response-residence time distribution function • Analysis of kinetic data from chemical reactors.

[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 443] SUSTAINABLE DEVELOPMENT & 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.

CHE 310] TRANSPORT PHENOMENA II

• Basic Principles of Heat Transfer, Similarities between Heat and Mass • Heat Conduction: Steady one-dimensional heat transfer - Heat transfer accompanied with heat production - Steady multidimensional heat transfer - Transient heat transfer • Convective Heat transfer: Heat convection in flows over bodies - Heat convection in pipes - Free convection - Condensation and evaporation - Heat Exchangers • Radiative Heat transfer: Basic principles of thermal radiation - Radiant heat exchange between surfaces.

[CHE 311] UNIT OPERATIONS I

• Introduction to separation processes (description and necessity) • DISTILLATION: Liquid-Vapor Equilibrium. Equilibrium diagrams, enthalpy-concentration diagrams. The Distillation Process. Fractional Distillation, Analysis and Design (McCabe-Thiele, Ponchon-Savarit graphical methods) • GAS ABSORPTION and GAS STRIPPING: Gas-Liquid equilibrium. Design elements of the absorption process. Analysis and Design of the Absorption Process. Absorption columns based on mass transfer rate – Packed Columns with inert materials. Analysis and design of the process of desorption, depletion or stripping (gas stripping) • LIQUID-LIQUID EXTRACTION: Liquid-liquid equilibrium and triangular coordinates/diagrams. General elements and design considerations of the Extraction process. Graphical methods of process design and analysis: Hunter-Nash, McCabe-Thiele and Varteressian-Fenske methods • ADSORPTION: Fluid-solid equilibrium. Langmuir, Freundlich, Temkin and Brunauer-Emmett-Teller (BET) isotherms. Dynamic behavior and basic principles of the Adsorption process. Process Analysis and Design.

[CHE 315] PROCESS DYNAMICS AND CONTROL

Introduction to process dynamics and automatic control-Basic concepts. •Description of mathematical methods for the analysis of dynamic systems (exponential matrix method, Laplace transforms method, Transfer function, Frequency response calculation. Bode diagrams, Lyapunov's method). •Dynamic response of physical systems. First-order systems, Second-order systems, Higher-order systems. •Dynamic analysis of non-linear systems. •Feedback control systems. PID controllers. Closed loop systems. •Dynamic systems optimization. •Analysis and design of control systems.

Elective Courses (1 out of 2)

[CHE 313] ADVANCED TECHNOLOGIES FOR ENERGY PRODUCTION AND STORAGE & ENERGY CYCLES

•Comparison of power generation systems. Energy, environmental, economic criteria. Definitions (primary, final energy). Electricity and heat transmission systems. High, medium, low voltage. District heating • Classification of storage systems (use, systems classification). Demand for storage in buildings, transport and chemical industry (energy and fuel supply, design change) • Electricity storage (Capacitors - Supercapacitors, superconducting electromagnetic storage systems). Electrochemical systems (lead-acid, nickel, lithium, sodium-sulfur, redox batteries). Chemical storage (electrolysis, methanization and chemical synthesis, gasification, liquefaction) • Mechanical storage (gases, liquids, solids). Flywheel installations. Reverse pumping systems • Heat storage technologies (sensible and latent heat storage, thermochemical-thermal storage, thermophysical properties and material requirements) Thermochemical storage (materials, design) • Systems comparison. Overview of technical and financial parameters. Comparison of costs, efficiency levels and energy cycles.

[CHE 314] POLYMERS AND MACROMOLECULES SCIENCE AND TECHNOLOGY

• Introduction to the science of polymers and macromolecules. Nomenclature of macromolecules. Types and degree of polymerization. Molecular weight distributions • Step-growth polymerization. Chemistry and kinetics of step-growth polymerization reactions (polymerization rate equations, molecular product distribution) • Chain-growth polymerization. Chemistry and kinetics of polymerization chain reactions (polymerization rate equations, degree of polymerization, kinetic constant). Effect of monomer chemical composition, primers, chain reaction retardation / inhibition, catalysis • Copolymerization. Chemistry and kinetics of copolymerization reactions. Ideal copolymerization, azeotropic copolymerization, alternating copolymerization • Polymer characterization techniques (osmometry, viscometry, gel chromatography) • Polymer solutions. Phase equilibria, solubility, binary systems, stability conditions • Melting and crystallization of polymers, thermodynamics and kinetics of crystallization of polymers. Glass polymers. Glass transition • Mechanical properties. Elastomeric polymers • Polymer rheology. Polymer molding processes.

[ENVE 332] METEOROLOGY AND CIMATE CHANGE

•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.

6^{th} Semester (Chemical Engineering)

Required Courses

[CHENVE 302] BIOCHEMICAL PROCESS ANALYSIS AND DESIGN

• Elements of microbiology and biochemistry •Kinetics of enzymatic reactions •Kinetics of reactions with immobilized enzymes •Kinetics of microbial growth •Kinetics of production of metabolic products •Mathematical simulation models •Design of classical bioreactors (batch, fed-batch, CSTR) •New generation bioreactors (Perfusion, Airlift, SBR, hollow-fiber, MBR, MBBR) • Aeration and agitation of bioreactors •Sterilization •Applications in industrial and environmental processes

[ENVE 335] OPTIMIZATION OF ENVIRONMENTAL AND ENERGY SYSTEMS

Introduction to Optimization Theory (Introduction, Optimization Model Classification, Nonlinear Optimization, Hollow Sets and Functions, Mathematical Optimization Theorems, Mathematical Optimization Problem Geometry) • Classical Optimization (Unlimited Optimization Problems, Lagrange Multipliers) • Linear Programming (Optimization in Linear Programming Problems, the Simplex Method) • Non-linear programming (Introduction, Unlimited Optimization Methods, Restricted Optimization Methods, Dynamic Programming) • Dynamic Programming (Introductory) (Introductory Fuzzy Logic, Neural Networks) • Advanced Methods Of Optimization (Genetic algorithms, Fuzzy Logic, Neural Networks) • Matlab applications

[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)

[CHE 312] MATERIAL SCIENCE AND TECHNOLOGY

• The concept of “material”; atomic structure and bonds; crystalline and amorphous structure • Mechanical properties; defects and reinforcing mechanisms; failure and ultimate properties • Phase diagrams of metals and microstructure development; metal alloys • Structure, properties and processing of ceramics • Structure properties and processing of polymers • Composites • Material selection for the design and manufacturing of products.

[CHE 316] WASTEWATER TREATMENT

Qualitative and quantitative characteristics of wastewater •Physical, chemical and biological processes in wastewater treatment •Preliminary treatment of wastewater •Primary wastewater treatment •Secondary wastewater treatment •Advanced wastewater treatment •Disinfenction •Water recycling •Treatment and management of sludge •Current trends in wastewater treatment

[CHE 402] PHYSICAL CHEMISTRY II

•Chemical kinetics and rate equations of chemical reactions. The necessity of rate equations in the design of chemical reactors. Order and stoichiometry of chemical reactions. The reaction rate constant. Analysis of reaction rate equations of 0^{th}, 1^{st}, 2^{nd}, •v-order reactions. Reaction's time. •Dependence of the kinetic constant on the temperature. Arrhenius equation, Collision theory, Activated-complex theory. •Reaction mechanism and rate-determination step. Relationship between kinetic equation and mechanism. •Kinetic equations from experimental kinetic data conducted in batch reactors. •Kinetic equations from the reaction mechanism: reversible, parallel, consecutive reactions. •Complex mechanisms and the steady-state (or unstable intermediate) approximation. Kinetic equations of homogeneous and heterogeneous reactions. Langmuir-Hinshelwood, Eley-Rideal and Mars van Krevelen heterogeneous reaction mechanisms •Kinetic studies of reactions in flowing systems (experimental CSTR reactors and differential plug flow reactors). •Introduction to Electrochemistry. Electrochemical equilibrium and electrochemical kinetics. •Charge transfer reactions. Anodic and Cathodic currents. Electrosynthesis and electrolysis. Faraday's Law. •10. Electrochemical bilayer. Electrode and electrochemical element dynamics. Potential change. Polarizable and non-polarizable electrodes. •Electrochemical equilibrium. Nernst's equation •Electrochemical kinetics. Overpotentials and causes of overpotentials. Butler-Volmer equation. Tafel equation. Fuel cells, Batteries, Electrolytic cells - General description and applications.

[CHE 318] CHEMICAL AND TECHNICAL THERMODYNAMICS

Equilibrium and stability • Ideal Gas Mixtures • Properties of Homogeneous Mixtures• Intermolecular forces and Equations of State for Mixtures • Fugacity in mixtures • Activity coefficient models • Liquid-gas phase equilibrium• Liquid-liquid phase equilibrium • Chemical reactions- Combustion • Chemical equilibrium

[ENVE 340] FIELD STUDIES I

The course includes practical training of students in topics related to the courses taught during the 2nd and 3rd year of the Curriculum. Specifically, they include environmental applications of Thermodynamics, e.g. environmentally friendly thermodynamic cycles, solar thermal systems, wind energy systems. Also desertification phenomena, highlighting the phenomenon and studying ways to avoid it.

[ENVE 346] INTERNSHIP

The Internship at Technical University of Crete is implemented within the framework of the funding project PA and it is an elective course in the curriculum of the School of Chemical and Environmental Engineering, but without any grade. 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. 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).

7th Semester (Chemical Engineering)

Required Courses

[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.

[CHENVE 401] ENVIRONMENTAL CATALYSIS

Part 1: • Introduction to homogeneous and heterogeneous catalysis, basic types of solid catalysts and photocatalysts, evaluation of catalytic properties, desired characteristics. •Basic mechanisms of catalytic and photocatalytic reactions. •Kinetics of catalytic reactions. •Synthesis and characterization methods of catalysts. •Adsorption and (photo) catalytic processes as anti-pollution technologies. •Catalytic processes for the control and treatment of gaseous emissions (NOx, SOx, CH4, CO, VOCs). •Catalytic processes for the production of clean energy.

Part 2: •Introduction to photochemical processes. •Photosynthesis. •Homogeneous photocatalysis. •Heterogeneous photocatalysis for hydrogen production. •Heterogeneous photocatalysis for the removal of pollutants in the gas phase and the reduction of CO2. •Heterogeneous photocatalysis for the removal of pollutants in the aqueous phase.

[CHE 317] CHEMICHAL PROCESS DESIGN AND ANALYSIS II

• Heterogeneous catalysis and catalytic materials. Production methods. Textural, morphology and physicochemical characterizations of catalytic materials. •Physical adsorption/desorption and chemisorption. Isotherms. •Heterogeneous catalytic reactions – Mechanistic/kinetic models and rates of fluid-solid catalytic reactions. •Bench scale catalytic reactors and kinetic data acquisition. Kinetic data analysis and quantitative interpretation. Intrinsic kinetics/activity. •External mass and heat transport processes in heterogeneous catalytic reactions – Interaction with intrinsic kinetics. •Internal transport properties (mass diffusion and intrapellet heat transfer) within porous catalysts – Interaction with intrinsic kinetics. •Overall interaction of external mass transfer, internal diffusion and intrinsic activity in catalytic pellets. Global pseudo-homogeneous rates and Effectiveness factors of industrial heterogeneous catalysts. •Kinetics data evaluation. Criteria for determining the influence of mass and heat transfer constrains on catalysts' global rate and effectiveness factor. •Catalysts deactivation. •Design of heterogeneous catalytic reactors: Fixed bed, fluidized bed, slurry and trickle-bed reactors.

[CHE 403] NANO-METARIALS AND NANO-TECHNOLOGY

• Introduction – Definitions Nanomaterials and Nanotechnology -Nanomaterials classification •Synthetic methods for materials preparation in nano dimensions: introduction, ceramic methods (solid state reactions), microwave synthesis, sol-gel method, template method («chemical engineering»), precursor method, hydrothermal methods, chemical vapour deposition (CVD), vapour phase epitaxial growth (VPE), molecular beam epitaxy (MBE), chemical vapour transport (CVT), intercalation reactions, Langmuir-Blodgett method, Method selection rules. •Carbon nanostructured materials: fullerenes, carbon nanotubes, graphene, graphene oxide, carbon nanodiscs, carbon nanodots, mesoporous carbons, carbon cuboids, hierarchical porous carbons, etc. •Mesoporous materials: Introduction –classification of porous materials, mesoporous silica materials (MCM-41, SBA-15), periodic mesoporous organosilicas (PMOs), ordered porous carbons OPCs (CMK-3 & 3DOM/m), metal organic frameworks (MOFs), covalent organic frameworks (COFs). •Zeolites and other microporous materials: classification of silicate materials, structure, properties, synthesis, reactions, applications. •Clays and layered double hydroxides (LDH): structure, properties, reactions, applications, pillared clays, clay/polymer nanocomposites. •Other layered (2D) materials: germanane, silicene, transition metal dichalcogenides (TMDs), MoS2, fluorographene, hBN ('white graphene') MXenes, 'black phosphorous', etc •Nanoparticles (ceramic, metallic, semiconducting, catalytic, polymeric, carbon-based, lipid-based): classification, properties, applications, preparative methods, characterization, health and safety Applications for: (a) Hydrogen technologies: hydrogen storage materials, fuel Cells, water splitting, (b) Biomimetic materials and biocatalysis: biomineralization, biomimetic principles of materials chemistry, enzyme immobilization on nanomaterials, (c) Medical uses of nanostructured materials: materials for Drug Delivery, Detection, Imaging, Hyperthermia.

Elective Courses (2 out of the 3)

[CHE 404] BIOMEDICAL TECHNOLOGY I

•Basic properties of cells and cell types, cell cultures, tissues, organs and anatomy in mammals, with emphasis on humans. •Main physicochemical factors required for normal function in mammals, with emphasis on humans, and ways to control them in vivo and in vitro. •Biological signals. •Introduction to biomedical equipment and measurements. •General characteristics of measurement systems. •Input - output signal converters. •Analog - digital electronics, Conductors, Insulators, Semiconductors. •Basic electronic devices. •Electrical safety. •Special electronic devices (nuclear electronics, Laser, Optronics, etc). •Introduction to nanotechnology. •Introduction to the management of biomedical technology.

[CHE 405] FOOD TECHNOLOGY

•Introduction to food technology •Physical, biochemical and microbiological properties of food materials •Basic principles of heat and mass transfer, •Elements of process control •Size reduction, mixing, filtration •Membrane processes, centrifugation, ion exchange •Spoilage and preservation of foods •Thermal processes, methods and equipment •Food packaging, disinfection, sanitation.

[CHE 406] ENVIRONMENTAL CHEMISTRY

Introduction to Environmental Chemistry

Part A: The Earth's atmosphere •The Earth's atmosphere •Stratospheric chemistry – ozone •Tropospheric chemistry – smog and precipitation •The chemistry of climate change

Part B: The hydrosphere

•The hydrosphere and the distribution of chemical species in aquatic systems •Gases in water •Natural and synthetic organic matter in water •Metals and semi-metals in the hydrosphere •Chemistry of colloids and surfaces • Water pollution and water treatment chemistry

Part C: The terrestrial environment

•The terrestrial environment and soil properties •The chemistry of solid wastes •Epilogue: The future Earth

8^{th} Semester (Chemical Engineering)

Required Courses

[ENVE 554] DESIGN OF CHEMICAL AND 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

[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 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

[CHE 407] TECHNICAL AND ECONOMIC PROCESS FEASIBILITY STUDY

•ntroduction to techno-economic evaluation •General design notions •Process design development, flowsheet synthesis •Heuristics for process equipment design, energy management and savings •Software use in process design •Analysis of cost estimation •Interest, time value of money •Profitability, alternative investments and replacements •Optimum design and strategy

[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 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.

[PEM 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 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.

[CHE 408] BIOMATERIALS AND BIOPLASTICS

• Introduction to biomaterials, biological response to biomaterials, types of biomaterials, •Processing and testing of biomaterials, important properties of biomaterials •Polymers and hydrogels, smart polymers •Chemical structure of biomaterials: crystal structure, point defect and diffusion of metals and ceramics, •Structure and synthesis of polymers, methods of polymerization, copolymer, material characterization techniques, X-ray diffraction. •Physical properties of biomaterials: crystallinity, linear, planar and volume defects, polymer crystallinity, thermal transitions of crystalline. •Mechanical properties of biomaterials: mechanical testing, hardness impact tests, fracture fatigue). •Degradation of biomaterials: corrosion/degradation of metals and ceramics, corrosion control, degradation of polymers, biodegradable materials. •Surface properties of biomaterials: Surface modification techniques, biological surface modification techniques, surface properties. •Biocompatibility, Biological testing of biomaterials, proteins on biomaterials, non-fouling surfaces •Biological response to biomaterials, inflammation and immunity •Applications of biomaterials (All throughout the course): drug delivery, tissue engineering, cardiovascular, orthopedic, dental, functional tissues, etc.)

[CHE 409] SOLID SATE PHYSICS AND SURFACE SCIENCE

•Solid surfaces and interfaces - introduction. The need for ultra-high vacuum for the study of individually clean surfaces - introduction to vacuum technology. •Surface chemical analysis. • Introduction to the main spectroscopic methods of chemical characterization of solid surfaces. •Atomic structure of solid surfaces - crystal structure elements in two dimensions. Determination of structure by electron diffraction and scan microscopy techniques. •Electronic properties of solid surfaces. •Metal-semiconductor surfaces. • Diffusion. Surface melting. •Adsorption processes on solid surfaces. Preparation and characterization of thin films - epitaxy.

[CHE 502] BIOMEDICAL TECHNOLOGY II

• Biomedical equipment & measurements. •Electrodes and sensors. •Bio-electric amplifiers, signals and noise. •Electrocardiograms. •The human respiratory system and its measurement. •The human nervous system and instruments for measuring brain function. •Medical ultrasound scans. •Radiology and nuclear medicine. •Electromagnetic interference in medical electronic equipment. •Medical bioinformatics – Auto diagnosis and Technologies. •Maintenance of medical equipment.

9th Semester (Chemical Engineering)

Required Courses

[CHENVE 501] ENVIRONMENTAL LEGISLATION II – INTRODUCTION TO PUBLIC WORKS LAW

• Introduction and connection to the 3rd semester compulsory course entitled "Environmental Law I". Environmental protection in domestic law. Sources of the Hellenic Environment Law. Constitutional protection of the environment (Article 24 of the Hellenic Constitution 1975/1986/2011/2008/2019). Constitutional protection of natural and cultural environment (Article 24 par. 1 and 6 of the Constitution). Constitutional protection of forests (Articles 24 par. 1 and 117 par. 3 & 4) [1st-3rd lecture] • The provision of Article 24 par. 2 of the Hellenic Constitution as regards the master plan of the country, and the arrangement, development, urbanisation and expansion of towns and residential areas in general [lecture 4th]. • The content and characteristics of the right to the environment. The environmental trial. Locus standi in environmental litigation. Examples from representative environmental cases [5th lecture] • The protection of the environment in domestic common legislation. The Act 1650/1986 as in force. Structure and topics of Act 1650/1986. The current system of spatial planning in Greece (Special and Regional Spatial Frameworks. Examples) [6th lecture] • The Administrative Organization of Environmental Protection in Greece [7th lecture] • Tools and mechanisms of direct State intervention for the protection of the environment. Administrative and environmental licensing. The environmental impact assessment process. EU directives and national implementation legislation. Environmental Impact Assessment and Strategic Environmental Assessment. Principles, mechanisms and tools [8th lecture] • Content and stages of environmental licensing. Representative case studies [9th lecture] • Case study "The Renewable Energy Sources (R.E.S.)": interaction of International, EU and domestic legislation and case law [10th lecture] • Introduction to Public Works legislation. Procedures regarding the award and execution of Public Works. Legislative framework for the public procurement. Harmonization of Greek legislation to the EU directives. Law 4412/2016 and recent amendments. Award criteria. Execution of Public Works. Public Works dispute resolution procedures [12th and 13th lectures].

[ENVE 555] DESIGN OF CHEMICAL AND 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.

[CHE 501] FUEL AND LUBRICANTS TECHNOLOGY

• Introduction to Fuel and Lubricant Technology. Various lubricant types, classification and properties. •Complete and incomplete combustion, calorific value, degree of efficiency. Liquids, gases and solid fuels. Fuel quality assurance. Evaluation procedures for fuel additives. Uses and applications. •Liquid fuel upgrade processes (oxidative desulphurisation, solvent extraction). •Crude oil and crude oil products. Production, composition, properties, evaluation, environmental impacts and problems arising from their use. •Diesel and heating oil. Composition, production and treatment processes. •Gasoline. Production, composition, properties, additives, mixing, environmental effects and problems arising from its use. • Shipping and Aircraft Fuels: Production, composition, properties, specifications, environmental impacts and problems arising from their use. •Biofuels. Raw materials, production, classification, composition and evaluation. Use of alternative fuels in internal combustion engines. Biodiesel and its production processes. Bioethanol and its derivatives, production processes, use as a component of gasoline. Biogas and its production processes. •Lubricants. Types, classification, properties, use, environmental impacts resulting from their use. •Mineral oils. Composition, production and refinement. •De-paraffin of lubricants. •Mixing, control and testing of lubricants. •Management of used lubricants

Elective Courses (1 out of 3)

[CHE 503] BIOREFINERIES AND CIRCULAR ECONOMY

•Introduction to Biorefineries and to integrated biomass management. Examples of 1st, 2nd and 3rd generation Biorefineries. •Separation processes used in Biorefineries. Introduction to the most important separation processes used in Biorefineries: Extraction, adsorption, floatation, ion exchange, distillation, membrane separation. •Forest Biorefineries. Management of woody biomass, production of high added value products. •Olive tree biorefinery. •Recovery of heavy metals from industrial and municipal wastewaters. •Sustainable Recovery of Energy from Waste in a Recycling Society. Optimization of Waste Management in Sustainable Resource Recovery (energy and materials)-Environmental Sustainability of Thermal Treatments. •Liquid biofuels - Biodiesel. Energy crops. Agro-industrial complex to liquid biofuels. Various energy sources. Transformation processes to biodiesel. Homogeneous-Heterogeneous- Enzymatic catalysis. Other production processes. •Bioethanol. Environmental assessment of biofuels. 2nd generation biofuels. Raw material to bioethanol. Biofuels Life Cycle Assessment. •3rd generation biofuel

[CHE 504] NATURAL GAS – BIOGAS - HYDROGEN TECHNOLOGIES

•Production, purification, transportation, and storage of Natural Gas. Fluid dynamics for piping and pump design. Liquid/gas flow patterns in pipeline networks. •Production and treatment on Biogas. Strategies for biogas fluid flow in the gas pipes. •Biogas and natural gas refinery and valorization (reforming, fuel cells, syngas, etc.). •Hydrogen: Properties, transportation, storage. •Hydrogen production: Technological advancements (electrolysis, hydrocarbon reforming, electrochemical conversion). •Power-to-gas technologies in emerging electrical systems. •Hydrogen fuel cells, Fuel cell electric vehicles (FCEVs) combined hydrogen, hydrogen fuel cell cars.

[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.

[CHE 410] METALLURGICAL PROCESSES να γίνει έλεγχος

Metallurgical Processes in Metals and Ceramics Production Energy and mass balances, basic metallurgical processes, reactor design, optimal metallurgical techniques in pyrometallurgy, hydrometallurgy and bio-hydrometallurgy, waste minimisation, structure and properties of ceramics (atomic arrangement, crystal structures, structural defects - phase diagrams), production process - forming methods - classification (traditional - advanced) - applications in metallurgy. Tutorial exercises. Laboratory exercises: 1. Liquid Casting, 2. Mixing-Extrusion, 3. Flame sintering - Measurement of Shrinkage, 4. Hg Porosimetry, 5. Dilatometry - Determination of coefficient of thermal expansion, 6. Measurement of porosity - Density - Water absorption (Archimedes method), 7. Flexural strength, 8. Spray drying.

10th Semester (Chemical Engineering)

Diploma thesis. No courses offered.

5th Semester (Environmental Engineering)

Required Courses

[CHENVE 301] CHEMICAL PROCESS ANALYSIS AND DESIGN I

Stoichiometry and kinetics of chemical reactions • Thermodynamics analysis of chemical reactions • The Arrhenius equation • Design of isothermal homogeneous chemical reactors (batch, CSTR, PFR) • CSTR reactors in series • Recycle PFR reactors • Design of non-isothermal homogeneous reactors • Non-ideal chemical reactors • Dynamic reactor response-residence time distribution function • Analysis of kinetic data from chemical reactors.

[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 443] SUSTAINABLE DEVELOPMENT & 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 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 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 332] METEOROLOGY AND CLIMATE CHANGE

•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. • Climate and Climate Classification • Climate change. • Climate change adaptation and mitigation technologies • Climate change risk management. • Resilience.

[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 projects.

6^{th} Semester (Environmental Engineering)

Required Courses

[CHENVE 302] BIOCHEMICAL PROCESS ANALYSIS AND DESIGN

• Elements of microbiology and biochemistry •Kinetics of enzymatic reactions •Kinetics of reactions with immobilized enzymes •Kinetics of microbial growth •Kinetics of production of metabolic products •Mathematical simulation models •Design of classical bioreactors (batch, fed-batch, CSTR) •New generation bioreactors (Perfusion, Airlift, SBR, hollow-fiber, MBR, MBBR) • Aeration and agitation of bioreactors •Sterilization •Applications in industrial and environmental processes

[ENVE 335] OPTIMIZATION OF ENVIRONMENTAL AND ENERGY SYSTEMS

Introduction to Optimization Theory (Introduction, Optimization Model Classification, Nonlinear Optimization, Hollow Sets and Functions, Mathematical Optimization Theorems, Mathematical Optimization Problem Geometry) • Classical Optimization (Unlimited Optimization Problems, Lagrange Multipliers) • Linear Programming (Optimization in Linear Programming Problems, the Simplex Method) • Non-linear programming (Introduction, Unlimited Optimization Methods, Restricted Optimization Methods, Dynamic Programming) • Dynamic Programming (Introductory) (Introductory Fuzzy Logic, Neural Networks) • Advanced Methods Of Optimization (Genetic algorithms, Fuzzy Logic, Neural Networks) • Matlab applications

[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)

[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 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 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

7th Semester (Environmental Engineering)

Required Courses

[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 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 421] APPLICATIONS IN ENVIRONMENTAL MODELING

•Introduction to the methodology of modelling 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 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) • Biological removal of nutrients (nitrification; denitrification; biological removal of phosphorus) • Disinfection of treated wastewater (disinfectants; chlorination; ozonation; UV).

[ENVE 433] HYDRAULICS II

A. HYDRAULICS AND HYDROLOGY LABs: 1. Hydraulic jump and stilling basins, 2. Specific energy-critical depth, 3. Flow over rectangular, vee notch and Broad crested weir

B. GROUNDWATER FLOW LABs: 4. Darcy Law – Demonstration of groundwater flow, calculation of hydraulic gradient and calculation of hydraulic conductivity, 5. Demonstration of groundwater flow, and calculation of hydraulic conductivity in confined aquifer

C. HYDROMETRY LABs: 6. Hydrometry – Hydrology, 7. Hydrometric networks – state of technology, 8. Methods and equipment of flow measurements, 9. H-Q curves, 10. Floods and flood peak discharge estimation, 11. Hydraulic works and control cross-sections, 12. Hydrometeorological measurements

Elective Courses (2 out of 4)

[CHENVE 401] ENVIRONMENTAL CATALYSIS

Part 1: •Introduction to homogeneous and heterogeneous catalysis, basic types of solid catalysts and photocatalysts, evaluation of catalytic properties, desired characteristics. •Basic mechanisms of catalytic and photocatalytic reactions. •Kinetics of catalytic reactions. •Synthesis and characterization methods of catalysts. •Adsorption and (photo) catalytic processes as anti-pollution technologies. •Catalytic processes for the control and treatment of gaseous emissions (NOx, SOx, CH4, CO, VOCs). •Catalytic processes for the production of clean energy.

Part 2: •Introduction to photochemical processes. •Photosynthesis. •Homogeneous photocatalysis. •Heterogeneous photocatalysis for hydrogen production. •Heterogeneous photocatalysis for the removal of pollutants in the gas phase and the reduction of CO2. •Heterogeneous photocatalysis for the removal of pollutants in the aqueous phase.

[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 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 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.

8th Semester (Environmental Engineering)

Required Courses

[ENVE 554] DESIGN OF CHEMICAL AND 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

[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 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 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)

Elective Courses (1 out of 5)

[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.

[PEM 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 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 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.

[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.

9^{th} Semester (Environmental Engineering)

Required Courses

[CHENVE 501] ENVIRONMENTAL LEGISLATION II – INTRODUCTION TO PUBLIC WORKS LAW

•Introduction and connection to the 3rd semester compulsory course entitled "Environmental Law I". Environmental protection in domestic law. Sources of the Hellenic Environment Law. Constitutional protection of the environment (Article 24 of the Hellenic Constitution 1975/1986/2011/2008/2019). Constitutional protection of natural and cultural environment (Article 24 par. 1 and 6 of the Constitution). Constitutional protection of forests (Articles 24 par. 1 and 117 par. 3 & 4) [1st-3rd lecture] •The provision of Article 24 par. 2 of the Hellenic Constitution as regards the master plan of the country, and the arrangement, development, urbanisation and expansion of towns and residential areas in general [lecture 4th]. •The content and characteristics of the right to the environment. The environmental trial. Locus standi in environmental litigation. Examples from representative environmental cases [5th lecture] •The protection of the environment in domestic common legislation. The Act 1650/1986 as in force. Structure and topics of Act 1650/1986. The current system of spatial planning in Greece (Special and Regional Spatial Frameworks. Examples) [6th lecture] •The Administrative Organization of Environmental Protection in Greece [7th lecture] •Tools and mechanisms of direct State intervention for the protection of the environment. Administrative and environmental licensing. The environmental impact assessment process. EU directives and national implementation legislation. Environmental Impact Assessment and Strategic Environmental Assessment. Principles, mechanisms and tools [8th lecture] •Content and stages of environmental licensing. Representative case studies [9th lecture] •Case study "The Renewable Energy Sources (R.E.S.)": interaction of International, EU and domestic legislation and case law [10th lecture] •Introduction to Public Works legislation. Procedures regarding the award and execution of Public Works. Legislative framework for the public procurement. Harmonization of Greek legislation to the EU directives. Law 4412/2016 and recent amendments. Award criteria. Execution of Public Works. Public Works dispute resolution procedures [12th and 13th lectures].

[ENVE 555] DESIGN OF CHEMICAL AND 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.

[ENVE 512] ECOLOGICAL ENGINEERING AND CIRCULAR ECONOMY

The Circular Economy refers to a new development model where the goal is to valorise by-products and waste and to preserve resources within the economic activity for as long as possible, but also to develop new ecological processes and technologies that will design out the production of waste and will minimize the environmental footprint. Ecological Engineering is the engineering science that is inspired by and adopts the ecological principles to produce sustainable solutions and transform them into social and technical action, meaning the adaptation of construction techniques, closing material flow cycles, material flow management, spatial symbiosis of material and energy users, so as to be compatible with nature with the least possible footprint and impact.

• Main environmental and social challenges for Europe until 2050. Introduction to Sustainable Development and its goals. Presentation of the linear problem-solving process and the multifaceted problems that this approach creates. The transition to a circular problem-solving process. Circular economy and systems thinking. Closing material cycles. • Principles and objectives of circular economy. Application framework and areas of implementation. The need for new technologies of reduced energy consumption and reduced environmental footprint. The role of ecological engineering in the service of circular economy goals. • Introduction and definition of Ecological Engineering and Technology. Basic concepts. Nature-based Solutions and Green infrastructure: technologies and combined solutions in the built environment. Ecosystem services, categorization, value and origin. Land use and biodiversity. The role of the modern Environmental Engineer. • Green infrastructures in the urban environment. Circular cities. Categories and types of nature-based solutions. Introduction to the natural systems of Constructed Wetlands for wastewater and sewage sludge management. Types of constructed wetlands and description. Component parts of Artificial Wetlands systems, construction and operational parameters. Use of plants and fillers. Mode of operation and maintenance. • Physical, chemical, biological processes taking place in constructed wetlands. • Design equations of constructed wetlands systems. Design examples. Modern design models for different applications. Integrated design of constructed wetlands facilities. • Green roofs, green/vertical walls. Categories, types, methods and materials for construction. Design, operation and maintenance requirements. • Design of stabilization ponds and bioretention systems. Categories and applications. Phytosanitization. • Circular urban water management. Integrated ecological design (construction techniques, landscape architecture and regenerative design). Urban agriculture and aquaculture. • Circular waste management. Recovery, reuse and recycling of treated effluents, irrigation of commercial crops, composting of by-products, biogas production. The contribution of nature-based solutions to the circular economy. • Case studies of circular economy and examples of Nature-based solutions for different applications and climatic conditions. • Green infrastructure - solutions based on nature and human well-being and prosperity in the urban environment, urban air quality. Participation of interested parties, citizens, social groups in decision-making. • Green infrastructure and sustainable solutions in industry. Industrial sustainability, industrial ecology. Applications of ecological engineering in industry. Design examples.

Elective Courses (2 out of 6)

[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 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 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 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 • Specialized 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 (Environmental Engineering)

Diploma thesis. No courses offered.

Further information regarding the implementation of Internship may be found in the School website:
https://www.chenveng.tuc.gr/en/studies/undergraduate/new-curriculum-chenveng/1st-semester

CLARIFICATIONS - TRANSITIONAL PROVISIONS

concerning the undergraduate courses of the renamed School of Chemical and Environmental Engineering (CHENVENG), and the study Program for the academic year 2022-2023 onwards.

- The **new study program of School of CHENVENG** concerning both divisions starting from the 3rd year will start only from the 1st year and concerns the students admitted to our School in the academic year 2021-2022.
- Students of the previous years will attend the **former study program of the School of Environmental Engineering (ENVENG).**

The course assignments and transition provisions are as follows:

1. The former study program course (2020-21 and previously) **ENVE 100 Environmental Geology** of the 1st semester, is renamed to **ENVE 100 GEOLOGY**.
2. **ENVE 264 Soil Mechanics and Foundations** course will only be taught in the academic year 2021-22 in the 4th semester. Onwards the course will be selected for the next 2 years (until June 2024), in the spring & fall semesters by the students of previous semesters that do not have a transferable grade.
3. The former study program course (2020-21 and previously) **ENVE 133 Environmental System Using Computer Aided Design** of the 1st semester, is renamed **ENVE 133 COMPUTER AIDED DESIGN** and is transferred to the 3rd semester.
4. The former study program course (2020-21 and previously) **ENVE 112 ECOLOGY** of the 1st semester, is renamed **ENVE 112 ECOLOGY AND INTRODUCTION TO TECHNICAL ECOLOGY.**
5. The former study program course (2020-21 and previously) **ENVE 113 Introduction to Environmental Engineering Science** of the 1st semester, is renamed **ENVE 113 INTRODUCTION TO CHEMICAL AND ENVIRONMENTAL ENGINEERING.**
6. The former study program course (2020-21 and previously) **ENVE 132 General Chemistry** of the 2nd semester is transferred to the 1st semester. Students of earlier academic years (2020-21 and backwards) that have not been successful have to attend the course, regardless of the transfer.
7. The former study program course (2020-21 and previously) **ENVE 126 Environmental Microbiology** of the 2nd semester, is renamed to **ENVE 126 MICROBIOLOGY.**
8. The former study program course (2020-21 and previously) **CHENVE 201 Physical Chemistry** of the 4th semester, is renamed **CHENVE 201 PHYSICAL CHEMISTRY I** and is transferred to the 2nd semester. Students of earlier academic years who have not been successful must attend the course, regardless of the transfer.
9. The former study program course (2020-21 and previously) **ENVE 212 Water Pollution Control** of the 4th semester is renamed **ENVE 212 INSTRUMENTAL CHEMICAL ANALYSIS.**
10. The former study program course (2020-21 and previously) **ENVE 229 Environmental Thermodynamics** of the 4th semester, is renamed **ENVE 229 THERMODYNAMICS.**
11. The former study program course (2020-21 and previously) **ENVE 332 Environmental Meteorology and Air Quality Models** of the 5th semester, is renamed **ENVE 332 METEOROLOGY AND AIR QUALITY MODELS.**
12. The former study program course (2020-21 and previously) **ENVE 336 Numerical Methods in Environmental Engineering** of the 6th semester, is renamed to **ENVE 336 NUMERICAL ANALYSIS.**

13. The former study program course (2020-21 and previously) **ENVE 335 Optimization of Environmental Systems** has renamed to **ENVE 335 OPTIMIZATION OF ENVIRONMENTAL AND ENERGY SYSTEMS.**
14. The former study program course (2020-21 and previously) **ENVE 443 Sustainable Development (ISO 14000&LCA)** of the 7th semester is renamed to **ENVE 443 SUSTAINABLE DEVELOPMENT & LCA.**
15. The former study program course (2020-21 and previously) **ENVE 554 Design of Environmental Plants and Environmental Impact Assessment I** is renamed to **ENVE 554 DESIGN OF CHEMICAL & ENVIRONMENTAL PLANTS AND ENVIRONMENTAL IMPACT ASSESSMENT I**.
16. The former study program course (2020-21 and previously) **ENVE 555 Design of Environmental Plants and Environmental Impact Assessment II** μετονομάζεται σε **ENVE 555 DESIGN OF CHEMICAL & ENVIRONMENTAL PLANTS AND ENVIRONMENTAL IMPACT ASSESSMENT II.**
17. The course **HEAT AND MASS TRANSFER** (5th semester) will not be taught in fall semester 2022-23. Students that failed the course (admitted 2020 and previously), will select it in the fall semester of 2022-23. The course will be taught parallel with the course (co-teaching) **TRANSPORT PHENOMENA I** of the 4th semester.
18. The course **GEODESY** (2nd semester) **WILL NOT BE TAUGHT** in the academic year 2022-23. Therefore, only theory will be examined in the 2022-23 exams.
19. For former students, the Social Science courses of 5th and 6th semesters have been moved to the 3rd and 4th semesters. In addition, the elective course **SSCI 201 MICRO-MACRO ECONOMIC ANALYSIS** (3rd semester) has been added to the program, which can also be chosen by former students (ENVE).

V. CONTACT

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APPENDIX I

GUIDELINES FOR DIPLOMA THESIS

I. ROAD MAP FOR THE PREPARATION OF THE DIPLOMA THESIS AND THE COMPLETION OF STUDIES

STARTING A DIPLOMA THESIS

- Choose subject and supervisor (attention: only a faculty member of the School of Chemical Engineering and Environmental Engineering Supervisor can be appointed supervisor, and he/she chairs the three-member Examination Committee).

- Investigate the availability of the other three members of the Three-Member Examination Committee (2 full members and one deputy), who may be faculty members of the School of Chemistry or other Schools or a researcher of a recognized research body.

- Apply to the Assembly of the Department of the School of Chemical and Environmental Engineering for the approval of the thesis title and the three-member Examination Committee. A Diploma Thesis proposal, i.e. thesis plan summary, should be attached to the application. The student should prepare the summary plan within a time limit determined by the Supervising Professor in collaboration with the three-member committee. This time limit may not exceed **three months** from the date of undertaking the Diploma Thesis.

- The Departmental Assembly decides on the approval of the application and appoints three-member Examination Committee.

WORKING ON A DIPLOMA THESIS

- The progress of the work is monitored at regular intervals by the Supervising Professor in collaboration and the three-member Committee.

- The elaboration of the diploma thesis is completed in 1 year from the approval of the Proposal. Failure to complete within this limit means that the student will have to look for another subject and / or another supervisor.

- Thesis writing. **Attention:** The student should strictly follow the instructions for thesis composition below.

- At the end of the writing, the student in collaboration with his/her supervisor must check the text of the thesis for plagiarism with the appropriate software. The software is available at the Library of the Technical University of Crete and the excerpt of the software report should be attached to the text of the Diploma thesis.

- The student submits the text of the thesis to the Three-Member Committee for corrections / remarks.

EXAMINATION OF THE DIPLOMA THESIS

After acquiring the agreement of the members of the Three-Member Examination Committee, the student should follow the steps cited below for his / her examination:

- **Set the day and time for the presentation of the thesis**, in collaboration with the Three-Member Examination Committee.

- Contact the Department of Academic Affairs of TUC for **the reservation of a presentation room** of the diploma thesis **or** in case of **online presentation**, notify the link to the Secretariat of the School.

- Complete and submit the **form "Template for posting a Diploma Thesis abstract"**, in docx format, at least 1 week before the presentation to secretariat@chenveng.tuc.gr (The title of the Diploma Thesis should be checked for discrepancies with the one approved by the Department Assembly). Attention: The announcement of the presentation of the diploma thesis is posted by the Secretariat in the "Academic Announcements" of TUC, **1 week before the presentation**

- Print the form **"Proceedings of the Three-member Committee",** in docx or pdf format. The document should be completed (with the rating) and signed by the members of the Committee, after the examination, and returned to the Secretariat.

- Submit the diploma thesis text to the Institutional Repository of TUC, through the website of the Library, after the completion of any changes requested by the Committee (http://www.tuc.gr/4777.html).

SUPPORTING DOCUMENTS FOR THE DIPLOMA

- **Certificate of the Library** i) on non-indebted material and ii) on electronic deposit of the diploma thesis in the Institutional Repository.

- **Certificate from the Telecommunications, Networks and Computing Infrastructure Department** regarding the non-possession of loaned equipment owned by TUC.

The Secretariat receives the above documents (a and b) from the respective services of TUC, without the intervention of the student

- **Hand in** the **Academic Identity card** (pass) to the Secretariat of the School

After completing the above process and the secretariat concludes the final control, students can receive the Certificate of Completion of Studies by the KEF (building D3).

Twenty days after the end of each examination period, the University announces its Graduates. Graduates can receive a Diploma Certificate from KEF (building D3).

II. GUIDELINES FOR WRITING A DIPLOMA THESIS

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:
The subject of the study, the way it is approached and any relevant issues to the subject.
The purpose of the diploma thesis. The problem to be solved is specified.
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 essential 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 only 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 CO_2, m^3/h or $m^3\ h^{-1}$, NH_4NO_3, NO_3^-,

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),…

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.

8. 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.

Templates for Cover page and Second Page Follow.

TECHNICAL UNIVERSITY OF CRETE
School of Chemical and Environmental Engineering

Advanced Semester Direction: Chemical Engineering / Environmental Engineering (Select one)

TITLE OF DIPLOMA THESIS

DIPLOMA THESIS

BY

NAME SURNAME

CHANIA, MONTH, YEAR

TECHNICAL UNIVERSITY OF CRETE
School of Chemical and Environmental Engineering

Advanced Semester Direction: Chemical Engineering / Environmental Engineering (Select one)

TITLE OF DIPLOMA THESIS

DIPLOMA THESIS

BY

NAME SURNAME

THREE MEMBER EXAMINATION COMMITTEE:

Professor *(Advisor)*

Professor

Professor