ERASMUS

HELLENIC MEDITERRANEAN UNIVERSITY

COURSE OUTLINES

Department of Mechanical Engineering

School of Engineering

Academic Year 2026-2027

TABLE OF CONTENTS

BUILDINGS ENERGY PERFORMANCE SIMULATION

COURSE OUTLINE

Responsible: Georgios Stavrakakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	8000.1.211.0	SEMESTER	1st
COURSE TITLE	BUILDINGS ENERGY PERFORMANCE SIMULATION		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	WEEKLY TEACHING HOURS	CREDITS
Total		

COURSE TYPE general background, special background, specialised general knowledge, skills development	
PREREQUISITE COURSES	Heat and mass transfer, Fluid mechanics, Mechanical design, Numerical methods.
LANGUAGE OF INSTRUCTION and EXAMINATIONS	
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Winter Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The aim of the course is for students to acquire comprehensive knowledge on buildings' energy performance simulation, specifically regarding established methods for dynamic and simple energy analysis, special focus on the zonal modelling method including building discretization into thermal zones, interpretation of energy-audits data to model input conditions, understanding of building-shell thermophysical and optical properties, calculation of heating and cooling systems efficiency ratio, simulation set-up, modelling procedure and assessment of results referring to state and impact Key Performance Indicators (KPIs). The course includes an energy analysis project concerning the parametric analysis of building-energy upgrading and techno-economic impact assessment.

General Competences

Upon successful completion of the course, students will be able to:

- Understand the steps of a building energy audit
- Discretize buildings into thermal zones
- Compile energy-audit information to suitable modelling input conditions
- Compute thermophysical and optical properties of building envelope
- Calculate building heating and cooling systems efficiency ratios/performance coefficient
- Familiarized with energy simulation through setting-up a case study using building energy simulation

software
- Analyse simulation results towards state and impact KPIs in the framework of techno-economic studies using building energy simulation techniques

3. SYLLABUS
Energy balance in buildings: Building-physics principles, heat transfer in buildings, energy breakdown in energy consumption per end-use and per energy vector, compilation of primary energy consumption, energy-induced emissions, buildings' energy-saving potential. **Energy audits**: Energy-related data collection, recording of building use, systems and operation schedules, interpretation of architectural design, recording of structural elements, extraction of properties used as input conditions in energy modelling, Building energy benchmarking/rating. **Building thermal zones**: Discretization into thermal zones, calculation of air infiltration, ventilation specifications, impact of shading in energy performance. **Building envelope thermophysical and optical properties**: Calculation of thermal transmittance and the impact on energy performance, building thermal-insulation adequacy assessment, structural elements reflectivity and emissivity. **Building-systems' properties calculation**: Estimation of heater-boiler efficiency, calculation of COP/EER of air-conditioning systems, efficiency of solar collector for hot water production purposes, lighting adequacy, etc. **Energy-performance simulation**: Exhibition of building energy modelling set-up, thermal zoning, imposing suitable input conditions (based on previous knowledge on building envelope systems' properties affecting the energy balance), execute simulations, simulation data processing towards state and impact KPIs for various energy-upgrading scenarios. **Assessment of energy investments in buildings**: Prediction of Net Present Value, Internal Rate of Return and other special indicators for assessing the viability of retrofit scenarios for various building uses. **Assignment**: Techno-economic study for energy-upgrading of a building case study.

4. TEACHING and LEARNING METHODS - EVALUATION	
DELIVERY Face-to-face, Distance learning, etc.	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	Presentation of electronic slides
TEACHING METHODS The manner and methods of teaching are described in detail.	**Activity** / **Semester workload** **Course total** /
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	Students will conduct an assignment / case study involving building energy analysis. There will be a final exam. Student final grade will be the average of the grade of final exam and of the assignment.

5. ATTACHED BIBLIOGRAPHY
Hensen, J., & Lamberts, R. (Eds.) (2019). Building performance simulation for design and operation. (2nd expanded ed.) Routledge Taylor & Francis Group. Fundamentals of Building Performance Modeling Handbook, IESVE 2025.

Brackney, L., Parker, A., Macumber, D., & Benne, K. (2018). Building energy modeling with OpenStudio: A practical guide for students and professionals. Springer International Publishing.

MECHANICAL DRAWING II

COURSE OUTLINE

Responsible: Konstantinos Kontaxakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.2.005.0	**SEMESTER**	2nd
COURSE TITLE	Mechanical Drawing II		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	5
Total	**3**	**5**

COURSE TYPE general background, special background, specialised general knowledge, skills development	Special Background
PREREQUISITE COURSES	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Spring Semester
COURSE WEBSITE (URL)	https://eclass.hmu.gr/modules/document/index.php?course=MECH126

2. LEARNING OUTCOMES

Learning outcomes

The course Mechanical Drawing II - CAD aims to utilize and deepen the existing basic knowledge, standardizations and regulations, acquired in the Mechanical Drawing I and their applications in integrated Mechanical Drawings. The students will be invited to realize drawings of assemblies of mechanical devices.

The aim of the course of the Mechanical Drawing II - CAD is to offer to the students the opportunity to apply the rules of the Mechanical Drawing and the standardization of machine elements and parts, in order to acquire the ability and the skills:

- to know in depth the international regulations of standardization of the Mechanical Drawing,
- to understand complex mechanical drawings and assemblies, as a composition of the individual parts,
- to transform their thoughts, ideas and calculations into engineering drawings regardless of the degree of complexity
- to make the desired or necessary corrections, upgrades and modifications of complex mechanical devices
- to prepare complex mechanical drawings in appropriate design software.

In Engineering Drawing II - CAD, the students are trained in depth, in 2D computer aided design using the AutoCAD platform.

General Competences

Upon successful completion of the course, students will be able to apply successfully the rules of the Mechanical Drawing and the standardization of machine elements and parts, in order to acquire the ability and the skills:

- to know in depth the international regulations of standardization of the Mechanical Drawing,
- to understand complex mechanical drawings and assemblies, as a composition of the individual parts,
- to transform their thoughts, ideas and calculations into engineering drawings regardless of the degree of complexity
- to make the desired or necessary corrections, upgrades and modifications of complex mechanical devices
- to prepare complex mechanical drawings in appropriate mechanical drawing software.

3. SYLLABUS

Preparation of 13 engineering drawings and assemblies for the implementation of all the following modules:

- Tolerances in the mechanical drawing.
- Welding and design of welded structures.
- Drawings of machine elements and parts of any kind.
- Search and use templates and machine component catalogs.
- Views, sections and half sections of assemblies.

Drawings of mechanical assemblies using normalized machine elements (threads, screws, shafts, bearings, gears, pulleys, springs, seals, piping, reducers, welds).

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	Presentation of electronic slides. Use of 2D computer aided design (AutoCAD platform).
TEACHING METHODS The manner and methods of teaching are described in detail.	(see table below)
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	The theory is taught in English, in the form of lectures using audiovisual teaching aids, while the laboratory is taught through demonstration, practical exercises, and the participation of students in the presentation of the course. The Mechanical drawing projects of typical mechanical engineering assemblies are prepared in the laboratory, under the supervision of professors.

Activity	Semester workload
Lectures	13
Practical Exercises	13
Laboratory Exercises	39
Independent Study	60
Course total	**125**

5. ATTACHED BIBLIOGRAPHY

Manual of Engineering Drawing: British and International Standards, Colin H. Simmons, Dennis E. Maguire, Neil Phelps.

INTRODUCTION TO MODERN PHYSICS – QUANTUM STRUCTURE OF MATTER

COURSE OUTLINE

Responsible: Georgios Kavoulakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.4.006.0	**SEMESTER**	2nd
COURSE TITLE	Introduction to Modern Physics – Quantum Structure of Matter		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	0	4
Total	**0**	**4**

COURSE TYPE general background, special background, specialised general knowledge, skills development	Undergraduate course
PREREQUISITE COURSES	Calculus of one variable Differential Equations Linear Algebra
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Spring Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

This course introduces students to elementary concepts of quantum physics. It begins with the end of classical physics and describes the evolution of quantum theory, its basic principles, as well as its consequences in the macrocosm.

Starting with the Schrodinger equation, along with certain fundamental principles of quantum theory—such as the uncertainty principle and the Pauli exclusion principle—as well as the relevant formalism, the course concludes with (i) the explanation of the periodic table of elements and (ii) the consequences of quantum theory on well-known and elementary properties of matter. These include the typical density of matter, its compressibility, electrical conductivity, etc.

Upon successful completion of the course, the student will be able to:

Know the basic principles of quantum physics.

Understand the concept of the wavefunction.

Know how to solve simple quantum mechanics problems.

Understand basic properties of matter.

General Competences

Independent work

Working in an interdisciplinary environment Generation of new research ideas Promotion of free, creative, and inductive thinking

3. SYLLABUS
The End of Classical Physics – From Classical to Quantum Description Black-body radiation and Planck's explanation Photoelectric effect Compton effect The quantum view of matter **Old and New Quantum Theory** The planetary model of the atom and Bohr's theory De Broglie matter waves The foundation of quantum theory The wavefunction and the Schrodinger equation The statistical significance of the wavefunction and observable quantum mechanical quantities The uncertainty principle The harmonic oscillator The Pauli exclusion principle **Two Important Problems of Fundamental Significance** The hydrogen atom and atomic orbitals The periodic table of elements **From Atoms to Molecules and Condensed Matter** The quantum theory of the chemical bond Solids: Conductors, Semiconductors, Insulators The end of stars: White dwarfs, neutron stars, and black holes The discovery of the transistor

4. TEACHING and LEARNING METHODS - EVALUATION	
DELIVERY Face-to-face, Distance learning, etc.	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	
TEACHING METHODS The manner and methods of teaching are described in detail.	<table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>**Course total**</td><td></td></tr></table>
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	Quizzes Final written exam

5. ATTACHED BIBLIOGRAPHY
https://cup.gr/book/introduction-to-quantum-physics/

MECHANICAL DESIGN I

COURSE OUTLINE

Responsible: Markos Petousis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.7.001.0	**SEMESTER**	1st
COURSE TITLE	Mechanical Design I		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	0	5
Total	**0**	**5**

COURSE TYPE general background, special background, specialised general knowledge, skills development	
PREREQUISITE COURSES	3d CAD Machine Elements Mechanical drawing
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Winter Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

“Mechanical Design I” aims to integrate basic mechanical engineering knowledge for the processing of technical problems related with the products design.

Basic mechanical engineering knowledge, such as mechanical drawings, materials technology, mechanics, materials strength, machine elements and manufacturing technologies, are combined in an applied level for the design and development of a new or the redesign of an existing mechanical product. Understanding the industrial design stages (from the conceptual design, to the process of the idea and the evaluation of the prototype) is achieved from the students with the implementation of a mechanical design project through decision making processes.

General Competences

The student who has successfully completed the Mechanical Design I class, will have the ability to:

- Analyze a technical problem related to the design of a mechanical product
- Seek ideas that lead to the solution of a technical problem
- Select the optimum solution and covert it to a mechanical setup
- Implement full design of the mechanical setup
- Manufacture a prototype model for the mechanical setup
- Present the developed solution of the technical problem studied

For the project implementation students employ advanced products design, analysis and prototype manufacturing methods, such as CAD/CAM/CAE software tools and 3d printers.

3. SYLLABUS

1. The mechanical design process
2. Technical problems formulation and analysis
3. Collection and processing of information
4. Specifications list
5. Conceptual Design
6. Synthesis and evaluation of technical solutions
7. Development and design of a technical solution
    - Materials, parts, standardization
    - Loads, construction analysis
    - Kinematics, mechanisms
    - Safety
    - Manufacturing and production
    - Assembly
    - Maintenance, reliability
    - Aesthetics, ergonomics
    - Billing
    - Innovation
    - Design optimization
8. Production systems and processes selection
9. Organizing and administration of working groups
10. Mechanical design software tools in the computer

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Project
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	
TEACHING METHODS The manner and methods of teaching are described in detail.	**Activity** / **Semester workload** **Course total** /
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	

5. ATTACHED BIBLIOGRAPHY

MECHANICAL DESIGN II

COURSE OUTLINE

Responsible: Markos Petousis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.8.001.0	**SEMESTER**	2nd
COURSE TITLE	Mechanical Design II		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	0	5
Total	**0**	**5**

COURSE TYPE general background, special background, specialised general knowledge, skills development	
PREREQUISITE COURSES	3d CAD Machine Elements Mechanical drawing Mechanical Design I
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Spring Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

"Mechanical Design II" is a continuation of "Mechanical Design I" course, for the acquisition of an integrated knowledge and the development of the skills of the structural Engineer to the students, which aims at:

- the application of the basic engineering knowledge already acquired by the student, for integrated and autonomous management of a technical problem, related to the design of a Mechanical device

- the student's understanding and application of the advanced imaging and computing tools provided by the CAD / CAE platforms in the design and optimization of products and technology systems

General Competences

The student who has successfully completed the Mechanical Design II class, will have the ability to:

- Analyze a technical problem related to the design of a mechanical product
- Seek ideas that lead to the solution of a technical problem
- Select the optimum solution and covert it to a mechanical setup
- Implement full design of the mechanical setup
- Manufacture a prototype model for the mechanical setup

Present the developed solution of the technical problem studied

3. SYLLABUS
The mechanical design process 2. Technical problems formulation and analysis 3. Collection and processing of information 4. Specifications list 5. Conceptual Design 6. Synthesis and evaluation of technical solutions 7. Development and design of a technical solution - Materials, parts, standardization - Loads, construction analysis - Kinematics, mechanisms - Safety - Manufacturing and production - Assembly - Maintenance, reliability - Aesthetics, ergonomics - Billing - Innovation - Design optimization 8. Production systems and processes selection 9. Organizing and administration of working groups 10. Mechanical design software tools in the computer

4. TEACHING and LEARNING METHODS - EVALUATION	
DELIVERY Face-to-face, Distance learning, etc.	Project
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	
TEACHING METHODS The manner and methods of teaching are described in detail.	**Activity** / **Semester workload** **Course total** /
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	

5. ATTACHED BIBLIOGRAPHY

OPTIMAL CONTROL

COURSE OUTLINE

Responsible: Alina Ektami

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.8.018.0	**SEMESTER**	2nd
COURSE TITLE	Optimal Control		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	5	6
Total	**5**	**6**

COURSE TYPE general background, special background, specialised general knowledge, skills development	Advanced Specialization Course
PREREQUISITE COURSES	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Spring Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course focuses on the principles of optimal control, with an initial emphasis on the theory and application of optimal control to linear systems. Students will acquire the knowledge and skills required to design controllers that optimize system performance. Towards the end of the course, fundamental concepts of nonlinear optimal control are introduced.

Upon successful completion of the course, students will be able to:

- Design optimal controllers for linear systems using methods such as the Linear Quadratic Regulator (LQR).
- Apply numerical techniques and software tools to solve optimal control problems.
- Demonstrate a basic understanding of the challenges and methods associated with nonlinear optimal control.
- Apply optimal control methods to engineering problems involving real-world data.

General Competences

- Search for, analyze and synthesize data and information using appropriate technologies.
- Work independently.
- Work effectively in teams.
- Make decisions.
- Work in an interdisciplinary environment.

3. SYLLABUS

Theoretical Part (Lectures)

- Introduction to Optimal Control: Definition and applications of optimal control to real-world problems (e.g., automatic control systems, robotics, and logistics).
- Fundamental concepts: system state, control variables, and optimization criteria.
- Optimal Control Methods for Linear Systems: Linear Quadratic Regulator (LQR).
- Practical applications.
- Introduction to Nonlinear Systems: Fundamental differences between linear and nonlinear systems.
- Overview of methods for the control of nonlinear systems (e.g., linearization and optimal control based on Pontryagin's Maximum Principle).

Laboratory Part

- Solving optimal control problems using analytical and numerical methods.
- Use of software tools (MATLAB and Python) for system analysis and controller design.

Individual or Group Project

Students will develop a project involving the design of an optimal control system based either on real-world data or on the simulation of a practical application. Examples include:

- Trajectory optimization for a robotic vehicle, where the objective is to determine an optimal trajectory that minimizes travel time or energy consumption or maximizes passenger comfort.
- Warehouse management, involving the optimal control of incoming and outgoing product flows to minimize storage costs and maximize operational efficiency. The objective is to maintain inventory at an optimal level while avoiding both overstocking and stock shortages.

4. TEACHING and LEARNING METHODS - EVALUATION	
DELIVERY Face-to-face, Distance learning, etc.	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	• Use of Information and Communication Technologies (ICT) in teaching. • Use of Information and Communication Technologies (ICT) for communication with students through the e-Class platform.
TEACHING METHODS The manner and methods of teaching are described in detail.	<table><tr><td>**Activity**</td><td>**Semester workload**</td></tr><tr><td>**Course total**</td><td></td></tr></table>
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	1. Written final examination (70%). 2. Individual or group laboratory project (written report and oral examination) (30%). The assessment criteria are announced to students at the beginning of the semester and are available on the course webpage in the e-Class platform.

5. ATTACHED BIBLIOGRAPHY

- Bryson, A. E., & Ho, Y.-C. (1975). *Applied Optimal Control: Optimization, Estimation, and Control*. Taylor & Francis.
- LaValle, S. M. (2006). *Planning Algorithms*. Cambridge University Press.
- Bertsekas, D. P. (2017). *Dynamic Programming and Optimal Control* (Vols. 1–2). Athena Scientific.
- Laporte, G., & Vogiatzis, C. (2016). *Introduction to Vehicle Routing Problem*. Springer.

- Krikelis, N. (2000). *Modeling and Optimal Control of Systems*. Fountas Publications. *(in Greek)*

SOLAR ENERGY AND APPLICATIONS

COURSE OUTLINE

Responsible: Georgios Arnaoutakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.8.022.0	**SEMESTER**	2nd
COURSE TITLE	Solar Energy and Applications		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	6
Total	**4**	**6**

COURSE TYPE general background, special background, specialised general knowledge, skills development	
PREREQUISITE COURSES	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Spring Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

This course presents concepts and technologies related to the production of electrical and thermal energy through the utilization of solar radiation. For this purpose, the course is divided into three sections, a) Solar Geometry and the Properties of Solar Radiation, b) Solar Radiation Utilization Technologies for Direct Electricity Generation, and c) Solar Radiation Utilization Technologies for Direct Heat Generation.

After successful completion of the course, students will have:

• understood basic properties of solar radiation, calculating basic angles of solar geometry and solar potential
• understood the basic operation & energy production of photovoltaics from different absorber materials
• learned to calculate efficiency & energy production of different technologies and geometries of solar collectors
• learned to compose photovoltaic and solar thermal energy production systems with storage and their dimensioning
• performed measurements for the evaluation of photovoltaic and solar thermal systems

General Competences

• Search, analysis and synthesis of data and information, using necessary technologies
• Decision making
• Independent work
• Teamwork
• Working in an interdisciplinary environment

• Generation of new research ideas
• Promoting free, creative and inductive thinking

3. SYLLABUS

The course is divided into three sections:

a) Solar Geometry and the Properties of Solar Radiation. The first section presents and analyzes the basic concepts governing Solar Geometry, such as the basic angles that determine and characterize the sun's path on the horizon, such as solar declination, hour angle, sunrise and sunset time, solar altitude, solar azimuth, the concepts of solar and civil time, the surface azimuth and finally calculates the angle of incidence of solar radiation on a surface. The basic relationships that characterize the quantity and spectrum of solar radiation are also given, such as its three basic components (direct, diffuse and reflected) and empirical methods for estimating the available radiation at a geographical location and the radiation incident on a surface are presented.

b) Solar Radiation Utilization Technologies for Direct Electricity Generation. In the section on the production of electricity directly from solar radiation, the various photovoltaic system technologies are presented. The photoelectric and photovoltaic phenomenon is analyzed, basic technological concepts of electrical power generation from photovoltaic collectors are given, the basic layout-structure and the process of composition of a photovoltaic station are analyzed and the mathematical background is presented, with its numerical-computational application, for calculating the electrical power generation from photovoltaic panels.

c) Solar Radiation Utilization Technologies for Direct Heat Generation. In the section on heat generation from solar radiation, the various available solar collector technologies are given, such as open type, flat selective, vacuum tubes and parabolic mirrors, and their basic technical characteristics are presented. The analytical mathematical background for calculating the efficiency and heat generation from solar collectors and the numerical methodology for its application are also given. Indicative applications of the available solar collector technologies for hot water production, space heating, industrial uses and electrical power generation through solar thermal steam & gas turbine power plants are presented.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	In person
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	*The course is supported by computational tools and laboratory exercises on the above three distinct subjects.*
TEACHING METHODS The manner and methods of teaching are described in detail.	**Activity** / **Semester workload** **Course total** /
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	

5. ATTACHED BIBLIOGRAPHY

FINAL PROJECT THESIS

COURSE OUTLINE

Responsible: Georgios Arnaoutakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.9.014.0	**SEMESTER**	Winter/Spring
COURSE TITLE	Final Project Thesis		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	0	30
Total	**0**	**30**

COURSE TYPE general background, special background, specialised general knowledge, skills development	
PREREQUISITE COURSES	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS	
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Both Winter and Spring Semesters
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

After the successful preparation of the Thesis, students will be able to tackle a fairly complex engineering topic, that is:

- to grasp its complexity
- to identify the individual requirements (scientific, technical, organizational, economic)
- to seek the best from a series of proven solutions
- to design its implementation
- to design, analyze and simulate its operation, if necessary
- to construct or supervise and coordinate its construction
- to evaluate its performance
- to propose improvements

General Competences

Through the preparation of their thesis, and depending on its topic, students also will have the opportunity to develop the following general skills:

- communication skills through their communication with stakeholders from the technical, academic and administrative fields in the subject of their thesis and the promotion of their work through all available printed and electronic media

• the ability to research, search and exchange information or data through their work in an international academic environment

• to write comprehensive, technically and linguistically sound scientific-technical texts

• to present and support their work publicly and to large audiences

• to write and publish scientific articles in international journals and conferences in English

• to develop critical thinking, with the ultimate goal of contributing to the local and global development and prosperity

3. SYLLABUS

The Final Project Thesis is an extensive work – analytical, synthetic, experimental or related to a specific application – that is prepared by senior students in order to obtain the title of Graduate Mechanical Engineer. The Thesis has a fairly complex and multi-level scientific-technical subject that is generally related to the direction of studies chosen by the student.

It constitutes a concentrated culmination of the studies and its purpose is to give the student the opportunity to complete their knowledge and present their abilities in the elaboration of an independent topic of the Science of Engineering.

The subject of the work is determined either by a professor or upon the proposal of the student and in collaboration with the supervising professor.

The Final Project Thesis consists of a comprehensive review of literature that can be followed by either:

• modeling

• design

• fabrication

• characterization

of advanced engineering topics in one of the three sectors in the department:

• Energy

• Robotics

• Manufacturing

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	In Person
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	
TEACHING METHODS The manner and methods of teaching are described in detail.	<table><tr><td>**Activity**</td><td>**Semester workload**</td></tr><tr><td>**Course total**</td><td></td></tr></table>
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	

5. ATTACHED BIBLIOGRAPHY

GEOTHERMAL - BIOENERGY - COGENERATION - SMART GRIDS

COURSE OUTLINE

Responsible: Georgios Arnaoutakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0813.9.016.0	**SEMESTER**	1st
COURSE TITLE	Geothermal - Bioenergy - Cogeneration - Smart Grids		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	6
Total	**4**	**6**

COURSE TYPE general background, special background, specialised general knowledge, skills development	
PREREQUISITE COURSES	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Winter Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

This course examines forms of Renewable Energy Sources, such as Geothermal Energy and Bioenergy from Biomass, Biofuel or Biogas. Advanced energy systems that contribute to rational energy use and the maximization of energy efficiency are also examined, such as Cogeneration systems and Smart energy networks, "Power to X" and hydrogen technologies.

Upon successful completion of the course, students will be able to:

- Understand the theoretical background and technologies for the utilization of geothermal fields.
- Know the processes of woody biomass utilization and the aspects of biofuel production (composting, gasification, transesterification, pyrolysis, anaerobic digestion).
- Know the basic cogeneration technologies and can develop operating algorithms depending on the priorities of each project.
- Prepare dimensioning and energy calculations for cogeneration systems and district heating - district cooling networks.
- Analyze and implement strategies for the optimal use of smart grids to propose targeted energy solutions to consumers.
- Become familiar with the technologies that convert energy into fuels or chemical products (Power to Gas, Power to Liquids, Power to Heat) and understand their techno-economic feasibility

• Know the technologies for the production and use of hydrogen and understand their role in the energy economy.

General Competences
Upon successful completion of the course, students will be able to: • Search, analysis and synthesis of data and information, using the necessary technologies • Adaptation to new conditions • Independent work & Teamwork • Working in an international environment and interdisciplinary environment • Generating new research ideas • Project design and management • Respect for diversity and interculturality • Respect for the natural environment • Demonstrating social, professional and ethical responsibility & sensitivity to gender issues • Decision-making & Exercising criticism and self-criticism Promoting free, creative and inductive thinking

3. SYLLABUS

In Geothermal energy, the topic is initially presented as a renewable energy source, and the available geothermal fields are distinguished, while the methodologies for exploration and assessment of geothermal potential are analyzed. Basic geological - geotechnical concepts are presented. The basic technologies for the exploitation of geothermal fields in the production of electrical and thermal energy are presented, as well as the design, siting and dimensioning methods

Regarding Biomass, the basic raw materials in the production of biomass and biofuels are presented (wood, by-products of agricultural crops, energy crops, urban or livestock organic waste, waste from the food industry). Biofuels are distinguished into solid, liquid and gaseous and their basic characteristics are presented (density, moisture content, net calorific value). The basic biofuel production processes are presented (composting, gasification, transesterification, pyrolysis, anaerobic digestion). Characteristic quantities of the biomass production process are given, regarding the required raw material and the production cost per unit of final product.

The basic alternative technologies for cogeneration of electricity and heat are presented, including thermoelectric plants, decentralized systems and trigeneration units. The concept of district heating and district cooling systems is given. Their basic components are presented, including networks, heat exchangers, alternative connectivity, etc. and typical examples of dimensioning and design of cogeneration and district air-conditioning systems are presented.

Furthermore, the course introduces the concepts of smart grids, presenting the conceptual model of smart grids and analyzing:

- the functionalities of smart grids
- the concept of demand management from the consumer's perspective and the available implementation strategies
- the implementation programs of smart grid processes
- the required technologies (telecommunications, electrical networks, demand management technologies and applications, decentralized energy production and storage devices)
- the expected benefits and difficulties of developing smart grids.

In addition, the technologies that convert electrical energy into other forms of energy or chemical products (Power-to-X) are presented, with emphasis on the production of hydrogen through electrolysis (Power-to-Gas), the conversion to liquid fuels (Power-to-Liquids) and the use for thermal energy (Power-to-Heat). In addition, examples are given for the idea of ??storing excess renewable electricity for future use, increasing the flexibility and sustainability of energy systems.

Finally, an introduction is made to the technologies for the production and use of hydrogen, as well as its integration into the energy economy. The role of hydrogen as a clean energy solution and the challenges facing its wider adoption are analyzed.

4. TEACHING and LEARNING METHODS - EVALUATION	
DELIVERY Face-to-face, Distance learning, etc.	In person
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	
TEACHING METHODS The manner and methods of teaching are described in detail.	**Activity** / **Semester workload** **Course total** /
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	

5. ATTACHED BIBLIOGRAPHY

HELLENIC MEDITERRANEAN UNIVERSITY

International Relations Office

Estavromenos, 71410 Herakleion, Crete, Greece

iro.hmu.gr

Generated on August 25, 2026