UNIVERSITY OF WESTERN MACEDONIA ΜΑΚΕΔΟΝΙΑΣ

SCHOOL OF ENGINEERING ΣΧΟΛΗ

INTER-DEPARTMENTAL MASTER PROGRAMME in

RENEWABLE ENERGY SOURCES & BUILDINGS ENERGY MANAGEMENT

Co-organised by the Department of Mechanical Engineering (administration support)

and

the Department of Electrical and Computer Engineering

COURSES SYLLABUS

ACADEMIC YEAR 2022-2023

KOZANI 2023

https://www.ape.uowm.gr/

Contents

A. 1st Semester Courses..... 3
B. 2nd Semester Courses..... 19
C. 3rd Semester Courses..... 42

A. 1st SEMESTER COURSE OUTLINES

HEAT TRANSFER

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0121**	**SEMESTER**	1st
COURSE TITLE	HEAT TRANSFER		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7.0
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES104/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aims to provide students with necessary knowledge and skills in order to understand and solve Heat Transfer problems in engineering applications especially in the fields of renewable energy and building installations.

Resuming lectures the student would be capable of:

- Describing the fundamental principles and laws of heat transfer
- Distinguish and analyse in depth heat transfer mechanisms (conduction, convection, radiation) in steady and transient condition for single- or multi-dimensional problems
- Resolve steady and transient heat transfer problems in complicared geometries with single or combined heat transfer modes
- Understand in depth numerical analysis and solution methods (finite differences, energy balance) for single- or multi-dimensional problems
- Apply technical heat transfer calculations in practical applications (heat exchangers, insulation, solar collectors, building installations)
- Evaluate operation of practical applications and propose optimum solutions.

General Skills

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information with the use of the necessary technology
Adapting to new situations
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment

Decision-making *Working Independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *.....* *Others…* *……..*

Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

1.Introduction to the heat transfer mechanisms.
2.Differential equations of heat conduction.
3.Steady heat conduction.
4.Transient heat conduction.
5.Numerical methods in steady heat conduction.
6.Numerical methods in transient heat conduction.
7.Forced convection.
8.Natural convection.
9.Thermal and solar radiation.
10. Radiation heat transfer.
11. Design and analysis of heat exchangers.
12. Heat transfer in building design.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of teaching process via the electronic platform e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final examination (100%) including: • analysis of theoretical issues based on student knowledge and judgement, • solution of relative exercises.

Activity	*Semester Workload*
Lectures	47
Group project	66
Individual study	62
Individual exam	
Group exam	
Total	***175***

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Cengel A.Y., and Ghajar J.A., Heat and Mass Transfer: Fundamentals and Applications, 5th

Ed., McGraw Hill, 2015.
2. Cengel A.Y., and Ghajar J.A.,Μεταφορά μάζας και θερμότητας, 4η Έκδοση., Εκδόσεις TZIOLA, Θεσσαλονίκη, 2013.
3. Bergman L.T., Lavine S.A., Incoprera P.F., DeWitt P.D., Fundamentals of Heat and Mass Transfer, 7th Ed., John Wiley & Sons, 2011.
4. Lienhard J.H.IV., and Lienhard J.H.V., A Heat Transfer Textbook, 3rd Ed., Phlogiston Press, 2003
5. Bejan A., and Kraus A.D., Heat Transfer Handbook, John Wiley & Sons Inc., 2003.
6. Rohsenow W.M., Hartnett J.P., Cho Y.I. (Eds), Handbook of Heat Transfer, 3rd Ed., McGraw Hill, 1998
7. Bird R.B., Stewart W.E., Lightfoot E.N., Transport Phenomena, 2nd Ed., Wiley, 2005.
8. Moss J. K., Heat and Mass Transfer in Buildings, 2nd Ed., Taylor and Francis Co., 2007.

- Related academic journals

1. International Journal of Heat and Mass Transfer (Elsevier)
2. ASME Journal of Heat Transfer
3. Heat and Mass Transfer (Springer)

ENERGY ECONOMICS AND ENERGY MARKETS

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0161**	**SEMESTER**	1ST
COURSE TITLE	ENERGY ECONOMICS AND ENERGY MARKETS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2,8	7
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES107/

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

Guidelines for writing Learning Outcomes

The course aims to introduce students in the main concepts and principles of Energy Economics. The course includes a concise outline of economics of the energy and the environmenta and develops the concepts of the energy markets and their operation. In addition, environmental and social impacts of the energy projects and how they are affecing the energy procing is also included in the Module.
Upon the successful course completion, students would be able to show a complete knowledge of energy economics as well as their interconnection with energy markets, externalities and environmental / social impacts.

General Skills

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working Independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*.....*
Production of new research ideas	*Others…*

.....

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

1st Section: Global Energy Balance and the National Energy system
Global Energy Balance across different periods in time
Primary and final energy consumption
Installed Power and energy production in our planet
Global energy mix
Relationship between the energy consumption and the economic growth
Energy production and demand in Greece - National Energy Balance
Basic energy sources and contribution in the national energy balance
The energy autonomy great issue

2nd Section: Main power generation technologies - Renewable and conventional energy sources
Basic categories of power generation plants
Basic principles and characteristics of power generation systems (thermal, Hydro, RES)
Thermal and electric energy cogeneration plants
Power and Energy Loads Demand analysis
Load Demand curves and base - peak load plants (Ramp Rate)
Energy storage systems

3rd Section: Basic Engineering Economics for Energy Projects
The most important current energy projects in the country
Funding of energy projects
Feasibility studies: scope and objectives
Basic economic characteristics of energy Projects. Capital and Operating Costs.
BreakEven Point Analysis.
Cash flows. Time value of money.
Energy Investments evaluation. Simple and Complex Evaluation Criteria.
Examples and Case Studies
ESCOs (basic characteristics - regulatory framework in Greece)

4th Section: Electricity Markets in Greece
The structure of the Greek electricity system
Electricity market in Greece, Regulatory framework, stakeholders, control organisations, role and intervention rights
Electrical networks and Renewable Energy Sources
Central and Distributed Power Generation - and smart networks
Reliability of power networks and consumers
Demand management

Participation in electricity markets (consumers and producers)
Power and energy electricity supply tariffs in Greece
Competitive and control premiums
The target model
Natural Gas and its Applications
Natural Gas Transportation Networks

5th Section: Environmental Economics - Externalities - ESCOs

Externalities in energy projects
Environmental impacts in the production and use of energy
Environmental Impact Assessments
The impacts of the most widely applied energy projects
Environmental Economics. The economic pollution problem in regional and local range. The socially optimum pollution level.
The economic problem of climate change. Economic incentives and penalties - pollution rights.
The most important environmental valuation methods. Revealed preference and stated preference methods. The replacement cost and the contingent valuation method.

6th Section: Energy Markets and Energy Policy

Basic principles and basic characteristics of electric energy markets
Energy market liberisation
Energy as a public or merit good
Energy Costs
Environmental and Macroeconomic energy cost
Energy taxation
Long term planning of the energy system
The Energy Choice - The Energy Trilemma
Marginal System Pricing
Daily energy planning
Utilities needs, markets, pricing.
Introduction in the competition economy in the energy markets
Energy pricing mechanisms
Net metering, Energy Communities
The limitation of energy resources and its impact in the energy prices
Social impacts of energy projects
EU energy policy and contemporary energy issues
The Greek energy policy and its prospects
Electromobility: Prospects and challenges

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*	• Support of learning process through e-class platform.

TEACHING METHODS *The manner and methods of are described in detail:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	<table><tr><th>*Activity*</th><th>*Semester Workload*</th></tr><tr><td>Lectures</td><td>47</td></tr><tr><td>Group project</td><td>66</td></tr><tr><td>Individual study</td><td>62</td></tr><tr><td>Individual exam</td><td></td></tr><tr><td>Group exam</td><td></td></tr><tr><td>***Course Total***</td><td>***175***</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	I. Individual Projects (30%): - solution of selected problems - Case studies - Development of best solution methodology II. Written final examination (70%) including: - analysis of theoretical issues based on student knowledge and judgement, - solution of relative exercises.

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Bhattacharyya, Subhes C., Energy Economics, Concepts, Issues, Markets and Governance, ISBN 978-1-4471-7468-4, Springer
2. Peters, Timmerhaus, Σχεδιασμός και Οικονομική Μελέτη για Μηχανικούς, Εκδόσεις Τζιόλα
3. RAE, www.rae.gr
4. C.R.E.S. webpage www.cres.gr

- Related academic journals:

1. Applied Energy (Elsevier)
2. Renewable Energy (Elsevier)
3. Renewable and Sustainable Energy Reviews (Elsevier)
4. Energy Economics (Elsevier)
5. Environmental Economics and Management (Elsevier)

ELECTRICAL ENERGY SYSTEMS
COURSE OUTLINE

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0171**	**SEMESTER**	1ST
COURSE TITLE	ELECTRICAL ENERGY SYSTEMS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES109/

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

Guidelines for writing Learning Outcomes

The course aims to provide high level specialized education in electrical energy systems as they are used in buildings and interact with Renewable Energy Sources (RES). The basic parameters of electrical grids are analyzed, along with explaining the methods of interfacing RES with the grid. At the same time, emphasis is placed on the storage of electricity that can increase the penetration of RES in electricity networks. The course also examines the economic valuation of RES investments based on different pricing and aid schemes.

Upon successful completion of the course the student will:

1. Understand and realize a building as a "system" and recognize its specific features when it interacts with energy networks.
2. Categorizes buildings according to how Renewable Energy Systems (RES) are integrated and operated.
3. Know and explain the effects of increased RES penetration on electricity networks, and propose ways to address them.
4. Determine the available ways of interconnecting RES units with the grid, and analyze

the specific characteristics of the different types of power inverters.
5. Has state-of-the-art knowledge on integrating energy storage into RES systems in buildings, as well as evaluating the possibilities of installing such systems in parallel with RES units.
6. Be able to study in-depth and design RES systems in buildings, taking into account their specific characteristics.
7. Incorporate appropriate economic parameters when evaluating different technical solutions in the study of RES systems in buildings.

General Skills

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working Independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	……..

- Search, analyze and synthesize data and information using the necessary technologies
- Use of foreign language bibliography
- Decision making
- Teamwork in an interdisciplinary environment
- Project management and scheduling
- Oral presentation of results

3. SYLLABUS

The course consists of the following sections:

- The building as a system - interaction with the grid
  - Nearly-zero energy buildings (NZEBs)
  - Net-zero energy buildings
  - Electrical power generation in buildings
  - The building as a nanogrid
- Effect of increased RES penetration into the grid
  - Need to provide flexibility
  - Power quality issues (overvoltages, reverse flow, etc.)
  - Demand side management and demand response
- Interconnection of RES units with the grid
  - Power electronics for grid integration of RES
  - Types and characteristics of modern power inverters
  - Selection, dimensioning, settings and calculations
  - Electrical characteristic and parameters of photovoltaic (PV) panels
  - Detailed design of PV systems with inverters
  - Special software
- Electricity Storage using batteries
  - Use storage for self-consumption and reduce demand
  - Cooperation of different storage systems with different power / speed characteristics
  - Energy modeling, load and generation profiles
  - Design and configuration of typical PV installations with storage

- Detailed examples
- Financial evaluation of RES investments in electricity grids
  - The importance of the electricity market
  - Key support schemes for RES and important parameters
  - Available tools and examples of financial evaluation

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*	• Support of learning process through e-class platform. • Specialized simulation software of power electronics systems
TEACHING METHODS *The manner and methods of are described in detail:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Group project (100%): - Complete design and application of grid integration of a PV system on a building - Presentation of group project (10%)

Activity	***Semester Workload***
Lectures	24
Group project	39
Individual study	60
Individual exam	1
Group exam	1
Course Total	***125***

5. ATTACHED BIBLIOGRAPHY

Suggested bibliography:

- Electricity and electronics for renewable energy technology - an introduction, Ahmad Hemami, Taylor & Francis (2016)
- Electric Energy: An Introduction, Mohamed El Sharkawi, CRC Press (2013)
- Electric Energy Storage Systems - Flexibility Options for Smart Grids, Przemyslaw Komarnicki, Pio Lombardi, Zbigniew Styczynski, Springer-Verlag Berlin Heidelberg (2017)

- Related academic journals:

- IEEE POWER AND ENERGY
- ELSEVIER'S APPIED ENERGY JOURNAL
- ELSEVIERS' RENEWABLE ENERGY JOURNAL

MECHANICAL ENERGY SYSTEMS

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0181**	**SEMESTER**	1st
COURSE TITLE	MECHANICAL ENERGY SYSTEMS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES108/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aims to deliver specialized knowledge for technology, analysis, design and optimization of existing power production and distribution.

Upon successful completion student would be capable to:

1. Thoroughly know characteristics and operation of all existing power production technologies
2. Accomplish full analysis, design and evaluation of energy installation and units.
3. Develop integrated studies for energy units optimization

General Skills

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
.....
Others…
.....

Decision-making
Working independently
Team work
Working in an international environment

Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

1.Introduction to energy systems.
2.Properties of pure substances, gases and liquids.
3.Internal combustion engines.
4.Gas turbines.
5.Steam generators and steam turbine plants.
6.Steam power cycles.
7.Cogeneration of power and heat.
8.Combined gas-steam cycles.
9.Refrigerators and heat pumps.
10. Optimization of energy systems.
11. Thermal design and optimization of energy systems

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of teaching process via the electronic platform e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final examination (100%) including: • analysis of theoretical issues based on student knowledge and judgement, • solution of relative exercises.

Activity	***Semester Workload***
Lectures	24
Group project	39
Individual study	60
Individual exam	1
Group exam	1
Course Total	***125***

6. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Cengel A.Y., and Boles M.A., Thermodynamics: An Engineering Approach, 8th Ed., McGraw Hill, 2015.
2. .Cengel A.Y., and Boles M.A., Θερμοδυναμική για Μηχανικούς, 7η Έκδοση, Εκδόσεις ΤΖΙΟΛΑ, Θεσσαλονίκη, 2011 (ή οποιαδήποτε άλλη Ελληνική έκδοση).
3. Bejan A., Advanced Engineering Thermodynamics, 3rd Ed., John Wiley & Sons Inc., 2006.
4. Heywood J. B., Internal Combustion Engine Fundamentals, Mc Graw Hill, 1988
5. Πολυζάκης Α., Λειτουργία Αεριοστροβίλων και Παραγωγή Ενέργειας – Προώθηση (Θεωρία), HEAT COOL POWER, 2012.
6. Nag P.K., Power Plant Engineering, 4th Ed., Mc Graw Hill., 2014.
7. Bejan A., Tsatsaronis G., and Moran M., Thermal Design and Optimization, John Wiley & Sons Inc., 1996.
8. Weedy B.M., and Cory B.J., Μεταφορά και διανομή ηλεκτρικής ενέργειας, Εκδόσεις ΙΩΝ

9. Jenkins et. al. Distributed Generation, IET, 2010, ISBN 978-1-84919-116-6

- Related academic journals

4. ENERGY
5. ENERGY MANAGEMENT
6. JOURNAL OF POWER SOURCES
7. EEE POWER AND ENERGY MAGAZINE

RENEWABLE ENERGY TECHNOLOGIES

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE UNIT CODE	**MN0191**	**SEMESTER**	1ST
COURSE TITLE	RENEWABLE ENERGY TECHNOLOGIES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2,8	6
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES101/

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

Guidelines for writing Learning Outcomes

The course aims to introduce students in the modern renewable energy technologies, and issues arising from climate change. Upon the successful course finalization, students would be able to present a thorough and complete view on subjects of solar energy, wind energy, biomass, geothermal energy, hydraulic energy and ocean energy.

General Skills

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and information with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working Independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	……..

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making

Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

1. Climate change and sustainability.
2. Depletion of energy sources and necessity for renewable power.
3. Thermal solar technologies.
4. Photovoltaic solar technologies.
5. Hydroelectric power technologies.
6. Wind power technologies.
7. Biomass power technologies.
8. Waste power technologies.
9. Geothermal power technologies.
10. Ocean power technologies.
11. Renewable energy systems life-cycle analysis.

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*	• Support of learning process through e-class platform.
TEACHING METHODS *The manner and methods of are described in detail:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS..*	<table><tr><th>***Activity***</th><th>***Semester Workload***</th></tr><tr><td>Lectures</td><td>36</td></tr><tr><td>Group project</td><td>66</td></tr><tr><td>Individual study</td><td>42</td></tr><tr><td>Individual exam</td><td></td></tr><tr><td>Group exam</td><td></td></tr><tr><td>***Course Total***</td><td>***150***</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	I. Individual Projects (100%): - solution of selected problems - Case studies - Development of best solution methodology - Public Presentation

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. **Renewable Energy Technologies,** Jean-Claude Sabonnadiere, ISBN: 978-1-84821-135-3, 477 pages, July 2009, Wiley-ISTE
2. Renewable Energy, Technology, Economics and Environment, Editors: **Kaltschmitt**, Martin, **Streicher**, Wolfgang, **Wiese**, Andreas (Eds.) , ISBN 978-3-540-70949-7, 2007, XXXII, 564 p.
3. **Advanced Renewable Energy Sources: RSC** , Gopal Nath Tiwari, Rajeev Kumar Mishra, 562 pages, **Publisher:** Royal Society of Chemistry (November 25, 2011)
4. C.R.E.S. webpage www.cres.gr

- Related academic journals:

1. Applied Energy (Elsevier)
2. Renewable Energy (Elsevier)
3. Renewable and Sustainable Energy Reviews (Elsevier)

B. 2nd SEMESTER COURSE OUTLINES
SOLAR ENERGY SYSTEMS

6. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDY	POST-GRADUATE		
COURSE CODE	**MN0211**	**SEMESTER**	2nd
COURSE TITLE	SOLAR ENERGY SYSTEMS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7,5
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES106/

7. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

Guidelines for writing Learning Outcomes

The aim of this course is the development of deep knowledge and capability to analyze and design solar thermal systems to cover thermal loads and of photovoltaic systems to cover electrical loads. Upon the accomplishment of the subject students would design systems which can support fully or partially to monthly estimated loads, succeeding fossil fuels conservation and environmental impacts minimization.

General Skills

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and information with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working Independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*

Working in an interdisciplinary environment	.....
Production of new research ideas	*Others…*
	.....

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

8. SYLLABUS

The course is outlined in 13 lectures covering the following:

1. Solar energy & Solar geometry
2. Thermal conversion of solar energy
3. Conversion units – flat solar collector
4. Energy balance – solar collector's efficiency
5. Storage of solar thermal energy
6. Calculation of thermal loads
7. f-chart method
8. Φ-f chart method
9. Photovoltaic conversion of solar energy
10. Photovoltaic systems
11. Design of stand-alone photovoltaic systems
12. Grid connected photovoltaic

9. 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*	• Support of learning process through e-class platform.
TEACHING METHODS *The manner and methods of are described in detail:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	
STUDENT PERFORMANCE EVALUATION	Final written examination (100%):

Activity	***Semester Workload***
Lectures	39
Group project	
Individual study	70
Individual exam	
Group exam	78.5
Course Total	187,5

Description of the evaluation procedure *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	- Problems solution - Case study - optimization methodology

10. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. J. Duffie & W.A. Beckman, Solar Engineering of Thermal Processes, 4th Edition, 936 pages, May 2013, ISBN: 978-0-470-87366-3**,** John Wiley & Sons
2. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Revised Edition, May 22, 2002, 525 Pages, ISBN 9780849324093, CRC Press
3. Konrad Mertens, Photovoltaics: Fundamentals, Technology and Practice, ISBN: 978-1-118-63416-5, 294 pages, February 2014, John Wiley & Sons
4. Handbook of Photovoltaic Science and Engineering, 2nd Edition, Antonio Luque (Editor), Steven Hegedus (Co-Editor), ISBN: 978-0-470-72169-8, 1162 pages, December 2010, John Wiley & Sons

- Related academic journals:

1. Applied Energy (Elsevier)
2. Renewable Energy (Elsevier)
3. Renewable and Sustainable Energy Reviews (Elsevier)

WIND ENERGY SYSTEMS OUTLINE

4. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0221**	**SEMESTER**	2nd
COURSE TITLE	**WIND ENERGY SYSTEMS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES105/

5. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of this course is the development of deep knowledge and understanding of the operation of contemporary wind turbines. Furthermore, special emphasis is put on investigating the optimum exploitation of the available wind potential, on wind park design and on the implementation of a wind power project. Moreover, the environmental and financial performance of wind power installations is also investigated along with special topics like the offshore wind power activity, the wind power integration etc.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
……..

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

6. SYLLABUS

The course is outlined in several units covering the following:

1. Energy Balance of Our Planet
2. Renewable Energy Sources (RES) Contribution
3. Comparison between Fossil Fuels & RES(Wind mainly)
4. Introduction to Wind Energy Technology
5. Wind Power Industry and Markets
6. Fundamental Principles of Wind Energy Exploitation
7. Technology of Modern Wind Turbines
8. Wind Potential Evaluation-Wind Parks
9. Wind Potential-Resource Analysis
10. Wind Energy Prediction Analysis
11. Technical Availability of Wind Parks
12. Financial Evaluation of Wind Energy Projects
13. Environmental Assessment of Wind Parks
14. Social Approval of Wind Energy Applications
15. Wind Farm Development
16. Design and Optimization of Wind Power Stations
17. Wind Power Project Development-Construction-Commissioning
18. Wind Park Operation and Maintenance
19. Wind Energy Integration in Electrical Grids
20. Offshore Wind
21. Special Wind Energy Applications (Hybrid Systems, Stand-alone, Desalination, etc.)
22. Future Development of Wind Energy

5. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures and laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of teaching process via the electronic platform e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure*	I. Individual Projects (30%): - solution of selected problems

Activity	***Semester Workload***
Lectures	39
Individual Projects	78,5
Non guided study	70
Course Total	187,5

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	- Case studies - Development of best solution methodology II. Written final examination (70%) including: - analysis of theoretical issues based on student knowledge and judgement, - solution of relative exercises.

7. ATTACHED BIBLIOGRAPHY

Προτεινόμενη Βιβλιογραφία :

1. "**Wind Energy**" Volume of the Comprehensive Renewable Energy Encyclopedia by Elsevier, published May 2012, ISBN 978-0080878720 (*Volume Editor J.K. Kaldellis*)
2. "**Computational Applications of Soft Energy Resources: Wind Energy-Hydro Power**", Stamoulis Editions, Athens, 2005; ISBN: 960-351-631-7, (*J.K. Kaldellis, K. Kavadias*)
3. "**Wind Energy Management**", Stamoulis Editions, Athens, 1999; ISBN: 960-351-255-9, (*J.K. Kaldellis*)

-Συναφή επιστημονικά περιοδικά:

1. Applied Energy (Elsevier)
2. Renewable Energy (Elsevier)
3. Renewable and Sustainable Energy Reviews (Elsevier)

EMERGING RENEWABLE ENERGY TECHNOLOGIES AND ENERGY STORAGE

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0231**	**SEMESTER**	2nd
COURSE TITLE	EMERGING RENEWABLE ENERGY TECHNOLOGIES AND ENERGY STORAGE		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES113/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course provides participants an in depth investigation of new emerging renewable technologies and energy storage systems

1. Introduction to Energy Storage (ES).
2. Economic benefits and policies of ES.
3. Mechanical ES: Pumped hydroelectric, Compressed Air ES, Flywheels.
4. Thermal ES: Sensible heat ES, Latent heat ES, Thermochemical ES, Seasonal ES.
5. Chemical ES: Biomass and biofuels, Non renewable hydrogen, Renewable hydrogen, Hydrogen storage, Hydrogen economy.
6. Electrochemistry, Catalysis, Electrocatalysis, Chemical Kinetics.
7. Electrochemical ES: Batteries, Flow batteries, Fuel Cells.
8. Electrical ES: Capacitors, Supercapacitors, Superconducting Magnet ES.
9. Design and modeling of energy storage systems.
10. Design and modeling of electrochemical power generation.
11. New materials and innovative processes.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*

Working in an international environment *Working in an interdisciplinary environment* *Production of new research ideas*	*Production of free, creative and inductive thinking* *……* *Others…* *……..*

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

12. Introduction to Energy Storage (ES).
13. Economic benefits and policies of ES.
14. Mechanical ES: Pumped hydroelectric, Compressed Air ES, Flywheels.
15. Thermal ES: Sensible heat ES, Latent heat ES, Thermochemical ES, Seasonal ES.
16. Chemical ES: Biomass and biofuels, Non renewable hydrogen, Renewable hydrogen, Hydrogen storage, Hydrogen economy.
17. Electrochemistry, Catalysis, Electrocatalysis, Chemical Kinetics.
18. Electrochemical ES: Batteries, Flow batteries, Fuel Cells.
19. Electrical ES: Capacitors, Supercapacitors, Superconducting Magnet ES.
20. Design and modeling of energy storage systems.
21. Design and modeling of electrochemical power generation.
22. New materials and innovative processes.

6. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures and laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of teaching process via the electronic platform e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final examination (100%) including: • analysis of theoretical issues based on student knowledge and judgement, • solution of relative exercises.

Activity	*Semester Workload*
Lectures	39
Group project	
Individual study	70
Individual exam	
Group exam	78.5
Course Total	187,5

8. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Ter-Gazarian A.G., Energy Storage for Power Systems, 2nd Ed., The Institution of Engineering and

Technology, 2011.
2. Barnes F.S., and Levine J.G., Large Energy Storage Systems Handbook, CRC Press, 2011.
3. Warnick C.C., Mayo H.A., Carson J.L., Sheldon L.H., Hydropower Engineering, Prentice Hall Inc., 1984.
4. Genta G., Kinetic Energy Storage: Theory and Practice of Advanced Flywheel Systems, Butterworth & Co., 1985
5. Dincer I., Rosen M.A., Thermal Energy Storage: Systems and Applications, 2nd Ed., John Wiley & Sons, 2011.
6. Kalaiselvam S., and Parameshwaram R., Thermal Energy Storage Technologies for Sustainability, Elsevier Inc., 2014.
7. Shlogl R. (Ed)., Chemical Energy Storage, Walter de Gruyter Gmbh., 2013.
8. Luque R., Campelo J., Clark J., Handbook of Biofuels Production, Woodhead Publishing Limited, 2011.
9. Scragg A.H., Biofuels: Production, Application and Development, CAB International, 2009.
10. Gandia L.M., Arzamendi G., Dieguez P.M. (Eds)., Renewable Hydrogen Technologies, Elsevier B.V., 2013.
11. Dell R.M., and Rand D.A.J., Understanding Batteries, The Royal Society of Chemistry, 2001
12. Crompton T.R., Battery Reference Book., 3rd Ed., Reed Educational and Professional Publishing Ltd., 2000.
13. Larminie J., and Dicks A., Fuel Cell Systems Explained, 2nd Ed., John Wiley and Sons Ltd., 2003.
14. Vielstich W., Lamm A., Gasteiger H.A., Handbook of Fuel Cells: Fundamentals, Technology, Applications, 2003.
15. Conway B.E., Electrochemical Supercapacitors, Kluwer Academic/Plenum Press, 1999.
16. Yu A., Chabot V., Zhang J., Electrochemical Supercapacitors for Energy Storage and Delivery, CRC Press, 2013

- Related academic journals

1. Energy Storage
2. International Journal of Hydrogen Energy
3. Journal of Power Sources
4. Journal of Electrochemical Society
5. Journal of Applied Electrochemistry

SMART GRIDS

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDY	POST-GRADUATE		
COURSE CODE	**MN0241**	**SEMESTER**	2nd
COURSE TITLE	Smart Grids		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7,5
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES110/

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

Guidelines for writing Learning Outcomes

The aim of this module is to deliver an introduction to Smart Grids and further analysis of the smart grids components and principles. The basic components and principles of the electricity grid are analyzed together with the interaction of the grid to the Renewable Energy Sources. On completion, the students will be able to:

1. Realize the necessity of the smart grids.
2. Realize the operation principles of a microgrid with increased RES penetration.
3. Define the technologies that constitute a grid smart.

General Skills

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working Independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*.....*
Production of new research ideas	

• Search, analyze and synthesize data and information using the necessary

technologies
- Use of foreign language bibliography
- Decision making
- Teamwork in an interdisciplinary environment
- Project management and scheduling
- Oral presentation of results

3. SYLLABUS

The course consists of the following sections:

Distributed Electrical Power Generation

- Necessity for connection in electricity network.
- Types and characteristics of distributed generation units.
- Impediments on the Penetration of Distributed Generation Units into the Network. The Role of Existent Electrical Grid.
- Protection of the supply network and problems due to distributed production units.
- Meters and smart meters.
- Internal and external transmission substations. Limitations due to distributed production units.
- Simulation of the distribution network of an urban area.
- Smart Grids and Possible Ways for Smart Grid Implementations for the Increase of Penetration of Distributed Generation Units into Electricity Network.
- The microgrid as a necessary construction unit of the smart electrical grid, Definition and characteristics, topologies, smart meters.
- Implementation of topology - Microgrid control
- Primary control (voltage regulation and frequency of weak or islanded microgrid) without software use.
- Primary control (voltage regulation and frequency of weak or islanded microgrid) with software use.
- Secondary microgrid control with software use. Application of policies for energy management, demand and distributed productions.
- Tertiary microgrid control for low cost operation.
- Microgrid control with forecast models . Artificial intelligence
- Interactivity with protocols of energy management and demand in buildings.

Simulation of microgrids and weak networks in PSCAD

- Experimental data based simulation of the microgrid units. Models of photovoltaics, wind turbines, batteries and loads.
- Behavior of the simulation model and comparison with experimental data.
- Expansion of the simulation model in IEEE networks.
- The role of smart cars on the smart grid.

European Guidelines for Smart Grids

- Architectures, Protocols, Interfunctionality, The role of smart meters.
- The situation in EU member states relative to smart grid and smart meter implementation

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning etc. .*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	• Support of learning process through e-class platform.

Use of ICT in teaching, laboratory Education, communication with students	• Specialized simulation software of power electronics systems, laboratory and relevant tools.
TEACHING METHODS *The manner and methods of are described in detail:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	I. Group project (60%): - Investigation of existing smart grids case studies or study of a smart microgrid. III. Presentation of group project (40%)

Activity	***Semester Workload***
Lectures	39
Group project	34
Individual study	60,5
Individual exam	31
Group exam	21
Course Total	**187,5**

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Smart grids notes – Dimitrios Tsiamitros (e-class)

BUILDING ENERGY SYSTEMS

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	*Postgraduate*		
COURSE CODE	**MN0251**	**SEMESTER**	2nd
COURSE TITLE	BUILDING ENERGY SYSTEMS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES103/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The purpose of the course is to introduce students to Regulation Energy Performance of Buildings and provide knowledge in heat pump technology, geothermal and electricity cogeneration. Also, to provide knowledge for energy analysis and evaluation of energy saving systems. Upon completion, students will have the opportunity to present a comprehensive view of energy saving technologies in buildings.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
……..

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently

Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

1. INTRODUCTION TO ENERGY (ENERGY - FUEL - ENERGY MANAGEMENT - STATISTICS - ASSESSMENT & ENERGY MEASUREMENT PARAMETERS)
2. OBJECTIVE AND DESIGN OF AN ENERGY STUDY - INSPECTION
3. ENERGY BUILDINGS (BUILDING SHELL AND THERMAL INSULATION ADEQUACY)
4. ENERGY BUILDINGS (HEATING AND ELECTRICITY SYSTEMS - PASSIVE SOLAR SYSTEMS)
5. HEAT PUMPS
6. GEOTHERMAL ENERGY
7. COGENERATION
8. ENERGY MANAGEMENT IN BUILDINGS (DEGREE DAYS METHOD – CUMULATIVE SUM METHOD - BASE TEMPERATURE METHOD)
9. ENERGY MANAGEMENT IN BUILDINGS (BIN METHOD)
10. ENERGY SYSTEMS - COMPARISON AND FEASIBILITY ANALYSIS
11. ELECTRICITY & LIGHTING
12. CONTROL SYSTEMS, TECHNOLOGIES AND ENERGY BUILDING UPGRADE
13. APPLICATIONS

7. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures and laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of teaching process via the electronic platform e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final examination (100%) including: • analysis of theoretical issues based on student knowledge and judgement, • solution of relative exercises.

Activity	*Semester Workload*
Lectures	39
Individual Projects	78.5
Non guided study	70
Course Total	187.5

9. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. T.O.T.E.E. 20701-1 / 2010
2. T.O.T.E.E. 20701-2 / 2010
3. T.O.T.E.E. 20701-3 / 2010

4. T.O.T.E.E. 20701-4 / 2010
5. T.O.T.E.E. 20701-5 / 2010
6. TECHNICAL CHAMBER OF GREECE: INTRODUCTION IN THE ENERGY SECTOR
7. TECHNICAL CHAMBER OF GREECE: SAVING TECHNOLOGIES AND ELECTRICAL ENERGY MANAGEMENT SYSTEMS ¨
8. Dimitris ARAVANTINOS: HEAT ISOLATION ADEQUACY OF BUILDINGS
9. TG THEODOSIOU: ENERGY PERFORMANCE OF BUILDINGS
10. APOSTOLOS K. MICHOPOULOS: SPECIFICATIONS OF HEATING AND ELECTRICITY INSTALLATION AND CALCULATIONS
11. PETROLIAGKI MARGARITA: ENERGY AUDIT BUILDING & ENERGY INSPECTORS
12. TSIKALOUDAKI KATERINA: PROCEDURES OF AN ENERGY AUDIT BUILDING AND COLLECTION NECESSARY DATA
13. PAUL O' CALLAGHAN "ENERGY MANAGEMENT"

PASSIVE AND BIOCLIMATIC SYSTEMS USE

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0261**	**SEMESTER**	2nd
COURSE TITLE	PASSIVE AND BIOCLIMATIC SYSTEMS USE		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7,5
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES102/

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*

Guidelines for writing Learning Outcomes

The aim of this course is the development of deep knowledge in design of buildings adapted to local climate conditions, maximizing inhabitants' comfort, and minimizing energy consumption. Upon the accomplishment of the subject students would design buildings under bioclimatic principles with almost zero consumption and negligible environmental impacts.

General Skills

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working Independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	……..

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making

Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

The course is outlined in 13 lectures covering the following:

1. Climate & Environment
2. Structured environment – urban climate
3. Climate factors and buildings energy behavior
4. Building cell & thermal behavior
5. Solar gains and solar protection
6. Indoor climate – thermal comfort
7. Passive heating systems
8. Natural cooling in buildings
9. Natural lighting in buildings
10. Building surroundings – microclimate
11. Optimal cost methodology

4. TEACHING AND LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning etc. .*	Face-to-face lectures and laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory Education, communication with students*	Support of teaching process via the electronic platform e-class.
TEACHING METHODS *The manner and methods of are described in detail:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	<table><tr><th>***Activity***</th><th>***Semester Workload***</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Group project</td><td></td></tr><tr><td>Individual study</td><td>70</td></tr><tr><td>Individual exam</td><td></td></tr><tr><td>Group exam</td><td>78.5</td></tr><tr><td>***Course Total***</td><td>187,5</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	I. Individual Projects (100%): - solution of selected problems - Case studies - Development of best solution methodology - Public Presentation

5. ATTACHED BIBLIOGRAPHY

Suggested bibliography:

1. **Carbon-Neutral Architectural Design,** Pablo M. La Roche, ISBN: 978-1-43984-513-4 December 15, 2011, CRC Press
2. **Cost Optimal and Nearly Zero-Energy Buildings (nZEB): Definitions, Calculation Principles and Case Studies**, Jarek Kurnitski, ISBN 978 978-1-4471-5609-3, 2013, Springer-Verlag London.
3. **Ενεργειακός σχεδιασμός και παθητικά ηλιακά συστήματα κτιρίων**, Παπαδόπουλος Μιχάλης, Αξαρλή Κλειώ, ISBN: 978-960-599-019-0, 2015,ΕΚΔΟΣΕΙΣ ΚΥΡΙΑΚΙΔΗ ΜΟΝΟΠΡΟΣΩΠΗ ΙΚΕ
4. **ECOΔOMEIN**, SUE ROAF, MANUEL FUENTES, STEPHANIE THOMAS, ISBN: 978-960-8455-66-5, 2009, ΨΥΧΑΛΟΣ ΦΙΛΙΠΠΟΣ & ΣΙΑ ΕΚΔΟΤΙΚΗ Ο.Ε.

- Related academic journals:

1. Applied Energy (Elsevier)
2. Renewable Energy (Elsevier)
3. Renewable and Sustainable Energy Reviews (Elsevier)

ENERGY CONSERVATION SYSTEMS AUTOMATION

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0271**	**SEMESTER**	2nd
COURSE TITLE	ENERGY CONSERVATION SYSTEMS AUTOMATION		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, Tutorials, Laboratory	3	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Scientific Expertise
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES112/

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aims to introduce the student to the concepts related to the topic of automation of building facilities in order to save energy and generally of intelligent management of buildings.

The students are required to implement a selection of laboratory experiments that cover all the main types of building automation, providing relative laboratory reports.

Furthermore, students are required to complete various assignments, dealing with simulating of building automation systems using specialized software, solving of problems and practical applications.

On successful completion of this module the student will be able to:

- Recognize and describe the system devices
- Explain the principles of building automation systems
- Explain in detail the basic functions of building automation system devices
- Implement experiments in the laboratory and analyze their operation
- Design simple automation systems and Simulate them using special software and Lab equipment
- Collaborates with fellow students in project development

General Skills

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Search for, analysis and synthesis of data and information, with the use of the necessary technology*
Adapting to new situations	*Adapting to new situations*
Decision-making	*Decision-making*
Working independently	*Working independently*
Team work	*Team work*
Working in an international environment	*Working in an international environment*
Working in an interdisciplinary environment	*Working in an interdisciplinary environment*
Production of new research ideas	*Production of new research ideas*
	……
	Others…
	……..

- Search, analyze and synthesize systems using necessary technologies
- Individual work
- Decision making
- Design and Project Management
- Teamwork

3. SYLLABUS

The course consists of the following sections:

1. Definition and Development of Buildings Installations Automation
2. Digital Controllers, Sensors and Actuators
3. Technologies of local networks and the Internet in the management building installations
4. Communication Standards for management building installations
5. Process Control, PID controllers and adaptive control
6. Climate Control systems, cooling, lighting and building security

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*	• Support of the learning process through the e-class electronic platform. • Specialized Industrial simulation software.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of*	I. Written examination (35%) comprising: – Multiple choice or yes/no questions

Activity	***Semester Workload***
Lectures	26
Tutorials focusing on methodology application and case studies	13
Assignments based on lectures and tutorials	16
Laboratory experiments	26
Group assignments on the laboratory experiments	20.5
Construction of simple control system	16
Individual Study	70
Course Total	***187.5***

evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	– Analysis of theoretical subjects requiring the judgment of the student – Solving problems relating to control systems II. Assignments on the Lectures/Tutorials part (15%) – Problem solving – Simulation of automation applications III. Laboratory part (50%) – Group reports on the laboratory experiments (20%) – Individual work, Realize of a simple control system (20%) – Laboratory examination (30%)

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Intelligent buildings and building automation / Shengwei Wang.
2. "Βιομηχανικά δίκτυα και εξελιγμένος προγραμματισμός PLC", Χρήστος Παπαζαχαρίας Εκδόσεις ΒΡΕΤΤΟΣ [ISBN: 978-960-98307-1-3]
3. Lecture notes

SMART BUILDINGS DESIGN

1. GENERAL

SCHOOL	POLYTECHNIC		
ACADEMIC UNIT	MECHANICAL ENGINEERING (responsible)		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**MN0281**	**SEMESTER**	2nd
COURSE TITLE	SMART BUILDINGS DESIGN		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/RES111/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aims to introduce the meaning of intelligent management of energy consumption in the design of intelligent buildings. Basic rules for smart electrical installations, BUS systems and KNX technique are analyzed. KNX is the world standard for intelligent electrical installations. This technique is the most widely used both in Europe and in Greece. At the end, students will have the ability to analyze and programme a basic installation of intelligent energy management.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
……..

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making

Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

1. Introduction to Intelligent Electrical Installations
2. Topology of Smart Electrical Installations
3. Communication in Smart Electrical Installations
4. Base materials for Smart Electrical Installations
5. Structure and Types of BUS devices
6. Programming of Intelligent Electrical Installations (ETS)
7. Practical applications
8. Constructing smart electrical installations

8. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face lectures and laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of teaching process via the electronic platform e-class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	I. Individual Projects (50%): - solution of selected problems - Case studies - Development of best solution methodology II. Team projects in complex applications of large scale applications (50%)

Activity	***Semester Workload***
Lectures	39
Individual Projects	78,5
Non guided study	70
Course Total	187,5

10. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

a. EIB/KNX: Η νέα τεχνική ηλεκτρικών εγκαταστάσεων κτιρίων στην πράξη, Γεώργιος Γρ. Σαρρής
b. EIB/KNX-Anlagen, Rainer Scherg
c. Ηλεκτρικές Εγκαταστάσεις Κτιρίων: Τεχνική EIB-instabus, Στέφανος Τουλόγλου

C. 3rd SEMESTER COURSE OUTLINE
DIPLOMA THESIS

1. GENERAL

SCHOOL	**POLYTECHNIC**		
ACADEMIC UNIT	**MECHANICAL ENGINEERING (responsible)**		
LEVEL OF STUDIES	**POST-GRADUATE**		
COURSE CODE		**SEMESTER**	**3rd**
COURSE TITLE	**DIPLOMA THESIS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
RESEARCH-WRITING-PRESENTATION		30
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	RESEARCH PROJECT
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Either Greek or English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://ape.uowm.gr/index.php?option=com_content&view=article&id=57&Itemid=218&lang=el

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This extended written project is an extensive study in a scientific area of the Master. The thesis is meant to demonstrate that the student is able to work and to pursue science in a specific subject.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations

Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management

3. SYLLABUS

Each student can choose a thesis topic to develop the thesis. The assignment of the thesis can be undertaken during the second semester and preparation is undertaken throughout the period of the third semester of study

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	
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.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	I. Individual Project (100%): - solution of selected problems - Case studies - Development of best solution methodology - Public Presentation

Activity	*Semester workload*
Individual Study	400
Thesis writing	250
Presentation	100
Course total	750

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals: