EEE-A.8.1.7 BUILDING ENERGY ANALYSIS

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	EEE-A.8.7	SEMESTER	8th
COURSE TITLE	BUILDING ENERGY ANALYSIS		

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 and practice exercises	3	4
Total	3	
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*	Specialty Course
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (Materials In English for Erasmus Students)
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/EEE196/

(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 objectives of the course are:

- Understanding the importance of energy assessment of buildings in order to implement appropriate energy saving interventions for improving their energy performance.
- Getting familiar with the requirements of European legislation for the energy performance of buildings.
- Getting familiar with the concepts, the technical parameters and the different methodologies available for the evaluation of the effect that individual building elements (opaque or transparent) and electromechanical systems have on the energetic behaviour of buildings, in accordance with environmental conditions and

special requirements of each type of use.

- Assessing the contribution of additional parameters to the energy behaviour of buildings, such as the human presence and the use of electronic, electrical or other devices.
- Assessing the contribution of renewable energy sources and advanced automation systems to the energy performance of buildings.
- Getting familiar with different energy saving interventions and technologies, in accordance with the specific requirements of each construction type.
- Enhancing the knowledge and critical ability of the student in order to assist him/her in transferring the theoretical knowledge into practice.

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

- Understand and apply European and national legislation on the requirements for energy efficient buildings.
- Study and evaluate how the energy performance of buildings is affected by different structural elements of the building envelope or individual electromechanical installations, such as heating, cooling or air-conditioning installations, hot water installations and lighting installations. Also, be able to consider other parameters such as heat gains from the presence of individuals and devices.
- Take into account the impact of renewable energy sources on energy consumption.
- Be familiar with different methods of energy analysis, such as static methods, dynamic methods and quasi-steady state methods. Also, be aware of their specific features and capabilities, along with considering popular software packages that implement these methods in practical applications.
- Propose modern energy interventions in buildings and evaluate their effectiveness in the overall energy consumption reduction, in relation to the total economic cost and the specific application requirements.
- Apply their theoretical background in the energy analysis of different types of buildings, such as domestic or tertiary sector 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	*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…*
	…….

The course aims in developing the following skills:

- Search for analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Promoting free, creative and inductive thinking

(3) SYLLABUS

The course comprises the following topics:

- General information on the energy performance of buildings.
- Embodied energy, operation energy and equivalent greenhouse gas emissions.
- Requirements of European legislation for energy efficient buildings and for energy certification and labeling. International standards for the determination of the energy performance of buildings.
- Design conditions and parameters.
- Behavior of opaque and transparent building elements.
- Static and dynamic models for energy calculations. Data-driven energy analysis models. The quasi-stable state physical model.
- Determination of thermal zones.
- Parameters and calculations for the assessment of energy exchanges between indoor and outdoor environments.
- The influence of the thermal capacity of building elements on their thermal inertia.
- Heat transfer due to infiltration and mechanical ventilation.
- Solar gains. Principles of solar geometry. Assessment of incident solar radiation in horizontal, vertical and inclined structural elements. The effect of different shading types on solar gains.
- Internal heat gains due to human presence, devices and equipment. The energy consumption of electronic and electrical appliances or other devices depending on the type of use of the building.
- Requirements for lighting, lighting loads and natural lighting.
- Heating, cooling and air conditioning loads. Operation of heating, cooling and air conditioning systems. Operation and losses in heating and cooling distribution networks.
- Requirements for hot water systems.
- Renewable energy systems and their contribution to the energy performance of buildings.
- Building automation and control systems.
- Energy efficient interventions in buildings and the evaluation of their effect according to the type of each intervention and the estimated implementation cost.
- Energy measurements in buildings.
- Use of dedicated energy analysis software for energy analysis in buildings.

(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*	• Teaching using ICT infrastructure • Use of ICT in practice exercises by using special software

	• Use of ICT through the course's website for the distribution of educational materials in electronic form or other supplementary informative materials. The available e-class platform provides synchronous or asynchronous communication capabilities, as well as electronic submission of exercises or assignments.
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*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>28</td></tr><tr><td>Practice exercises</td><td>12</td></tr><tr><td>Study of learning materials</td><td>46</td></tr><tr><td>Preparation of assignments/projects</td><td>19</td></tr><tr><td>Course total</td><td>105</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.*	Evaluation Languages: Greek, English (for Erasmus students) Methods of evaluation: • Final Written Examination on the theoretical part of the course including solving exercises and problems of graded difficulty (75%) • Assignments/projects (25%) The final mark of the course is: 75% x of final written examination mark + 25% x of average assignments/projects mark Full information on how to evaluate is announced at the beginning of the semester at the course website.

(5) ATTACHED BIBLIOGRAPHY

1. L.D. Danny Harvey, 'A Handbook on Low-Energy Buildings and District Energy Systems: Fundamentals, Techniques, and Examples', Routledge, 2015.
2. S. Boemi, O. Irulegi, M. Santamouris, 'Energy Performance of Buildings, Energy Efficiency and Built Environment in Temperate Climates', Springer 2016.
3. S. Ferrari, V. Zanotto, 'Building Energy Performance Assessment in Southern Europe', Springer, 2016.
4. 2017 ASHRAE Handbook - Fundamentals, ASHRAE, 2017.
5. Technical directives TOTEE 20701-1 to 5, YPEKA, 2017.
6. A. Moronis, Lecture notes in Building Energy Analysis, 2018.