Course Title	Energy Assessment of Buildings				
Course Code	ME 307				
Course Type	Elective				
Level	BSc Level				
Year / Semester	3rd year / 5th semester				
Teacher's Name	Dr.-Ing. Paris A. Fokaides				
ECTS	6	Lectures / week	2	Laboratories/week	1
Course Purpose	The enforcement of the European Directives on Renewable Energy Sources and on the Energy Performance of Buildings provides for the first time, a set of integrated regulatory tools, towards a holistic approach of energy use, considering energy, environmental and economic parameters of energy policies and their implementation. The course Energy Assessment of Buildings aims to develop detailed knowledge and critical understanding of the core skills in rational use of energy sources in the energy design of buildings and in achieving high energy efficiency of new and existing buildings. By completion of this course the students will obtain an in-depth comprehension of the energy assessment of the performance of buildings. The course also aims to introduce some major definitions related to smart buildings and smart cities.				
Learning Outcomes	1. Analyse the basic principles that govern the energy transfer from and to the building envelope 2. Explain the parameters that affect the indoor thermal comfort 3. Calculate the relative indoor comfort indexes. 4. Outline the best practices in building's shell thermal insulation 5. Perform standard calculations for the overall heat transfer coefficient of building elements 6. Assess the building losses from vulnerable building elements such as the glazed areas and the thermal bridges 7. Interpret the principles related to the energy performance certification (EPCs) in process and 8. Generate an Energy Performance Certificate with the use of an appropriate software 9. Summarize the main aspects of smart buildings 10. Outline the main features of building information modelling and digital twins.				
Prerequisites	ME304 Heat Transfer		Corequisites		

Course Content	**1. Energy transfer principles** - Fundamentals of energy transfer mechanisms - Parameters affecting energy transfer mechanisms from and to the building envelope - Quantification of energy losses – worked examples **2. Indoor thermal comfort** - Energy interaction between building occumpant and building envelope - The Fanger model – worked examples - Quantification of thermal comfort indexes (PMV, PPD) - The psychrometric chart – worked examples - Building automation systems and regulation of thermal comfort **3. Building elements thermal behaviour** - Definition of the overall heat transfer coefficient of building elements - Calculation of energy losses from building elements consisting of several layers - Definition of thermal bridges and calculation of energy losses - Best practices in selection and application of buildings thermal insulation - Minimum legislative requirements in buildings thermal insulation **4. Buildings energy performance certification** - Fundamentals of calculation buildings heating and cooling loads - Building services contribution to buildings energy consumption - Definition of the operational and asset rating - Energy classification rationale – the reference building - Definition of buildings energy class – worked examples **5. Smart buildings** - Definition of smart buildings and smart cities

	- Major elements compromising a smart building - Use of building information modelling for design and operation of smart buildings. - Digital Twins and dynamic modelling of smart buildings energy performance - Integrated renewable energy technologies
Teaching Methodology	The teaching methodology of this course will be based on lecturing, demonstrating and collaborating. - Lecture notes, comprising of the fundamentals of each module of the course will be prepared and presented in class on a weekly basis. The notes will introduce the major concepts and will focus on specific learning outcomes of the course. - Demonstration activities including the solution of worked examples in class on a weekly basis. For each fundamental concept, at least one worked example will be solved during lectures. - Collaborating teaching through classroom discussion and debriefing will also be encouraged during lectures. Besides from the notes taken by students in class, all of the course material will be made available through the eLearning platform. The instructor will also be available to students during office hours or by appointment in order to provide any necessary tutoring.
Bibliography	Textbooks: 1. ASHRAE 2013 Handbook of fundamentals, ISBN: 978-1-936504-46-6 (SI) 2. VDI-Wärmeatlas, ISBN: 978-3-540-25504-8 References: - 2018/844/EC Directive on the energy performance of buildings (EPBD) - CEN/TR 15615 "Umbrella document" - EN 15603 Overall energy use and definition of energy ratings - ISO 7730:2005: Ergonomics of the thermal environment -- Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria - ISO 6946:2007: Building components and building elements -- Thermal resistance and thermal transmittance -- Calculation method - ISO 14683:2007: Thermal bridges in building construction -- Linear thermal transmittance -- Simplified methods and default values

	- ISO 13790:2008: Energy performance of buildings -- Calculation of energy use for space heating and cooling
Assessment	Students will be assessed through: - A semester assignment, concerning the calculation of the energy class of a building with the use of an appropriate software (SBEMcy) - A midterm test at the 7th week of the course, examining the fundamentals of conduction and convection - A final test at the end of the semester, in which all material will be examined. The weights of the course assessment are as follows: Assignment: 20% Midterm Exams: 20% Final Exams: 60%
Language	English