Institute for Interdisciplinary and Multidisciplinary Studies / SUSTAINABLE DEVELOPMENT / Energy and environmental refurbishment of building

Course:	Energy and environmental refurbishment of building			
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
13764	Optional	1	10	4+2+1
Programs	SUSTAINABLE DEVELOPMENT			
Prerequisites	None			
Aims	The goal of this course is to enable PhD students to become familiar with technical, environmental and cultural aspects of energy refurbishment of existing buildings. It is about elaboration of appropriate solutions and energy effects of thermal insulation of building envelope, related improvements of environmental parameters, including improvements of architectural aspects as a logical consequence of integrated refurbishment of buildings.			
Learning outcomes	Knowledge and understanding: On completion of this course the student will be able to: - interpret concept and goals of energy efficiency of buildings in general terms and specific requirements of energy refurbishment of existing buildings, - analyse energy review of a building as approved methodology for calculating of energy performance of a building, - analyse principles, technical and technological solutions of implementation of thermal insulation in relation with space conditioning and specific requirements of characteristic elements of building envelope, - reveal and assess energy needs of a building for thermal energy as expression of architectural characteristics of a building and the structure of its envelope, - reveal and assess environmental aspects of energy renovation of a building through indicators of energy efficiency, - assess and evaluate role of architectural aspects in energy renovation procedures in terms of adjustment of technical solutions of the systems for space conditioning and the systems for renewable energy sources with architecture of a building. Transferable / Key skills and other attributes: - Communication skills: oral defence of seminar paper, manner of expression at written examination. - Use of information technology: use of software tools in analysis and calculation of energy efficiency. - Analysis skills: application of appropriate analysis in solving of a building energy refurbishment. - Understanding and interpretation of problem: defining of the content of a building energy refurbishment.			
Lecturer / Teaching assistant	Dušan Vuksanović PhD Full Professor			
Methodology	Teaching (lectures and exercises), in combination with supervised work; consultations; project based teaching/learning; practical work; obtained knowledge and skills presentation			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	Introduction. Establishing and development of discipline, terminology and technical regulation.			
I week exercises				
II week lectures	Concept and content of energy refurbishment of a building. Concept founded on the natural coupling of energy and environmental aspects within energy efficiency of buildings.			
II week exercises				
III week lectures	Technical aspects of energy renovation of buildings. Energy review of a building as approved methodology for calculating of energy performance of a building.			
III week exercises				
IV week lectures	Analysis of principles, technical and technological solutions of implementation of thermal insulation in relation with space conditioning (heating and cooling) and specific requirements of characteristic elements of building envelope.			
IV week exercises				
V week lectures	Energy needs of a building for thermal energy as expression of architectural characteristics of a building and the structure of its envelope.			
V week exercises				
VI week lectures	Environmental aspects of energy renovation of a building. Indicators of energy efficiency.			
VI week exercises				
VII week lectures	Effects of the reduction of thermal energy emitted by the energy efficient buildings. Implementation of renewable energy sources as integral aspect of energy efficiency.			
VII week exercises				

VIII week lectures	Architectural aspects of energy renovation of buildings. Potentials of interventions in the domain of improvements in architectural function and especially in building envelope.
VIII week exercises	
IX week lectures	Aspects of adjustment of technical solutions of the systems for space conditioning (heating, cooling and ventilation) with architecture of a building.
IX week exercises	
X week lectures	Aspects of adjustment of technical solutions of the systems for renewable energy sources (solar hot water systems, photovoltaic systems) with architecture of a building.
X week exercises	
XI week lectures	Analysis of best practice examples – case study (consultations and discussion).
XI week exercises	
XII week lectures	Analysis of best practice examples – case study (consultations and discussion).
XII week exercises	
XIII week lectures	Analysis of best practice examples – case study through individual work (consultations).
XIII week exercises	
XIV week lectures	Individual analysis of best practice examples – case study through individual work.
XIV week exercises	
XV week lectures	Individual analysis of best practice examples – review and discussion.
XV week exercises	
Student workload	Per week 10 credits x 40/30 = 13.33 hours Structure: 2 hours of lectures 2 hours of exercises 9.33 hours of individual work Per semester Lectures and final exam: (13.33 hours) x 16 = 213.33 hours Necessary preparation before the start of the semester (administration, enrolment, verification): (13.33 hours) x 2 = 26.66 hours Total workload for the course: 10 x 30 = 300 hours Additional work for preparing correction of the final exam, including taking the exam: 0 - 60 hours (remaining time from the first and the second item to the total workload for the course of 300 hours) Structure of the workload: 213.33 hours (lectures and final exam) + 26.66 hours (preparation) + 60 hours (additional work)

Per week	**Per semester**
10 credits x 40/30=13 hours and 20 minuts 4 sat(a) theoretical classes 1 sat(a) practical classes 2 excercises **6 hour(s) i 20 minuts** of independent work, including consultations	Classes and final exam: **13 hour(s) i 20 minuts x 16 =213 hour(s) i 20 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **13 hour(s) i 20 minuts x 2 =26 hour(s) i 40 minuts** Total workload for the subject: **10 x 30=300 hour(s)** Additional work for exam preparation in the preparing exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total load for the item) **60 hour(s) i 0 minuts** Workload structure: **213 hour(s) i 20 minuts (cources), 26 hour(s) i 40 minuts (preparation), 60 hour(s) i 0 minuts (additional work)**
Student obligations	Attendance with active participation in consultations and discussions.
Consultations	
Literature	- Direktiva 2010/31/EU Europskog parlamenta i vijeća (EPBD), Službeni list Europske unije L153/13, 2010. - Pravilnik o minimalnim zahtjevima energetske efikasnosti zgrada, „Sl. list CG“, broj 23/2013, Podgorica, 2013.; www.energetska-efikasnost.me - Energetska efikasnost zgrada – Metodologija energetskog pregleda i proračuna indikatora EE, Mašinski fakultet i Arhitektonski fakultet UCG, Podgorica, 2011. - Zbašnik Senegačnik M.: Pasivna kuća, SUN ARH doo, Zagreb, 2009. - Brown G.Z., DeKay M.: Sun, Wind & Light – Architectural design strategies, John Wiley & Sons, Inc., New York, 2001 - Giebeler et al.: Refurbishment Manual – Maintanance, Conversions, Extensions; Birkhauser Basel Boston Berlin, Edition Detail Munich, 2009 - Current literature (scientific papers from international conferences and international journals)
Examination methods	Knowledge assessment is continuous during the semester, through pre-exam checks, and in the final exam. In total, student may collect max 100 points. The following is assessed: - seminar paper and other semester

			activities (homework etc.) 50%, - final exam 50%. The final exam consists of written and oral part. Written part may be realised through project task. Grades (A, B, C, D, E, F) are adjoined to collected number of points, in line with the Law of Higher Education and study rules at the University of Montenegro.			
Special remarks						
Comment						
Grade:	F	E	D	C	B	A
Number of points	less than 50 points	greater than or equal to 50 points and less than 60 points	greater than or equal to 60 points and less than 70 points	greater than or equal to 70 points and less than 80 points	greater than or equal to 80 points and less than 90 points	greater than or equal to 90 points