POLYTECHNIC OF MEĐIMURJE IN ČAKOVEC

COURSE SYLLABUS

ACADEMIC YEAR: 2020/2021

1. GENERAL COURSE INFORMATION				
1.1 Course name	**Energy sustainability and self-sustainability**			
1.2 Study program/s	Undergraduate professional study Sustainable Development			
1.3 Course status (O,E)	Electoral	**1.6 Mode of instruction (number of hours)**	**Lectures**	15
1.4 Course code	4080		**Exercises**	30
1.5 Course abbreviation	OEiS		**Seminars**	
1.6 Semester	VI		**E-learning**	
1.7 ECTS	4	**1.7 Place and time of instruction**	The premises of the Polytechnic of Međimurje in Čakovec, according to the schedule published on the website	

2. TEACHING STAFF			
2.1 Course leader/s-title	Ines Baksa, lecturer	**contact**	ibaksa@mev.hr
		contact	
2.2 Assistant/s- title		**contact**	
		contact	
2.3 Instruction held by- title		**contact**	

3. COURSE DESCRIPTION	
3.1 Course goals	The aim of the course is to train students for professional and responsible use of energy, and operational participation in proposing, designing, and implementing projects of renewable energy sources and energy efficiency.
3.2 Prerequisites	Passed exams in the course Energy Conversion, and the course Energy Plants.
3.3 Course outcomes	After successfully passing the course, the student will be able to: 1. Assess the importance of energy efficiency measures on the sustainability and self-sustainability of energy. 2. Assess the importance of renewable energy sources on the sustainability and self-sustainability of energy. 3. Recommend measures to increase the share of renewable energy sources in the energy system. 4. Valorize techno-economic budgets in small renewable energy projects. 5. Recommend and valorize the effect of energy efficiency measures in energy renovation of buildings. 6. Recommend and compare the effect of the use of renewable energy sources and heat pumps in buildings.
3.4 Course content	The course presents contents related to the implementation of technical energy postulates of energy efficiency and sustainability.

3.5 Types of coursework

X	Lectures	x	Exercises		Blended e-learning	x	Individual activities		Laboratory
x	Seminars and workshops		Distant learning	x	Field classes	x	Multimedia and network	x	Mentorship
	Other								

3.6 Language of instruction

Croatian / English

3.7 Monitoring students' work (enter the number of ECTS credits for each activity so that the total number of ECTS credits is equal to the total ECTS value of the course, 1 ECTS = 30 hours)

1,5	Class attendance	0,2	Seminars		Essay
	Class activity	0,2	Project		Report/paper
0,2	Midterm exams	0,2	Practical task	0,2	Continuous knowledge check
1,0	Written exam		Experimental work		
0,5	Oral exam		Research		

3.8 Assessment and evaluation of students' work during classes and at the final exam

Activity specification	Percent %	Points
Assessment during instruction		
Attendance	5%	5
Class activity	5%	5
Seminar/ project/ essay	20%	20
Midterm exam 1	20%	20
Midterm exam 2	20%	20
Oral exam	30%	30
Exam assessment for the students who failed to fullfil all the obligatory requirements during the semester		
Written exam	*60%*	*60*
Total:	**100%**	**100**

3.9 Assessment criteria – analysis per learning outcomes

	Ways of evaluating learning outcomes						
	Attendance	**Activity**	**Project**	**Mid-term exam 1**	**Mid-term exam 2**	**Practical work**	**Total**
Outcome 1		1	2	6		6	15
Outcome 2		1	2	6		6	15
Outcome 3		1	2	6		6	15
Outcome 4		1	2		6	6	15
Outcome 5		1	2		6	6	15
Outcome 6		1	2		6	6	15
Outcome not-related	5	5					10
Total	**5**	**11**	**12**	**18**	**18**	**36**	**100**

Grading of outcomes (in order to pass the mid-term exam/exam the student must achieve at least 50% points for each learning outcome)

Points	Grade
89 – 100	excellent (5)
76 – 88	very good (4)
63 – 75	good (3)
50 – 62	pass (2)
0 – 49	fail (1)

3.10 Specific features related with taking the course

If the student collects 50% of the points of each outcome, he / she directly takes the exam, provided that he / she has done practical work (seminars / project). During the exam, it is possible to orally check the knowledge from

	practical work (seminars / project). Once earned points for each learning outcome are no longer deleted unless the student, with the express approval of the course leader, decides to correct the result for each learning outcome, whereby the points won are deleted and newly earned points for that learning outcome are entered. The final grade is obtained on the exam period and is the sum of points earned during classes. Students who did not take the colloquium access the written part of the exam where all learning outcomes are checked, and are required to have completed practical work (seminars / project) before taking the exam.	
3.11 Students obligations	Full-time students are required to attend at least 70% of the total number of hours of lectures and exercises in order to exercise the right to take the exam. Part-time students are required to attend at least 30% of the total number of hours of lectures and exercises in order to exercise the right to take the exam. If the student has not fulfilled all the obligations set by the course, he is obliged to attend the lectures again and meet the conditions for taking the exam. Attendance can be offset by online tuition, organised webinars and added assignments given by teachers. One lesson lasts 45 minutes, and several hours form a teaching unit. Absence from one teaching unit is counted as one absence. Delays and apologies are recorded separately. In that case, if the student missed more than 50% of classes, and has a justifiable reason/apology, the request should be submitted to the Department Council, which then decides on the justification of student absences with the obligatory opinion of the course leader.	
3.12 Written assignments	Seminars / Projects	
3.13 Required reading	1.	P. D.Lund, J. A.Byrne, R. Haas, D. Flynn. Advances in Energy Systems. John Willey & Sons, 2019
	2.	O. Edenhoffer, R. P. Madruga, Y. Sokona: Renewable Energy Sources and Climate Change Mitigation. IPCC Special report. Cambridge University Press, 2012.
	3.	R. Ehrlich, H. Geller: Renewable Energy. A First Course. 2nd edition. Taylor & Francis, 2018.
3.14 Additional reading	1.	D. Y. Goswami, F. Kreith: Energy Efficiency and Renewable Energy Handbook. 2nd edition. CRC Press, 2016.
	2.	J. Böttcher: Wasserkraftprojekte. Springer Gabler, 2014.
	3.	E. Bolinn: Regenerative Energien in Gebäude nutzen. 2. Auflage. Springer Vieweg, 2016.
	4.	J. Siegenthaler: Heating with Renewable Energy. Cengage Learning, 2016.
	5.	Deutsche Gesellschaft für Sonnenenergie: Planning and Installing Photovoltaic Systems: A Guide for Installers, Architects and Engineers. 3rd Edition. Routledge, 2013.

4 ADDITIONAL COURSE INFORMATION	
4.1 Quality control	The quality of the program, teaching process, teaching skills and level of mastery of the material will be established by conducting a written evaluation based on questionnaires, and in other standardised ways and in accordance with the by-laws of the Polytechnic of Međimurje in Čakovec.
4.2 Contact the teacher	Students can contact the teacher during the office hours and during classes, while for short questions and explanations they can contact him/her any day during working hours by coming in person or by landline. It is also possible to ask questions by e-mail, which will be answered in 48 hours at the latest. It is desirable for students to come as often as possible for any possible questions during the teacher's office hours.
4.3 Information about the course	It is the obligation of each student to be regularly informed about the course. All notifications about the classes or possible postponement of classes will be posted on the bulletin board and on the website of the Polytechnic at least 24 hours in advance.
4.4 Course contribution to the study program	Course contribution to the study program in generic learning outcomes; I1 - Interpret information, ideas, problems and solutions to professional and General public, I2 - Use new technologies and techniques as part of a lifelong process Learning, I3 - Use foreign languages in professional communication and use of professional literature, I4 - Advocate an ethical approach to work and to project associates teams, I5 - Critically evaluate arguments, assumptions and data in order to create opinions and contributing to the solution of the problem. The contribution of the course to the study program in specific learning outcomes; I6 - Solve engineering problems of sustainable development by applying mathematics, physics, chemistry and biology, I7 - Analyze collected data in the field of sustainable development, I8 - Interdisciplinary to solve engineering problems of sustainable development, I10 - Interpret European Union legislation in the field of sustainable development, I11 - Apply basics of thermoenergetics, thermodynamics and hydromechanics In spatial design of thermodynamic systems, I14 - Apply and monitor conventional heating, cooling, and ventilation systems and devices, I15 - Maintain thermotechnical systems and thermal distribution networks I16 - Propose technical changes and upgrades to conventional ones thermotechnical systems in the direction of sustainable development, I26 - Formulate simple problems in the field of environmental protection Works solving them with the application of the principles of sustainable development, I27 - Assess potential risks to the environment and cooperate in the preparation of studies environmental protection and environmental impact studies.

5. ANALYSIS OF COURSE TOPICS (the number of hours is equal to the number of lectures and exercises of the course)				
LECTURES				
Hours	**Topic and description**	**Method** • Direct teaching (lecture, instruction, pp presentation) • Discovery learning (individual, lead, discussion) • Group learning • Case study • Field classes…	**Learning outcomes**	**Course outcome**
1.	Introductory lecture. Sustainable development. Energy sustainability. Self-sustainability. Energy efficiency.	Exposure, discovery learning, presentation	Use project knowledge of self-sustainability and energy efficiency	I1, I2
2.	Degree of action of energy conversions. Seasonal (annual) energy efficiency indicators. Jevons' paradox.	Exposure, discovery learning, presentation	Distinguish systems and features of various degrees of action of energy conversions	I1, I2
3.	Energy conservation. Energy intensity. EROIE.	Exposure, discovery learning, presentation	Distinguish the principles of energy conservation and energy intensity	I1, I2
4.	Cogeneration and trigeneration. Microcogeneration. Distributed electricity generation.	Exposure, discovery learning, presentation	Use the features of cogeneration, trigeneration and microcogeneration	I1, I2, I3
5.	Heat pump. Heat sources (air, soil, groundwater). Heat multiplier. Annual heat multiplier.	Exposure, discovery learning, presentation	Use the principles of heat pumps and heat multipliers	I1, I2
6.	Thermal energy recovery techniques.	Exposure, discovery learning, presentation	Apply various models and techniques of thermal energy recovery	I1
7.	Quantity and structure of energy consumption in the household. Low energy building technologies.	Exposure, discovery learning, presentation	Apply and differentiate technologies, quantity and structure of energy consumption in households	I5, I6
8.	Monitoring and management of energy consumption. Smart grids.	Exposure, discovery learning, presentation	Apply and differentiate the management of energy consumption of the smart grid	I3, I5, I6
9.	Anthropogenic influences. Climate change, acid rain, greenhouse effect, ozone holes, photochemical smog. Kyoto Protocol.	Exposure, discovery learning, presentation	Apply and distinguish primary, secondary and tertiary anthropogenic influences	I1, I2, I3

10.	Renewable energy sources of the first generation. Hydropower. Firewood, biomass briquettes, wood chips. Geothermal power plants, geothermal heating. Advanced geothermal systems.	Exposure, discovery learning, presentation	Apply and distinguish the features of renewable energy sources of the first generation	I2
11.	Second generation renewable energy sources. Solar heating. Photovoltaic power plants. Wind energy.	Exposure, discovery learning, presentation	Apply and distinguish the characteristics of second generation renewable energy sources	I2
12.	Third generation renewable energy sources. Solar thermal power plants. Gasification of biomass and biofuels. Ocean energy. Thermal energy of hot rocks in the underground.	Exposure, discovery learning, presentation	Apply and distinguish the characteristics of renewable energy sources of the third generation	I2
13.	Integration of renewable energy into the power system. Distributed production.	Exposure, discovery learning, presentation	Explain the integration of renewable energy into the electricity system of distributed generation	I3
14.	Intermittency. System stability. Flexible operation of thermal power plants.	Exposure, discovery learning, presentation	Explain the structural elements of the stability of the system of flexible drives of thermal power plants	I3
15.	Growth limits of the share of renewable energy sources in the electricity system and measures to move the growth limits.	Exposure, discovery learning, presentation	Apply engineering to increase the share of renewable energy sources in the power system	I3, I4
EXERCISES/ SEMINARS				
Hours	**Topic and description**	**Method** • Direct teaching (lecture, instruction, pp presentation) • Discovery learning (individual, lead, discussion) • Group learning • Case study • Field classes…	**Learning outcomes**	**Course outcome**
1.	Establishment of small renewable energy projects. Consents and permits.	Exposure, discovery learning, presentation	Explain project knowledge of approvals and permits for small renewable energy projects	I1

2.	Roof photovoltaic power plant project. Electrical engineering equipment of photovoltaic power plants.	Exposure, discovery learning, presentation	Apply systems and features of electrical engineering equipment of roof photovoltaic power plant	I1
3.	Roof photovoltaic power plant project. Productivity budget.	Exposure, discovery learning, presentation	Make a calculation of the productivity of the project of the roof photovoltaic power plant	I1
4.	Roof photovoltaic power plant project. Investment profitability calculation.	Exposure, discovery learning, presentation	Build the features of the cost-effectiveness calculation of the investment photovoltaic power plant	I2
5.	Roof photovoltaic power plant project. Other technical calculations.	Exposure, discovery learning, presentation	Explain the principles of the technical calculation of the roof photovoltaic power plant	I2
6.	Small hydropower project. Electrical engineering equipment of a small hydropower plant.	Exposure, discovery learning, presentation	Apply various models of electrical engineering equipment of small hydro power plant	I3
7.	Small hydropower project. Electrical engineering equipment of a small hydropower plant.	Exposure, discovery learning, presentation	Apply and distinguish input and output elements of electrical engineering equipment of small hydro power plant	I3
8.	Small hydropower project. Intervention in space. Dam, water intake, derivation channel, drainage channel.	Exposure, discovery learning, presentation	Apply and distinguish the characteristics of the project in the project area of the small hydropower plant	I4
9.	Small hydropower project. Flow curve and geodetic fall curve. Hydro potential curve.	Exposure, discovery learning, presentation	Apply and distinguish input and output flow curves and geodetic fall curves	I4
10.	Small hydropower project. Productivity of a small hydropower plant and calculation of return on investment.	Exposure, discovery learning, presentation	Build and differentiate the performance characteristics of a small hydropower plant and calculate the return on investment	I5

11.	Energy renovation project in buildings. Thermal envelope restoration.	Exposure, discovery learning, presentation	Develop an energy renovation project in building	I5
12.	Energy renovation project in buildings. Ventilation system with heat recovery.	Exposure, discovery learning, presentation	Build and explain a ventilation system with heat recovery	I5
13.	Energy renovation project in buildings. Integration of heating and cooling systems with renewable energy sources and heat pumps.	Exposure, discovery learning, presentation	Explain the integration of heating and cooling systems with renewable energy sources	I6
14.	Energy renovation project in buildings. Integration of heating and cooling systems with renewable energy sources and heat pumps.	Exposure, discovery learning, presentation	Develop structural elements of the energy renovation project	I6
15.	Presentations of seminar papers and discussions.	Exposure, discovery learning, presentation	Apply technical engineering in the final study	I1, I2, I3, I4, I5, I6