1. GENERAL INFORMATION

Study programme title	University Graduate Study Programme in Petroleum Engineering Subprogramme Energy production and supply		
Course title	Distributed Energy Systems	**Semester**	II.
Teacher	Asst. prof. Luka Perković	**Course code**	950549
Course type	☐ obligatory ☒ elective	**ECTS**	4
Location	VP03 - ground floor (Wed 11:00-15:00)		
Language	☒ Croatian ☒ English		

Class type	Weekly hours	Teaching staff	Office hours	Room	E-mail
Class	2	Asst. Prof. Luka Perković, Ph.D.	N/A (arrang. via email)	213	luka.perkovic@oblak.rgn.hr
Practice	2	Amalia Lekić, MSc	N/A (arrang. via email)	N/A	amalia.lekic@oblak.rgn.hr
Field lecture		-	-	-	-

E-learning level	3 (complex simplified cooperation)	**Percentage of on-line class (max. 20%)**	0%

2. COURSE DESCRIPTION

Course aims	Students should be able to distinguish between the Centralised energy systems and the Distributed energy systems with the associated pros and cons for the each. Students should be able to model the distributed energy system on a one-year time horizon with balancing of supply and demand of different forms of energy in order to examine the feasible power production concepts, make cross-analysis between the scenarios and make judgement on the possible outcomes in terms of emissions, integration of renewables and structure of primary energy supply.
Requirements for applicants	none
Programme level learning outcomes with course contribution	1. defining and solving engineering problems in the area of energy production and supply 2. analysis and optimization of energy systems 3. application of methods for the rational use of energy 4. defining, understanding and assessing factors in the wider social context and the impact of those factors on

	planning and construction of energy facilities and/or systems
Expected course level learning outcomes (4-10 outcomes)	1. explain the difference between the centralised and distributed energy systems 2. create model example of a single DES 3. analyse the performance of DES in terms of emissions and structure of primary energy supply 4. evaluate the possible introduction of upcoming technologies (electrification of transport, power-to-heat) on the performance of DES

Course contents by individual lessons

Class	Practice
1: Introduction into Distributed energy systems (DES) and difference to Centralised energy systems (CES) 2-5: Elements of DES (energy producers, energy storage, energy transmission/distribution, energy consumption, prosumers); microgrids, smart grids 6: Overview of the novel literature on the DES topic 7-10: EnergyPLAN software (introduction, system modelling, creation of different scenarios within the single DES, creation of interconnected DES, analysis of the emissions) 11: The role of Energy storage in DES 12: Power-to-heat and its influence on DES 13: Electrification of transport and its influence on DES 14: DES of the future, phasing-out of fossil fuels; uncertainty in external (environment) variables 15: Seminar assignment	1: Simple quantitative comparison between the hypothetical DES and CES (network losses, primary energy consumption) 2: Introduction to computer scripting in Python 3-5: Simple mathematical modelling of DES elements with plotting of the performance charts 6: Analysis of the scientific paper (selected by the teacher) on the DES topic 7-10: EnergyPLAN: software: analysis of CES/national energy system with close integration of electricity, heat and transportation demand; structure of primary energy supply with emphasis on fossil fuels; Renewable energy sources with emphasis on geothermal power production; modelling of system of interconnected DES as an alternative to CES 11: Modelling Energy storage in DES - influence on integration of RES 12: Modelling of integration of Power-to-Heat into DES - influence on integration of DES and structure of primary energy supply 13: Modelling of Electrification of transport into DES - influence on integration of DES and structure of primary energy supply 14: Modelling hypothetical DES of the future energy systems without fossil fuels with the uncertainty of environmental variables included in the modelling 15: Seminars kick-off

Students' obligations	Attendance of class lectures and practice.

Students' work track *(indicate share in ECTS points for each activity so that overall ECTS number corresponds to class credits score):*	Class attendance	1	Research	2.5
	Project	-	Report	-
	Colloquium	-	Seminar paper	0.5
	Practical work	-	Oral exam	-
	Written exam	-	(Extra)	-
Type of exam, grades and evaluation of students work during class and on final exam	Exam is conducted in the form of seminar. Seminar length should be between 8 and 10 pages. Positive grades are between 2 (worst) and 5 (best). The content of seminar, research output and analysis of results will be closely evaluated.			
Mandatory literature (available in the Library and via other media)	Introduction to Distributed Energy Systems (internal script) EnergyPLAN Documentation (Mar 2019 - online) Finding and Inputting Data into EnergyPLAN (Nov 2018 - online)			
Additional literature (at the moment of study program proposition application)	Research papers on the topic, provided by the Teacher			
Examination terms	Not predefined// Anytime the seminar is finished and sent via email.			
Other	N/A			

Course Teacher:

Asst. prof. Luka Perković, Ph.D.