1. GENERAL INFORMATION				
1.1. Course teacher	Associate Professor Tomislav Kurevija, PhD; Assistant Professor Luka Perković, PhD		1.6. Year of the study	II.
1.2. Name of the course	Geothermal power plants and district heating systems		1.7. ECTS credits	4
1.3. Associate teachers	Teaching Assistant Marija Macenić, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	30L+15E+10S+5e-learning
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2, 8,3% on line
2. COUSE DESCRIPTION				
2.1. Course objectives	Introducing students to deal comprehensively with the various energy conversion systems that can be brought to bear to exploit the energy contained in the geothermal fluids found in the reservoir. Since geothermal energy is extremely site specific, the fluids found in various sites around the world have dramatically different technical characteristics, creating engineering challenges that demand innovation. The students will also deal with specific aspects that influence the design and economics of geothermal projects, including means of discharging waste heat, how to cope with fluids that produce scale and corrosion, ways to mitigate environmental effects, and meeting regulations, obtaining permits, and financing.			
2.2. Enrolment requirements and/or entry competences required for the course	-			
2.3. Learning outcomes at the level of the programme to which the course contributes	Independently solve complex engineering problems in petroleum engineering and geoenergy engineering; Design wellbore for hydrocarbon and geothermal water exploitation; Analyse reservoir rock and reservoir fluids properties; Predict reservoir behaviour and the behaviour of hydrocarbon and geothermal water production system; Optimize hydrocarbon and geothermal water production; Compare specific procedures and processes in petroleum engineering and geoenergy engineering; Appraise process and facility's efficiency in petroleum engineering and geoenergy engineering; Assess the risk of accidental situations during various operations in petroleum engineering and geoenergy engineering; Assess the environmental impact of petroleum engineering and geoenergy engineering; Plan the methods and procedures for avoiding or minimizing environmental impact of petroleum engineering and geoenergy engineering activities; Appraise projects in petroleum engineering and geoenergy engineering.			

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2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Analyse specific aspects that influence the design and economics of geothermal projects; Solve various energy conversion systems to exploit the energy contained in the geothermal fluids found in the reservoir; Design and choose adequate geothermal power plant system depending on enthalpy resource; Elaborate economics of geothermal power plant projects, including means of discharging waste heat economics; Evaluate ways to mitigate environmental effects, and meeting regulations, obtaining permits, and financing.
2.5. Course content (syllabus)	Introduction to geothermal power generation; Overview of geothermal energy conversion systems: reservoir-wells-piping-plant-reinjection; Elements of thermodynamics, fluid mechanics, and heat transfer applied to geothermal energy conversion systems; Flash steam geothermal energy conversion systems: single-, double-, and triple-flash and combined-cycle plants; Direct steam geothermal energy conversion systems: dry steam and superheated steam plants; Total flow and other systems involving two-phase expansion; Binary geothermal energy conversion systems: basic Rankine, dual-pressure, and dual-fluid cycles; Combined and hybrid geothermal power systems; Waste heat rejection methods in geothermal power generation; Silica scale control in geothermal plants; Low-enthalpy resources as solution for power generation; District heating and characteristics of a modern district heating system; Energy sources for district heating and cooling; Cogeneration, biomass, waste to energy, industrial waste heat and geothermal energy for district heating; Energy storage for district energy systems; Prediction and operational planning in district heating and cooling systems; Project permitting, finance, and economics for geothermal power generation and district heating system.
2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☒ exercises ☐ online in entirety ☒ partial e-learning ☐ field work ☒ independent assignments ☒ multimedia and the internet ☐ laboratory ☒ work with mentor ☐ (other)
2.7. Comments:	-
2.8. Student responsibilities	Active participation in lecture, preparation and presentation of the seminar paper, taking the oral exams.

2.9. Monitoring student work									
	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report		NO			
	Essay		NO	Seminar paper	YES				
	Preliminary exam		NO	Practical work		NO			
	Project		NO	Written exam		NO	ECTS credits (total)	4	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	DiPippo, R. (2012.): *Geothermal power plants: principles, applications, case studies and environmental impact*, Butterworth-Heinemann. – selected chapters	NO	YES
	Wiltshire, R. ed. (2015.): *Advanced district heating and cooling (DHC) systems*, Woodhead Publishing. – selected chapters	NO	YES

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	Chandrasekharam, D. and Bundschuh, J. (2008.): *Low-enthalpy geothermal resources for power generation*, CRC press. – selected chapters	NO	YES
2.11. Optional literature	Huenges, E., Ledru, P. eds. (2011.): *Geothermal energy systems: exploration, development, and utilization*, John Wiley & Sons. – selected chapters		
2.12. Other (as the proposer wishes to add)	-		

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