



University of
Zagreb



University of Zagreb
**FACULTY OF MINING,
GEOLOGY AND PETROLEUM
ENGINEERING**



1. GENERAL INFORMATION			
1.1. Course teacher	Associate Professor Tomislav Kurevija, PhD		1.6. Year of the study
1.2. Name of the course	Exploration and exploitation of geothermal reservoirs		1.7. ECTS credits
1.3. Associate teachers	Teaching Assistant Marija Macenić, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course
1.5. Status of the course	<input checked="" type="checkbox"/> mandatory	<input type="checkbox"/> elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)
			I.
			6
			45L+0E+10S+5e-learning
			15
			level 2, 8,3% online
2. COUSE DESCRIPTION			
2.1. Course objectives	Introducing students to geothermal energy resources, mastering elements needed to assess discovered and available reserves of geothermal fluid and considering all available methods of exploration and exploitation of geothermal reservoirs. Students will learn how to best avoid environmental impact of hydrocarbon and geothermal reservoir management.		
2.2. Enrolment requirements and/or entry competences required for the course	No special requirements.		
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; Plan hydrocarbon and geothermal reservoir management; 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.		

This document was prepared in the framework of the project InterRGN – Internationalization of the Faculty of Mining, Geology and Petroleum Engineering, funded by the European Union from the European Social Fund. The content of this document is the sole responsibility of the University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering.



University of Zagreb



University of Zagreb
FACULTY OF MINING,
GEOLOGY AND PETROLEUM
ENGINEERING



<p>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</p>	<p>Assess potential geothermal reservoirs by analysing geological and thermogeological parameters; Geothermal reservoir engineering and categorization based on physical and thermodynamic data; Solve heat transfer equations in porous media and heat loss in a well; Evaluate geothermal brine reserves with technoeconomical elaboration of geogeneity potential; Elaborate technical procedures for administrative start-up of geothermal energy productions – reserves report and mining project; Analyse exploitation of geothermal reservoirs for production of heat and electricity; Thermodynamic interpretation of geothermal brine and steam reservoirs.</p>		
<p>2.5. Course content (syllabus)</p>	<p>Introduction to geothermal engineering, course overview; Geogeneity origins, calculation and mapping of terrestrial heat flow, temperature distribution within Earth and thermal energy source; Overview of properties of exploration fields and exploitation of geothermal reservoirs in Croatia, geological and thermogeological properties of thermal and subthermal sources; Categorization of geothermal reservoirs according to reservoir temperature and pressure, reserves determination, geological and thermogeological properties of geopressed reservoirs; Thermodynamic properties of reservoir rock and fluid, brine geochemistry, calculation methods and determination of reservoir temperature using chemical analysis of the brine; Methods of determining reservoir and brine temperature, geothermal gradient, calculations, correlations and correction of measured temperature values; Geological, thermogeological and physical parameters in geothermal engineering, correlations used to determine reservoir properties: temperature, thermal conductivity, thermal diffusivity, volumetric heat capacity, heat flow; Thermodynamic production analysis, sustainability and renewability of geothermal resources; Material balance equation – calculation for geothermal reservoir; Temperature change as a function of time during production, heat loss in well and in transport system; Design of reinjection of geothermal brine into the reservoir, isothermal production – brine production at constant temperature, time of isothermal production; Exploitation of geothermal brine for thermal energy, direct use of geothermal energy, case study of geothermal reservoirs Zagreb and Bizovac; Exploitation of geothermal brine for electric power, thermodynamic and mechanical aspects of geothermal power plants, case study of geothermal reservoirs Velika Ciglana and Kutnjak-Lunjkovec; Technoeconomical aspects of geothermal brine production; Regulations concerning exploration and exploitation of geothermal resources, enhanced geothermal systems, utilizing abandoned oil and gas wells as geogeneity resource.</p>		
<p>2.6. Format of instruction:</p>	<p><input checked="" type="checkbox"/> lectures <input checked="" type="checkbox"/> seminars and workshops <input type="checkbox"/> exercises <input type="checkbox"/> online in entirety <input checked="" type="checkbox"/> partial e-learning <input type="checkbox"/> field work</p>	<p><input checked="" type="checkbox"/> independent assignments <input checked="" type="checkbox"/> multimedia and the internet <input type="checkbox"/> laboratory <input checked="" type="checkbox"/> work with mentor <input type="checkbox"/> (other)</p>	<p>2.7. Comments: -</p>
<p>2.8. Student responsibilities</p>	<p>Active participation in lecture, preparation and presentation of the seminar paper, taking the oral exams.</p>		

This document was prepared in the framework of the project InterRGN – Internationalization of the Faculty of Mining, Geology and Petroleum Engineering, funded by the European Union from the European Social Fund. The content of this document is the sole responsibility of the University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering.



University of
Zagreb



University of Zagreb
**FACULTY OF MINING,
GEOLOGY AND PETROLEUM
ENGINEERING**



2.9. Monitoring student work	Class attendance	YES		Research	YES		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)	6
2.10. Required literature (available in the library and/or via other media)	Title						Number of copies in the library	Availability via other media
	Beardsmore G. R. (2001.): <i>Crustal Heat Flow: A Guide to Measurement and Modelling</i> , Cambridge University Press, pp. 334.						NO	YES
	Stober, I., Bucher, B. (2013.): <i>Geothermal Energy From Theoretical Models to Exploration and Development</i> , Springer, New York, pp290.						NO	YES
	Kutasov I.M. (1999.): <i>Applied Geothermics for Petroleum Engineers</i> , Elsevier, New York, pp. 360.						NO	YES
2.11. Optional literature	Toth, A. (2017.): <i>Flow and Heat Transfer in Geothermal Systems</i> , Elsevier.							
2.12. Other (as the proposer wishes to add)								