



University of
Zagreb



University of Zagreb
FACULTY OF MINING,
GEOLOGY AND PETROLEUM
ENGINEERING



1. GENERAL INFORMATION			
1.1. Course teacher	Assistant Professor Sonja Koščak Kolin, PhD		1.6. Year of the study
1.2. Name of the course	Well Test Analysis		1.7. ECTS credits
1.3. Associate teachers	-		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%)
level 2, 16,67% online			
2. COUSE DESCRIPTION			
2.1. Course objectives	The main goal of the course is to train students to determine the reservoir properties and production capabilities of wells by means of standard computer programs used in petroleum and geoenery industries. The well test analysis is based on the theory of fluid flow in a porous medium with the aim of determining the basic reservoir characteristics and hydrodynamic connections between the parts of the reservoir, necessary for the exploitation of oil, gas and geothermal field. Well tests are performed by causing fluid inflow into the well and its closure, and by measuring the consequences of such procedures on the pressure data response. Dynamic analysis of this data is necessary for monitoring production parameters and full reservoir engineering, as well as for its successful business management.		
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	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; Appraise projects in petroleum engineering and geoenery engineering.		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Define the theoretical concepts and industry standards for data analysis and interpretation of the well test results; Select well candidates and to determine test objectives in oil, gas and geothermal reservoirs; Apply the pressure build-up test analysis of the vertical well in the computer program Saphir; Apply the pressure analysis of the production test of a vertical well in the computer program Topaze; Analyse the pressure behaviour of fractured, horizontal and multiple fractured horizontal wells in oil and gas reservoirs; Evaluate reservoir properties for underground gas storage by applied well test analysis; Apply applications for digital connection of data analytics to production and reservoir models.		

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2.5. Course content (syllabus)	Introduction to well test analysis; Pressure Transient Analysis (PTA); Rate Transient Analysis (RTA); Methods for pressure build-up and drawdown test analysis; Applied analytical models for pressure analysis in software package Kappa Workstation (programme Saphir and Topaze); Applied numerical models for pressure analysis in software package Kappa Workstation (programme Saphir and Topaze); Reservoir models for pressure analysis cases with deviations from ideal conditions due to wellbore dynamics; Analysis of the pressure behaviour in vertically fractured wells, horizontal wells and in MFHW (Multy Fractured HW); Analysis of wells in a Bounded drainage area (Semi-steady state) and in Constant pressure boundaries (Steady state); Reservoir limit test and Interference test; Analysis of the pressure during the multiphase flow in the reservoir; Gas well testing (isochronal and modified isochronal test); Well test analysis in reservoirs for underground gas storage; Digital connection of data analytics to production and reservoir models (intelligent systems); Other test operations (DST-Drill Stem Testing)							
2.6. Format of instruction:	<input checked="" type="checkbox"/> lectures <input type="checkbox"/> seminars and workshops <input checked="" type="checkbox"/> exercises <input type="checkbox"/> online in entirety <input checked="" type="checkbox"/> partial e-learning <input type="checkbox"/> field work	<input checked="" type="checkbox"/> independent assignments <input checked="" type="checkbox"/> multimedia and the internet <input type="checkbox"/> laboratory <input type="checkbox"/> work with mentor <input checked="" type="checkbox"/> work in software	2.7. Comments: -					
2.8. Student responsibilities	Regularly attend classes (lectures, exercises and e-learning), create a project assignment in software, pass a colloquium.							
2.9. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES
	Experimental work		NO	Report		NO	E-learning exam	YES
	Essay		NO	Seminar paper		NO		
	Preliminary exam	YES		Practical work		NO		
	Project	YES		Written exam	YES		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
	<i>DDA – Dynamic Data Analysis Book (2017.):</i> https://www.kappaeng.com/downloads/ddabook , Kappa Engineering, 757 str. - selected chapters						YES	YES
	<i>Saphir (2016.): Ecrin Reference Manual</i> (modules: Diamant, Saphir, Topaze, Rubis, Amethyste). KAPPA Engineering. - selected chapters						YES	YES
	<i>Spivey, J.P., Lee, J.W. (2013.): Applied Well Test Interpretation</i> , Society of Petroleum Engineers, 386 str. - selected chapters						NE	YES
	<i>Mohaghegh, S.D. (2017.): Data-Driven Reservoir Modeling</i> , SPE, 166 str. - selected chapters						YES	YES
2.11. Optional literature	<i>Ahmed, T. (2010.): Reservoir Engineering Handbook</i> . Elsevier, 4th ed, 1463 str. - selected chapters							



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	Satter, A., Iqbal, G.M. (2016.): <i>Reservoir Engineering - The Fundamentals, Simulation, and Management of Conventional and Unconventional Recoveries</i> , Chapter 10 - Transient well pressure analysis, GPP, p. 171-183.
	Handbook of Petroleum Exploration and Production - Vol. 3 (2002.): <i>Chapter 1 - Principles of Transient Testing</i> , Elsevier, p. 1-23.
	Renpu, W. (2011): <i>Well Completion Formation Damage Evaluation</i> , Chapter 7 - <i>Advanced Well Completion Engineering</i> , GPP, p. 364-416.
	Zhuang, H.N. (2013.): <i>Dynamic Well Testing in Petroleum Exploration and Development</i> , Chapter 5 - <i>Gas Reservoir Dynamic Model and Well Test</i> , Elsevier, p. 225-410.
	Jiang, T. et al. (2019.): <i>Dynamic Description Technology of Fractured Vuggy Carbonate Gas Reservoirs</i> , Chapter 3 - <i>Well test analysis methods of fractured vuggy carbonate gas reservoirs</i> , GPP, p. 61-133.
	Temizel, C. et al. (2019.): <i>Formulas and Calculations for Petroleum Engineering</i> , Chapter 3 - <i>Well test analysis formulas and calculations</i> . GPP, p. 173-202.
2.12. Other (as the proposer wishes to add)	-