



## 1. GENERAL INFORMATION

<b>Study programme title</b>	University graduate study programme in geology				
<b>Course title</b>	Petroleum Geology		<b>Semester</b>	winter	
<b>Teacher</b>	Assist. Prof. Marko Cvetković, PhD & Assist. Prof. Iva Kolenković Močilac, PhD		<b>Course code</b>		
<b>Course type</b>	<input checked="" type="checkbox"/> obligatory <input type="checkbox"/> elective		<b>ECTS</b>	5	
<b>Location</b>					
<b>Language</b>	<input type="checkbox"/> Croatian <input checked="" type="checkbox"/> English				
<b>Class type</b>	<b>Weekly hours</b>	<b>Teaching staff</b>	<b>Office hours</b>	<b>Room</b>	<b>E-mail</b>
<b>Class</b>	2	Assist. Prof. Marko Cvetković, PhD & Assist. Prof. Iva Kolenković Močilac, PhD	Wednesday 12.00-14.00	V407	<a href="mailto:marko.cvetkovic@rgn.hr">marko.cvetkovic@rgn.hr</a> <a href="mailto:iva.kolenkovic@rgn.hr">iva.kolenkovic@rgn.hr</a>
<b>Practice</b>	3	Assist. Prof. Marko Cvetković, PhD & Assist. Prof. Iva Kolenković Močilac, PhD	Wednesday 12.00-14.00	V407	<a href="mailto:marko.cvetkovic@rgn.hr">marko.cvetkovic@rgn.hr</a> <a href="mailto:iva.kolenkovic@rgn.hr">iva.kolenkovic@rgn.hr</a>
<b>Field lecture</b>					
<b>E-learning level</b>	1	<b>Percentage of on-line class (max. 20%)</b>		5%	

## 2. COURSE DESCRIPTION

<b>Course aims</b>	<p>Aims of this course are to:</p> <ul style="list-style-type: none"> <li>- Define petroleum reserves and give an overview of production worldwide</li> <li>- Define composition of hydrocarbons, groups of compounds and their properties</li> <li>- Define depositional environments of source rocks</li> <li>- Explain accumulation and thermal transformation of organic matter through the phases of diagenesis, catagenesis and metagenesis</li> </ul>
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	<ul style="list-style-type: none"> <li>- Define types of kerogen and maturity of organic matter in source rocks using vitrinite reflectance</li> <li>- Define the generative potential and maturity of source rocks using results of Rock Eval Pyrolysis</li> <li>- Explain the concepts of primary petroleum migration, different theories aiming to explain the expulsion of fluids from source rocks of low permeability</li> <li>- Explain the concepts of secondary petroleum migration in hydrostatic and hydrodynamic settings</li> <li>- Explain concept of petroleum accumulation of oil and gas</li> <li>- Show at the field the outcrops of source rocks and reservoir rocks</li> </ul>
<p><b>Requirements for applicants</b></p>	<p>Applicants are required to:</p> <ul style="list-style-type: none"> <li>- Define and apply the principles of Physical geology, Historical geology, Sedimentary petrology and Sedimentology</li> <li>- Define basic compounds in organic chemistry (proteins, lipids, carbohydrates, alcohols, ethers)</li> </ul>
<p><b>Programme level learning outcomes with course contribution</b></p>	
<p><b>Expected course level learning outcomes (4-10 outcomes)</b></p>	<p>Upon finishing the course, student will be able to:</p> <ul style="list-style-type: none"> <li>- Define composition of hydrocarbons, groups of compounds and their properties, including main biomarkers</li> <li>- Explain and describe petroleum system and its components</li> <li>- Explain hydrocarbon formation in source rocks by thermal alteration of original organic matter</li> <li>- Explain the concepts of primary and secondary petroleum migration</li> <li>- Explain concepts of petroleum accumulation of oil and natural gas</li> <li>- Define and apply the mapping techniques used in petroleum exploration</li> <li>- Explain the concept of petroleum reserves' estimation</li> <li>- Give an overview of petroleum reserves' distribution and production worldwide</li> </ul>
<p>Course contents by individual lessons</p>	
<p>Class</p>	<p>Practice</p>
<p>C 1 –</p>	<p>P 1 –</p>

Getting to know students. Criteria for signature and passing the course. Structure of course.	Practical exercise Recognition of primary and secondary types of porosity on core samples. Calculation of porosity from results of laboratory measurements.
C2 – Primary and secondary porosity, total and effective porosity, importance of porosity in petroleum geology; methods of determination (laboratory methods) and evaluation (well log interpretation).	P2 – Practical exercise Recognition of primary and secondary types of porosity of thin sections under the microscope.
C3 – Total and effective permeability, importance of porosity in petroleum geology; methods of determination (laboratory methods). Correlations of porosity and permeability.	P3 – Demonstration exercise Determination of total permeability in laboratory
C4 – Composition and characteristics of the reservoir fluids: hydrocarbons, other organic compounds, elementary and group analysis, technological analysis, biomarkers.	P4 – Practical problem – Construction of lithofacies maps.
C5 – Composition and characteristics of the reservoir fluids: formation water	V5 – Practical problem – Construction of lithofacies maps.
C6 – Hydrocarbons origin: inorganic, organic theory of oil origin; accumulation and preservation of organic matter in sediments; oxic and anoxic environments.	V6 – Practical problem – Construction of lithofacies maps.
P7 – Kerogen: formation, composition, maturation, types and quality.	V7 – Practical problem – Construction of lithofacies maps.
P8 – Source rocks: definition, evaluation, determination of maturity; general scheme of oil and gas origin in relation with thermal maturity of source rocks.	V8 – Demonstration exercise Observation of source rocks under the UV light.
P9 – Primary petroleum migration. Different theories.	V9 – Practical problem – Estimation of oil reserves in reservoir within structural trap. Construction of structural contour map of the top and the base of the reservoir
P10 – Secondary Petroleum migration in hydrostatic and hydrodynamic settings.	V10 – Practical problem – Estimation of oil reserves in reservoir within structural trap.

	Construction of isochore map of the reservoir			
P11 – Petroleum accumulation. Classification of traps.	V11 – Practical problem – Estimation of oil reserves in reservoir within structural trap. Construction of isopach map from the oil-water contact to the reservoir top and isopach map from the oil-water contact to the reservoir base			
P12 – Unconventional Hydrocarbons: Oil shales, Heavy oil.	V12 – Practical problem – Estimation of oil reserves in reservoir within structural trap. Construction of cross-section through the reservoir. Calculation of reserves on the basis of isopach maps using Simpson's or trapezoidal formula.			
P13 – Unconventional Hydrocarbons: Tar sands, Shale gas and Gas hydrates.	V13 – Auditory exercise Classification of traps			
P14 – Regional petroleum geology: Croatian part of Pannonian basin.	V14 – Seminar Presentation of seminars			
P15 – Regional petroleum geology: Croatian Adriatic offshore.	V15 – Demonstration exercise Display of the Department's collection of source rocks, reservoir rocks and crude oil samples			
<b>Students' obligations</b>	Regular presence at the consultation meetings (maximum absence 2 times), preparation for consultation meetings (reading of literature), practical exercise finalized within 5 weeks after the problem has been set, preparation of seminar paper and presentation of seminar in front of the teachers and other students, attendance to field trip and preparation of the field trip journal			
<b>Students' work track</b> <i>(indicate share in ECTS points for each activity so that overall ECTS number corresponds to class credits score):</i>	Class attendance	0,5	Research	
	Project		Report	
	Colloquium		Seminar paper	1
	Practical work	1,5	Oral exam	1
	Written exam		Field trip	1
<b>Type of exam, grades and evaluation of students work</b> during class and on final exam	Seminar has to be presented and seminar paper and field journal submitted in order to attend oral exam. Oral exam is consisting of 5 questions each of which can be appointed 0-10 points. Final grade is based on the number of points achieved at the oral exam.			



<b>Mandatory literature</b> (available in the Library and via other media)	Biddle, K.T., Wielchowsky, C.C. (1994): Hydrocarbon Traps. In: Magoon, L.B., Dow, W.G. (eds.): The Petroleum system-from source to trap: AAPG Memoir 60. 219-235 pp. Byørlykke, K. (2010): Petroleum Geoscience: From Sedimentary Environments to Rock Physics. Chapters 12, 13, 14, 15, 21. Springer-Verlag, Berlin, 499 p. Selley, R.C. (1998): Elements of Petroleum Geology. Second edition, Academic Press, San Diego, California, USA, 470 pp.
<b>Additional literature</b> (at the moment of study program proposition application)	Tissot, B.P., Welte, D.H. (1984): Petroleum Formation and Occurrence. Second Revised and Enlarged Edition. Springer-Verlag, Berlin, 699 p.
<b>Examination terms</b>	Every Tuesday within exam-terms (at 10 AM).
<b>Other</b>	