

Lecturer

Name: Duje Smirčić

Background: Masters degree in Geology

Specialization: Junior researcher and teaching assistant at the Department of Mineralogy, Petrology and Mineral Resources

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Course Description

Title: GAS what's cooking!

Fields of activity: Chemical Engineering, Mechanical Engineering, Mining/Mineral Resources Engineering, Petroleum Engineering, Power Engineering, Rural and Surveying Engineering

Examination type: Written exam

Number of ECTS credits issued: 1 ECTS

Learning Goals and Objective: To provide knowledge about oil, natural gases and renewable types of energy, differences among them, production of and chemistry of oil and usage of both types of energy in everyday life

Syllabus

Name of activity	REFINING & MARKETING: From crude oil to customers
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Dmirti Rajko (Senior Professional Assistant at INA) and Damir Miletić (Director of R&M Support & Performance Monitoring at INA)
Short summary of content	Overview of the main activities in the downstream oil & gas value chain. Explanation of how crude oil is transformed into finished products (refining processes), how those products and feedstock are stored and transported (distribution), where those products are sold (markets), and how customers are reached. Apart from going through how the value chain functions, refining economics and markets trends are to be touched upon to see the impact of the external factors on internal performance.
Bibliography	No bibliography
Expected effect	Basic knowledge about Downstream sector in oil and gas industry

Name of activity	How we find gas and bring it up
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Ena Jakupec (Geological Senior Engineer at INA) and Dragutin Žagar (Oil Well Technology Senior Engineer at INA)
Short summary of content	A short introduction and overview into Upstream sector in the crude oil industry and how are we looking for gas and what are we doing after we actually find it. First part of presentation is about exploration phase of Upstream Gas Field lifecycle and how are we looking for interesting prospects in exploration areas before drilling into the Earth. Seismic surveys and data interpretation analysis are first data that are showing to us what is morphology of underground and is there any interesting geological traps and formations that can be potential hydrocarbon reservoir. All this data and results of analysis are used for economic cost evaluation of this new prospect and giving to us information of profitability of field development and bringing it into production. After the drilling phase of field development, time is to bring all that hydrocarbons to the surface in optimum and safe way. Depending on fluid properties, well geometry and expected flow rates it is time to make decision on so called well completion and surface design.
Bibliography	No bibliography
Expected effect	Students will get short introduction and overview into Upstream sector and how are engineers looking for gas and what are they doing after they find it

Name of activity	Introduction to Crude oil – properties, market, reserves, demand
Number of working hours	2 h
Type of activity	Lecture
Lecturer	Ivana Štagljar Mikac (Manager of Production Planning & Control at INA)

Short summary of content	Downstream – in general, crude oil processes more detailed, basics of refining Blending of finished products – methodology of blending, crucial parameters of diesel and gasoline fuel. Future outlook – focus on crude oil
Bibliography	No bibliography
Expected effect	Methodology of final products blending

Name of activity	How a vertically integrated oil company looks at the future
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Mihael Matošević (Strategy Development Specialist at INA)
Short summary of content	The main topic of this lecture will be INA and in general about vertically integrated companies and their advantages and disadvantages. INA Group has leading role in Croatian oil business and a strong position in the region in the oil and gas exploration and production, oil processing, and oil and oil products distribution activities. INA plc. is vertically integrated company and as an integrated oil and gas company represents a business entity that engages in the exploration, production, refining and retail. Typically, integrated companies divide their various operations into categories: upstream, which includes all exploration and production endeavours, and downstream, which is confined to refining and marketing activities. Apart from domestic upstream activities in Croatia (offshore and onshore), in the oil and gas exploration and production segment INA also has business operations in Angola and Egypt. INA manages two refineries: in Rijeka and Sisak, and a regional network of petrol stations in Croatia and regional countries. Trying to make energy available, INA wants to be a driver of social and economic development, taking care of people and the environment while fostering responsible business operations and local partnerships.

	In addition, attention will also be paid to current energy trends in the oil & gas industry and the way the companies adjust their business to the market conditions
Bibliography	No bibliography
Expected effect	INA d.d. activities and plans for the future

Name of activity	Relationship between plate tectonics and hydrocarbon generation and migration - Case study from Croatian part of Pannonian Basin
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Andrea Mišur (Geological Senior Specialist at INA)
Short summary of content	New discoveries often emerge from previous successes. Once a play concept has proven to be commercially profitable, Oil Company can apply acquired knowledge to a regional framework in search for new hydrocarbon accumulations. This lecture will outline the essential aspects of plate tectonics and its influence on hydrocarbon generation and migration. We will start from global processes which run regional tectonics, leading to formation of specific hydrocarbon fields. Examples how we have dealt with some of the greatest puzzles and challenges will be shown through interactive task solving
Bibliography	No bibliography
Expected effect	Students will get introduced to essential aspects of plate tectonics and its influence on hydrocarbon generation and migration

Name of activity	A look at biodiesel through green-coloured glasses
Number of working hours	2 h
Type of activity	Lecture
Lecturer	Aleksandra Sander (University Professor)

Short summary of content	Having in mind constant increase in energy consumption, especially in the transport section and consequently increased emissions of combustion products, the need for using alternative renewable fuels instead of fossil fuels is evident. When biofuel is used, harmful combustion emissions (CO ₂ , NO _x , SO _x) are reduced so it can be expected that if renewable fuel is produced by means of green technology, from waste materials or feedstocks not used for food, then we can say that this fuel is sustainable, ecologically and economically acceptable as well as easily available. Today, biofuels are blended with fossil fuels and used in cars, ships and airplanes. For this lecture, biodiesel is selected as an excellent representative of commercially used biofuels. Biodiesel and its production process will be analysed through 12 principles of green chemistry and green engineering. In this way the answer to the question about sustainability of biodiesel will be presented. Finally, we will be able to answer the question "Are biofuels – fuels of the future?"
Bibliography	No bibliography
Expected effect	Biodiesel and its production and sustainability

Name of activity	Basics of exploration for hydrocarbon accumulations
Number of working hours	2 h
Type of activity	Lecture
Lecturer	Marko Cvetković (Assistant Professor)
Short summary of content	The topic would cover the fundamentals of the approach of exploration for hydrocarbon accumulations from the geological aspect. First part of the lecture would cover the exploration process in the early history of hydrocarbon explorations. Second part would incorporate modern trends in the exploration process. Third part would introduce the evaluation of the basin via the basin analysis approach. Fourth part would explain the process evaluating leads. Fifth part would regard the results of drilling a well-a success story or learning from our mistakes.

Bibliography	No bibliography
Expected effect	Students will get introduced in exploration for hydrocarbon accumulations from the geological aspect

Name of activity	Assessment of crude oil and crude oil products
Number of working hours	2,5 h
Type of activity	Lecture with laboratory practice
Lecturer	Fabio Faraguna (University Professor) and Roko Blažić (University assistant)
Short summary of content	Refinery processing of crude oil involves a number of primary and secondary processes (e.g. separation, conversion and processing procedures) that are aimed at conversion of crude oil into valuable products (fractions) of the desired quality and yield. It is known that the yield and the quality of the resulting products depend primarily on the concentration and types of different chemical compounds in crude oil. Characterization of crude oil is essential to properly determine in which way the oil should be processed and which product can be economically produced. Preliminary assessment of oil is important, whether it is based only to determine the physical properties of fractions, or setting the correlation of these properties with structural data to conduct the classification and characterization of the final products. Certain properties of petroleum and petroleum products (physical, thermal, optical) are used as a standard to define the requirements for petroleum product. During this course participants will get acquainted with some standard methods for determining density, refractive index, viscosity, aniline point, flash point and distillation according to ASTM. They will also do laboratory measurements for unknown sample using some of the mentioned methods. The obtained results from measurements will be used in calculations to determine the affiliation of oil or petroleum fractions with the help of characterization number (K) and the index of correlation (I_k),. Also structural - group analysis using n-d-M method will be performed and if possible cetane / diesel indexes will be

	calculated.
Bibliography	No bibliography
Expected effect	Assessment of oil products – determination of the physical properties of fractions, setting the correlation of these properties with structural data to conduct the classification and characterization of the final products

Name of activity	Oil & Gas Industry – History and Future
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Igor Dekanić (University professor)
Short summary of content	Petroleum history, since the beginning of industrial production of petroleum at the mid of 19th Century has significant influence to je transport, warfare, global economy, and geopolitical relationships. Contemporary energy supply is characterized by the global energy consumption growth, and negative climate change concerns, as well. Global energy supply and demand pattern is created by the system of international energy markets. With the energy markets characterized by relatively cheap energy, more competitive are the industries with the energy input mix as cheap as possible. Energy policy is performs by imposing the system of taxes and stimulations in the sustainable market economy crucial are sustainable proportions of energy taxes and subsidies, in order to prevent the competitiveness of goods and services in economy. Decreases of the energy prices from the mid of 2014 until now, have significant influence of the energy position of the countries, which imports the significant part of energy needs. The biggest challenge to the further development of the low carbon energy supply is how to ensure the competitiveness of the national economy with the requirements of the energy mix changes. According to the most recent IEA outlook, electric vehicles, and the other clean energy sources will growth rapidly, and electric vehicles era is on the way, particularly in Europe and East Asia.

	However, oil & natural gas consumption is predicted to grow at least till 2040.
Bibliography	No bibliography
Expected effect	Students will get an insight on energy market and its economy

Name of activity	Smart energy systems
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Neven Duić (University professor)
Short summary of content	Transition to decarbonised energy systems is becoming more attractive with fall of investment costs of renewables and volatile prices and political insecurity of fossil fuels. The renewable energy resources are bountiful, especially wind and solar, while integrating them into current energy systems is proving to be a challenge. The limit of cheap and easy integration for wind is 20% of yearly electricity generation, while a combined wind and solar may reach 30%, pending on improving transmission capacities and flexibilization of conventional power plants. Going any further asks for implementation of really free energy markets, demand response, coupling of wholesale and retail energy prices through smart grids, and it involves integration between electricity, heat, water and transport systems. The cheapest and simplest way of increasing further the penetration of renewables is integrating power and heating/cooling systems through the use of district heating and cooling (which may be centrally controlled and may have significant heat storage capacity), since power to heat technologies are excellent for demand response. Electrification of personal car transport allows not only for huge increase of energy efficiency, but also, electric cars due to low daily use may be excellent for demand response and even for storage potential, through vehicle to grid technology. That will allow reaching renewable share of 80% in

	energy system, but the remaining 20%, part of transport and industrial processes that cannot be electrified, and backup of power system in times when neither wind nor solar are available, may be more an uphill battle without technology breakthrough. Biomass can probably cover half of that demand, and carbon dioxide from biomass combustion may be hydrogenised using hydrogen produced from excess renewables, resulting in electric fuels, like e-methane, e-methanol and e-DME.
Bibliography	No bibliography
Expected effect	Students will get introduced with cost-effective, sustainable and secure energy system in which renewable energy production, infrastructures and consumption are integrated and coordinated through energy services

Name of activity	Disruption in energy sector
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Tea Žakula (Assistant Professor and the Head of the Laboratory for Energy Efficiency)
Short summary of content	Energy has become a primary concern in countries worldwide and is a focus of debates on national safety, climate change, global economy, developing world, and many more. The energy sector is currently facing numerous important questions to be answered and problems to be solved; however, recent studies have shown that this sector has the lowest adoption rate of some new technologies such as artificial intelligence. This is a strong reason for raising awareness of challenges that emerging technologies pose and opportunities that they can offer. The presentation will describe the current state in the energy sector and provide some examples of disruptive processes/technologies. The main focus will be on buildings, in which we spend more than 90% of our time. Buildings use about 40% of total energy and more than 70% of the total electricity in the majority of developed countries. What do we know about buildings today and what do we expect from them

	in the future? How smart are our buildings and what characterizes a smart building? Are we today smarter than an African termite and why is that important for nearly zero-energy buildings? Today, when we have an abundance of advanced materials, are we creating buildings that are better-performing than those built in 12th century? How can a wall become a battery and help us earn money in addition to helping electricity grid? During the presentation we will try to explain why these questions are extremely important; in doing so, we shall use examples from the animal world, traditional and modern architecture, as well as some of the most advanced technologies related to the advanced control and smart grids.
Bibliography	No bibliography
Expected effect	Students will get basic knowledge in the current state in the energy sector and provide some examples of disruptive processes and technologies (with main focus on buildings)

Name of activity	Seawater Steam Engine – The most powerful technology for building sustainable communities and stopping the climate change
Number of working hours	1,5 h
Type of activity	Lecture
Lecturer	Zvonimir Glasnović (University Professor) and Karmen Margeta (Assistant Professor)
Short summary of content	It is clear that climate change is caused by economies that are founded on fossil fuels. The climate system is not “a boiler which will be heated by 2°C after which we could turn off the world economy”. Therefore, the climate system cannot be controlled and because of that a whole new approach to this problem is needed, in a way to directly act on the because we cannot influence the consequences (global warming), where it is important to emphasize that no one knows whether the climate change will unfold slowly (slow global warming, slow melting of the icebergs, slow sea level rising, etc.) or will it quickly come to impetuous changes which could lead to cataclysm. A radically new technology Seawater Steam Engine (SSE) is presented, which could completely reorient “high

	carbon economy” into “green economy” and it would be available to both developed countries and less developed ones. SSE technology can be simultaneously and continuously (throughout the whole year) produce both energy and drinkable water from renewable energy sources and seawater (or other unclean water sources: rivers, lakes, etc.), in that way it could enable the building of completely sustainable communities, i.e. the communities that are not dependent on outside energy sources and drinkable water. Given that it's about a technology that for only one input (RES energy) can give two outputs (energy and drinkable water) that the technology would be cheaper right from the start than any other technologies that separately produce energy and drinking water.
Bibliography	No bibliography
Expected effect	Basic knowledge about Seawater Steam Engine and its influence on climate changes

Name of activity	Team Design
Number of working hours	4 h
Type of activity	Workshop
Lecturer	Duje Smirčić (Teaching Assistant)
Short summary of content	Participants will be asked to use their „field-engineering skills and problem-solving abilities in order to develop a functionind device capable of solving the problem given by the partner company INA.
Bibliography	No bibliography
Expected effect	A successful project ☺

Name of activity	Comparison between different energy sources
Number of working hours	1,5 h
Type of activity	Discussion group

Lecturer	Duje Smirčić (Teaching Assistant)
Short summary of content	Students will discuss about different applications and usages of crude oil and petroleum in industry and everyday life compared to renewable energy sources.
Bibliography	No bibliography
Expected effect	Sharing opinions and points of view with each other

Name of activity	Final exam
Number of working hours	1 h
Type of activity	Examination
Lecturer	Duje Smirčić (Teaching Assistant)
Short summary of content	At the end of the course participants will be given a written exam with questions regarding all the lectures
Bibliography	No bibliography
Expected effect	Have at least 50% of the questions correctly answered for a passing grade

Pre-material

Name	Is the success of clean energy guaranteed?
Topic/field	Renewable energy
Professor/Author	Neven Duić
Link	http://powerlab.fsb.hr/neven/pdf/14/Duic-N-%20Is-the-success-of-clean-energy-guaranteed.pdf