UNIVERSITY OF MISKOLC
FACULTY OF **EARTH SCIENCE AND ENGINEERING**
1735

PETROLEUM ECONOMICS

MSc in Petroleum Engineering **MFKOT720012**

COURSE DESCRIPTION

University of Miskolc
Faculty of Earth Science and Engineering
Petroleum and Natural Gas Institute
September 2022

Course Data Sheet

Course Title: Petroleum Economics **Instructor:** Dr. Attila HOLODA, honorary associate professor	**Code:** MFKOT720012 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 1 (4)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination / practical mark / other):** examination
Credits: 2	**Course:** full time

Course Description:

1. Brief summary of some general economic issues in macro-economics, micro-economics,
2. Brief summary of some general economic issues in company management (Porter's model) and decision theory.
3. Basis of economic approach including cash flow modeling, time preference (concept of compound interest and present value).
4. Forecast of key factors determining E&P business in the future.
5. Methods determining key economic indicators.
6. Features of appraisal individual projects applying economic indicators and their constraints in risk-free case.
7. Basic geological, technical and economical features of petroleum industry investment in case of exploration, field development (risks, resources, reserves, venture capital).
8. Basic geological, technical and economical features of production and abandonment (risks, resources, reserves, venture capital).
9. Crude oil and natural gas price history and price forecasting models.
10. Risks "measurements" and their impact on project value (expected value concept, Monte Carlo simulation).
11. Evaluation uncertainty and risk of various parameter estimates and their impact on (economic) indicators calculated.
12. Non-quantifiable (risk) factors and their impact on project evaluation.
13. Assessment of project groups (portfolio evaluation).
14. The place and role of oil companies worldwide: typical contracts and tax systems in various countries ranked in terms of hydrocarbon availability, profitability and risk.

Competencies to evolve:

Knowledge:

Knows the economic processes related to the hydrocarbon industry.

Knows the equipment and methods required for the drilling and completion of oil, natural gas and water wells and has the necessary knowledge to plan drillings.

Knows the malfunctions that typically occur during the construction of oil, natural gas, and water wells and how to resolve them.

Knows the processes and phenomena occurring during production in petroleum and natural gas water wells.

Knows the equipment used for different types of production; and the methods ensuring the appropriate selection of the necessary equipment and procedures.

Knows the properties of the fluids found in petroleum, natural gas and geothermal reservoirs, as well as the storage rocks; characteristics of flow in such reservoirs.

Knows the production mechanisms of underground reservoirs and the primary or enhanced extraction mechanisms that ensure optimal production.

Knows the basics of numerical simulation of underground storages.

Knows the equipment and procedures related to the pipeline transportation of crude oil, natural gas and water.

Knows the basics of field and transmission line transport planning and operation.

Knows the methods and tools of computerized design and analysis in the hydrocarbon industry.

Ability:

Able to interpret the economic processes related to the hydrocarbon industry and to give adequate answers to them.
Able to manage groups operating the equipment required for the drilling and completion of oil, natural gas and water wells and to plan the drilling.
Able to avoid and eliminate malfunctions that typically occur during the construction of oil, natural gas, and water wells.
Capable of monitoring and forecasting the processes taking place in oil and natural gas water wells.
Able to choose the optimal production method, design and select the production equipment.
Capable of predicting the behavior of fluids in petroleum, natural gas, and geothermal reservoirs, the properties of reservoir rocks, and the characteristics of flow in such reservoirs.
Able to recognize the production mechanisms of underground reservoirs and select the primary or enhanced extraction mechanisms that provide optimal production.
Capable of numerical simulation of underground storages.
Able to supervise and inspect equipment related to pipeline transportation of crude oil, natural gas and water.
Able to select equipment for field and transmission line transport and supervise the operation of the equipment and manage the participating groups.
Capable of hydrocarbon industrial computer design and analysis.
Attitude:
Strives to enforce the requirements of sustainability and energy efficiency.
Strives to plan and execute his tasks at a high professional level, independently or in a work group.
Strives to do his work based on a system-oriented and process-oriented way of thinking, in a complex approach.
Strives to achieve research, development and innovation goals in the course of his/her work.
Open to further professional training for self-cultivation and self-development.
Committed to high-quality work and tries to convey this attitude to his colleagues.
Has adequate motivation to perform activities in frequently changing work, geographical and cultural environment.
In the course of his/her work, adheres to and complies with the SHE and QA/QC (safety health protection, environmental protection, and quality assurance and control) requirements systems.
Autonomy and responsibility:
Able to independently manage hydrocarbon industrial complex planning works and perform project management tasks, or participate in them.
Capable, as an efficient part of a group, of planning the drilling and completion of fluid producing wells and conducting deep drilling; to optimize the costs of deep drilling; to prevent malfunctions occurring during deep drilling.
Autonomously able to plan the production of fluid-producing wells, to achieve optimal production conditions; for the appropriate selection of the necessary equipment and procedures; to implement solutions that ensure maximum profit.
Capable of independently choosing the appropriate mechanisms for the production of underground reservoirs; to implement the most favorable "reservoir management".
Able to independently plan the transportation of fluids and operate the transportation equipment.
Able to autonomously plan the use of energy carriers produced from renewable natural resources and residual materials in the energy supply system, and manage the operation of the established system.
Takes responsibility for his/her professional decisions and the work processes carried out by him/her or under his/her control.

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Final exam	95 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Seba, R.D. (1998): Economics of Worldwide Petroleum Production. OGCI Publications Tulsa, p.582
- Megill, R.E. (1984): An Introduction to Risk Analysis. 2. Ed., PennWell Books Tulsa, p.274.
- Brealey/Mayers (2003): Principles of Corporate Finance, McGraw-Hill ISBN: 0072467665
- D. Johnston (1992): Oil Company Financial Analysis in Nontechnical Language (Pennwell Nontechnical Series)
- SPE (2007): Petroleum Resources Management System http://www.spe.org/industry/reserves/docs/Petroleum_Resources_Management_System_2007.pdf

Course Schedule for 2022/23 school year, fall term

Date	Topic
9/9/2022	Brief summary of some general economic issues in macro-economics, micro-economics,
9/16/2022	Brief summary of some general economic issues in company management (Porter's model) and decision theory.
9/23/2022	Basis of economic approach including cash flow modeling, time preference (concept of compound interest and present value).
9/30/2022	Forecast of key factors determining E&P business in the future.
10/7/2022	Methods determining key economic indicators.
10/14/2022	Features of appraisal individual projects applying economic indicators and their constraints in risk-free case. Basic geological, technical and economical features of petroleum industry investment in case of exploration, field development (risks, resources, reserves, venture capital).
10/21/2022	Test writing.
11/4/2022	Basic geological, technical and economical features of production and abandonment (risks, resources, reserves, venture capital).
11/4/2022	Crude oil and natural gas price history and price forecasting models.
11/11/2022	Risks "measurements" and their impact on project value (expected value concept, Monte Carlo simulation).
11/18/2022	Evaluation uncertainty and risk of various parameter estimates and their impact on (economic) indicators calculated.
11/25/2022	Non-quantifiable (risk) factors and their impact on project evaluation.
12/2/2022	Assessment of project groups (portfolio evaluation). The place and role of oil companies worldwide: typical contracts and tax systems in various countries ranked in terms of hydrocarbon availability, profitability and risk.
12/9/2022	Test writing.

Examination review questions

No.	Question
1	When quantity of product falls below gross margin-point (i.e. cost margin will be less than average cost) should production be stopped? 1/ yes; 2/ average cost is not depending on quantity of product manufactured; X/ production should be stopped only when quantity is falling below closing-point .
2	Does significant growing of supply cause increasing in the price of products? 1/ yes; 2/ no; X/ prices of products are determined by companies.
3	Which type of market can be characterized in the following way: producer is dominant, products are generic and long-run? 1/ push (supply) market; 2/ pull (demand) market; X/ competitive market.
4	Learning curve demonstrates that the growing cumulated quantity of product yields _ 1/ growing; 2/ decreasing; X/ no changing _ in industrial average unit cost.
5	Net cash flow in asset evaluation is equal subtraction of all incomes from all outcomes in the evaluation time period. Is it true? 1/ It's depending on accounting rules; 2/ no; X/ yes.
6	Is net cash flow influenced by DD&A? 1/ yes; 2/ no significantly; X/ no, since DD&A is a tool only for capital allocation against annual incomes.
7	What is taken into account when discounting net cash flow? 1/ opportunity cost; 2/ time value of money; X/ both.
8	Normal profit is the portion of accounting profit that free of corporate tax. Is it true? 1/ yes; 2/ no, since normal profit is defined for economic evaluation only X/ normal profit is earned by non-profit entities only.
9	Cost of equity should be calculated by _ 1/ governmental regulations; 2/ rules of professional societies; X/ decision of company management based on theoretical models.
10	Can cost of equity be deducted from incomes when corporate tax base is calculated? 1/ no, since cost of equity is a parameter of asset evaluation and it is not subject of bookkeeping; 2/ yes since all costs can be deducted from incomes; X/ yes, if it is below a threshold value.
11	What is the difference between discount rate and discount factor? 1/ nothing, they synonym terms; 2/ they are complements of each other; X/ discount factor is a co-efficient calculated as a function of elapsed time and discount rate.
12	Payback period (Pay Out Time) of an asset is finished in the year when accumulated discounted net cash flow changes sign from negative to positive. Is it true? 1/ yes; 2/ no, it is depending on a managerial decision; X/ no because no return is expected on cost of capital.
13	Does Internal Rate of Return (IRR or ROR) depend on discount rate (Weighted Average Cost of Capital) applied in asset evaluation? 1/ yes; 2/ yes in some cases; X/ no, since IRR is a specific discount rate at which NPV is equal to zero.
14	The Growth Rate of Return (GRR) index is the best yardstick of asset evaluation since it satisfy 3H rule i.e. it reflects impact of _ 1/ return; 2/ return and CAPEX; X/ return, CAPEX, and time-horizon.
15	Does Internal Rate of Return (IRR or ROR) index correlate well with Growth Rate of Return (GRR) index? 1/ no; 2/ always yes; X/ yes only then when all GRR indexes are calculated with the same discount rate.
16	Analyzing shape of annual net cash flow curve we can assume that an asset is a product of E&P by economics meaning. Is it true? 1/ yes, since there can be obtain phases (invention, growing, maturing, and decline) of product life cycles; 2/ no; X/ yes but in cases of oil bearing fields.
17	Value of a proved asset in moment of discovery is depending on _ 1/ economic return earned during exploitation and specific expectations of owner/renter; 2/ economic return earned during exploitation only; X/ exploration expenses (finding cost).
18	In accordance with definition of SPE Petroleum Resources Management System net recoverable resources are determined by reservoir, project and property. Is it true? 1/ yes; 2/ no; X/ the MacKelvey box doesn't contain project feasibilities.
19	Net recoverable resource _ 1/ always less; 2/ bigger or equal; X/ always bigger _ than reserve
20	Proved, probable, and possible reserve classes can be distinguished from each other by _ 1/ cost of production; 2/ uncertainty of information available; X/ maturity of the fields evaluated.
21	The three crude oil blend (Fateh, Dubai; Brent, London; WTI, New York) daily crude oil commerce is as much as _ 1/ 50%; 2/ 40%; X/ 3% _ of the worldwide commerce (being about 70 Mbopd).
22	The _ 1/ historical; 2/ current; X/ forecasted _ prices should be applied in asset evaluation.
23	Sunk Costs _ 1/ never should be taken into account; 2/ always should be taken into account; X/ should be taken into account only then when they can be accounted against later incomes _ in asset evaluation,
24	Is the Contractor Take (CT) index [being complementary of the Government Take or Host Country Take index] equal with net cash flow (NCF) on gross sale (GS)? 1/ yes; 2/ no, since CT=NCF/(GS-OPEX-CAPEX) ; X/ no, since CT is equal with contractor's profit.
25	Attractiveness of a host country is depending on oil-gas potential of the country exclusively. Is it true? 1/ yes; 2/ no; X/ not always since wrong fiscal terms, political conditions counter-act the impact of favorable oil/gas potential.
26	Correlation co-efficient confirm real (significant) connections when its absolute value is _ 1/ bigger then 0.5; 2/ bigger than the threshold value depending on size of sampled mass and probability of significance; X/ bigger than 0.9

27	Is the reserve calculated with Monte Carlo Simulation (MCS) completely independent from the reserve calculated with deterministic method? 1/ no since MCS is a stochastic method which is manipulating variables of deterministic models as stochastic variables; 2/ yes since both methods have different approaches; X/ MCS is not applicable in reserve evaluation.
28	Is the reserve calculated with Monte Carlo Simulation more accurate than the reserve calculated with deterministic method? 1/ yes of course; 2/ in some cases yes; X/ no, because MCS is based on deterministic variables, but MCS yields risk of reserve evaluated too.
29	Which is the best yardstick that shows risk of asset's net present value (NPV)? 1/ the standard deviation derived from probability distribution function of NPV; 2/ NPV calculation is very simple so practically uncertainty is negligible; X/ Value at Risk (VaR) which is equal with expected NPV less NPV at 5% cumulative probability.
30	Quantitative assessment of political risk is almost impossible. Management can only avoid or mitigate negative consequences with proper strategic and tactic decisions. 1/ yes; 2/ no; X/ only a newcomer can state like this.
31	What is the difference between uncertainty and risk? 1/ nothing; 2/ they are complement of each other; X/ while risk has a negative connotation ("loosing" or "not gaining"), uncertainty can be good or bad as well.
32	Is there any connection between probabilities of success and failure? 1/ yes there is since they are synonym terms; 2/ yes, they are complement of each other; X/ no since success factor has no meaning in case of failure.
33	Diversification CAPEX invested in E&P assets compensates entire risk. Is it true? 1/ yes; 2/ no since market risk (fall of oil/gas prices) has similar impact for every asset all over the World; X/ diversification is not a tool of risk mitigation.
34	Is the best risk mitigation procedure to avoid big risk? 1/ no since avoiding risk is not a risk mitigation procedure; 2/ yes since risk avoided doesn't cause loss; X/ it's not the best risk mitigation procedure since investors are not threated by risk but chance of big assets are missed as well.
35	Expected value and risk (comprised in Risk Adjusted Value) of each asset are to be optimized. Is it true? 1/ yes; 2/ no; X/ in case of unproved assets (exploration) only.
36	Does geological probability (Pg) indicate reserve volume of asset? 1/ yes; 2/ no since Pg shows probability of oil/gas presence only; X/ in case of sand reservoirs, yes.
37	Simple derivation of expected net present value (ENPV) is based on the rule that expected value is equal with sum of conditional values (in our case success and failure). Is it true? 1/ yes; 2/ no; X/ yes in case offshore assets.
38	Is it true that asset evaluation is based on cash flow modeling results exclusively? 1/ yes; 2/ yes, when Monte Carlo simulation results are available; X/ no since non-numerical viewpoints are to be taken into account.
39	Probable reserves (P2) can be assumed as risk of reserve evaluation. Is it true? 1/ no; 2/ yes since Value at Risk is calculated in similar manner; X/ sometimes it can be true.
40	Portfolio optimization gives a set of efficient portfolios which expected to yield the highest return for any given risk (or lowest risk for any given return). Is it true? 1/ no 2/ yes; X/ it is applicable in case of unproved assets only.

		Grade =	**Final mark**
	5, excellent =	36--40	.
	4, good =	32--35	.
	3, satisfactory =	28--31	.
	2, pass =	24--27	.
	1, fail =	24 >	.