

Course Title	Petroleum Geology		
Course Code	ES3101		
Offered	Study Year 3, Sem 1 Study Year 4, Sem 1		
Course Coordinator	Sylvain Rigaud (Dr)	srigaud@ntu.edu.sg	6513 8228
Pre-requisites	ES2002, ES2004		
AU	3		
Contact hours	Field Trip: 39, Laboratories: 39, Lectures: 13		
Approved for delivery from			
Last revised	16 Apr 2020, 16:16		

Course Aims

This course aims at introducing the petroleum system. You will discover how hydrocarbons are formed, how they migrate to accumulate into reservoirs, and how petroleum scientists pinpoint, recover, and process petroleum products. By bridging the tools of structural geology, sedimentology, field geology, stratigraphy, and basin analysis to the study of petroleum systems, you will learn how to apply geological principles to the study, exploration, and exploitation (drilling process) of petroleum resources, and become acquainted with the main geological methods used for oil and gas exploration. In addition, you will be offered the opportunity to become Student Members of the South East Asia Petroleum Exploration Society and attend the bimonthly meetings in Singapore, where you are encouraged to network with petroleum professionals and discuss internships and career prospects. As a result, you will not only gain knowledge in the field of petroleum, but also have increased career opportunities as a petroleum professional. Skills taught in this course are also applicable to geothermal and water exploration.

Intended Learning Outcomes

Upon successfully completing this course, you should be able to:

1. Explain the characteristics and fundamentals of a petroleum system.
2. Apply the scientific methods and tools geoscientists use in the office, lab, and field to pinpoint potential petroleum reserves, solve petroleum-related problems, and evaluate influence parameter on reservoir quality (porosity and permeability).
3. Reconstruct the depositional history of a sedimentary basin and assess the petroleum potential of a prospect / a region.

Course Content

How petroleum systems are formed, recovered, and processed and what they are used for.

How rock and reservoir properties (porosity, permeability) are affected by internal and external factors through time and space.

How to reconstruct the burial history of a sedimentary basin using back-stripping and petrographic techniques.

What is the current status of the oil and gas industry and what are its future challenges.

Assessment

Component	Course ILOs tested	ASE Graduate Attributes tested	Weighting	Team / Individual	Assessment Rubrics
Continuous Assessment					
Field Trip					
Project 1	1, 2, 3	1 - 10	30	individual	See Appendix for rubric
Laboratories					
Practical Quiz	1, 2, 3	1-3, 5-8	20	individual	See Appendix for rubric
Assignment	1, 2, 3	1-8, 10	30	both	See Appendix for rubric
Lectures					
Final Quizz	1, 2, 3	1-3, 5-9	20	individual	See Appendix for rubric
Total			100%		

These are the relevant ASE Graduate Attributes.

1. Apply environmental knowledge, concepts and skills to make sound decisions

Interpret evidence to give sound environmental advice to stakeholders

2. Demonstrate intellectual flexibility and critical thinking

Demonstrate intellectual flexibility to view environmental issues from multiple perspectives

Question assumptions behind current ways of solving environmental problems

3. Demonstrate passion and use advanced communication skills to share that passion

Effectively communicate environmental concepts in writing

Effectively communicate environmental concepts in speech

Effectively communicate environmental concepts in various forms of media such as data visualisation, diagrams, animation, video, or podcasts

4. Formulate key scientific questions and develop hypotheses

Research and formulate questions involving environmental issues

Create and evaluate hypotheses to research such questions

5. Conduct research

Search for relevant scientific literature

Synthesize findings from scientific literature into laboratory reports, presentations, written assignments and field reports

Make first-hand observations in order to draw conclusions

6. Solve environmental problems

Demonstrate creative approaches to solving environmental problems

Express and explain why the problems are important

7. Synthesize interdisciplinary approaches to solving problems

Apply techniques from diverse disciplines to solve environmental problems

Explain how a certain problem-solving approach may impact the environment or human society

8. Demonstrate the willingness and skills for lifelong learning

Demonstrate aptitude and enthusiasm to learn independently

Demonstrate good observation skills and a curiosity about the world

9. Demonstrate ethical values

Debate the ethical implications of scientific processes and results

10. Demonstrate collaboration and leadership skills

Learn collaboratively and be willing to share expertise with peers

Demonstrate leadership of small teams

Formative Feedback

Following lab sessions and field work, you will receive direct written feedback up to two weeks after you present your assignments and reports. In this way the lecturer and you can monitor progress. You will also be given oral feedback on your project and final tests.

Learning and Teaching Approach

Field Trip (39 hours)	<p>Through individual projects, you will learn how to collect data to solve a specific scientific problem and present your results to the class via an oral and a poster presentation.</p> <p>This project will</p> <ul style="list-style-type: none">i) introduce you to a petroleum prospect and its characteristicsii) help you familiarize with petroleum-related terms and issuesiii) develop your summarizing and presentation skills <p>Part of the project may take place in the field.</p>
Laboratories (39 hours)	<p>Lab sessions will</p> <ul style="list-style-type: none">i) Consolidate your petrographic skills.ii) Introduce you to petrophysics and seismic interpretation.

	ii) Allow you to apply logging-while-drilling scientific methods. iv) Introduce you to basin analysis.
Lectures (13 hours)	Lectures will pass on the theoretical knowledge required to understand the different components of the petroleum system and petroleum-related scientific methods.

Reading and References

1- Hyne, N.J. (2012) Nontechnical guide to petroleum geology, exploration, drilling and production. Penn Well Corporation. 3rd edition, 698pp. ISBN-13: 978-0878148233

2- Bjorlykke, K. (2015) Petroleum Geoscience: from sedimentary environments to rock physics. ISBN 978-3-642-34132-8. Springer-Verlag Berlin Heidelberg, 662pp.

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned readings and activities, attend all classes punctually and take all scheduled assignments, reports and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements. You are expected to participate in all seminar discussions and activities.

(2) Absenteeism

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [Academic Integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Sylvain Rigaud (Dr)	N2-01b-30	6513 8228	srigaud@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/ Activities
1	Course introduction / Selection of projects / Sedimentary rocks & Hydrocarbons	1, 2, 3	Ref. book 1
2	Petroleum products & Resources / Porosity	1, 2	Ref. book 1
3	Maturation, migration & accumulation of Hydrocarbons / Diagenesis	1, 2, 3	Ref. book 1
4	Siliciclastic reservoirs / Microfacies analysis	1, 2, 3	Ref. books 1, 2
5	Carbonate reservoirs / Microfacies analysis	1, 2, 3	Ref. books 1, 2
6	Sedimentary basins and petroleum systems / Seismic interpretation	1, 2, 3	Ref. book 2
7	Log interpretation / Prospect volumetrics	1, 2, 3	Ref. book 2
8	Sequence Stratigraphy / Prediction of petroleum system elements	1, 2	Ref. book 2
9	Basin Analysis / Burial Graphs	1, 2, 3	Ref. book 2
10	Regional assessment: SE Asia	1, 2, 3	Ref. book 2
11	Project presentations	1, 3	
12	Project presentations	1, 3	
13	Final Quiz / Laboratory Practical Quiz	1, 2, 3	

Appendix 1: Assessment Rubrics

Rubric for Field Trip: Project 1 (30%)

SECTION	UNSATISFACTOR Y (fail mark)	MARGINAL (fail mark)	SATISFACTOR Y (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
Format	· Not adapted	· Poorly adapted	· Adapted	· Well-adapted	· Reference work	2.5
	· No organization	· Poorly organized	· Organized	· Well-organized, consistent	· Perfectly organized, well-thought and consistent work	
Illustrations	· No or fictive illustrations	· Incomplete, non-representative or disproportionate illustrations	· Representative illustrations	· Clear, representative illustrations	· Neat and meaningful scientific illustrations	5
	· No legend, label, scale, orientation, title	· Minimalistic legend and labels, inaccurate scale bars	· Important features labelled, properly scaled	· Most features labelled, properly scaled	· All features labelled, homogeneously scaled	
Description / Context	· No description, no context	· Incomplete descriptions, no context	· Description and context provided	· Clear descriptions and context	· Thoughtful, clear and	5

					complete information	
Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Important implications provided	· Most scientific implications provided	· Advanced state of scientific knowledge	5
	· No research, no sources	· Limited research, cited sources not relevant	· Sources cited appropriately	· Relevant and well-cited sources	· Diverse, relevant and thoroughly cited sources	
Mechanics	· Illegible / Inaudible	· Messy, rushed job	· A few typos, mostly clearly presented	· Well-written, seamless presentation	· Well-written, seamless and meaningful presentation	2.5
	· Not refined, copy-pasted text (plagiarism)	· Poorly refined text	· Mostly refined, clean-up text	· Comprehensive yet succinct	· Excellent summary	

Rubric for Laboratories: Practical Quiz (20%)

SECTION	UNSATISFACTORY (fail mark)	MARGINAL (fail mark)	SATISFACTORY (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
Format	· Not adapted, not organized	· Poorly adapted & organized	· Adapted & organized	· Well-adapted, organized and consistent	· Reference work	2.5
Drawings / Pictures / Charts	· No or fictive drawings/pictures /charts	· Incomplete, non-representative or disproportionate drawings/pictures /charts	· Representative drawings/pictures /charts	· Clear, representative drawings/pictures /charts	· Neat and meaningful scientific drawings/pictures /charts	5
	· No legend, label, scale, orientation, title	· Minimalistic legend and labels, inaccurate scale bars	· Important features labelled, properly scaled	· Most features labelled, properly scaled	· All features labelled, homogeneously scaled	
Description / Context	· No description, no context	· Incomplete descriptions, no context	· Description and context provided	· Clear descriptions and context	· Thoughtful, clear and complete information	5
Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Important implications provided	· Most scientific implications provided	· Advanced state of scientific knowledge	5
Mechanics	· Illegible	· Messy, rushed job	· A few typos, grammar mistakes	· Well-written and comprehensive	· Well-written, comprehensive and refined	2.5

Rubric for Laboratories: Assignment (30%)

SECTION	UNSATISFACTORY (fail mark)	MARGINAL (fail mark)	SATISFACTORY (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
Format	· Not adapted, not organized	· Poorly adapted & organized	· Adapted & organized	· Well-adapted, organized and consistent	· Reference work	2.5
Drawings / Pictures / Charts	· No or fictive drawings/pictures /charts	· Incomplete, non-representative or disproportionate drawings/pictures /charts	· Representative drawings/pictures /charts	· Clear, representative drawings/pictures /charts	· Neat and meaningful scientific drawings/pictures /charts	5
	· No legend, label, scale, orientation, title	· Minimalistic legend and labels, inaccurate scale bars	· Important features labelled, properly scaled	· Most features labelled, properly scaled	· All features labelled, homogeneously scaled	
Description / Context	· No description, no context	· Incomplete descriptions, no context	· Description and context provided	· Clear descriptions and context	· Thoughtful, clear and complete information	5
Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Important implications provided	· Most scientific implications provided	· Advanced state of scientific knowledge	5
Mechanics	· Illegible	· Messy, rushed job	· A few typos, grammar mistakes	· Well-written and comprehensive	· Well-written, comprehensive and refined	2.5

Rubric for Lectures: Final Quiz (20%)

SECTION	UNSATISFACTORY (fail mark)	MARGINAL (fail mark)	SATISFACTORY (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
Format	· Not adapted, not organized	· Poorly adapted & organized	· Adapted & organized	· Well-adapted, organized and consistent	· Reference work	2.5
Drawings / Pictures / Charts	· No or fictive drawings/pictures /charts	· Incomplete, non-representative or disproportionate drawings/pictures /charts	· Representative drawings/pictures /charts	· Clear, representative drawings/pictures /charts	· Neat and meaningful scientific drawings/pictures /charts	5
	· No legend, label, scale, orientation, title	· Minimalistic legend and labels, inaccurate scale bars	· Important features labelled, properly scaled	· Most features labelled, properly scaled	· All features labelled, homogeneously scaled	
Description / Context	· No description, no context	· Incomplete descriptions, no context	· Description and context provided	· Clear descriptions and context	· Thoughtful, clear and complete information	5

Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Important implications provided	· Most scientific implications provided	· Advanced state of scientific knowledge	5
Mechanics	· Illegible	· Messy, rushed job	· A few typos, grammar mistakes	· Well-written and comprehensive	· Well-written, comprehensive and refined	2.5

Appendix 2: Intended Affective Outcomes

As a result of this course, it is expected you will develop the following "big picture" attributes:

An ability to look at natural environments in a new light.

A perseverance capacity to solve a challenging task.

A notion of space and time adapted to the geological scale.

A clear appreciation of the current status and potential future of the oil industry.