### Course Title (in English)
Petrophysics and Well Log Interpretation

### Course Title (in Russian)
Петрофизика и интерпретация данных ГИС

### Lead Instructor(s)
Alexei Tchistiakov

### Status of this Syllabus
The syllabus is a work in progress (draft)

### Contact Person
Alexei Tchistiakov

### Contact Person’s E-mail
A.tchistiakov@skoltech.ru

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### 1. Annotation

#### Course Description
Formation evaluation (or well log analysis or petrophysics) is at the intersection of a number of disciplines, including, but not limited to, geology, geophysics, and reservoir engineering. Each discipline that encounters and uses well log data does so from its own perspective. In doing so, each discipline sometimes uses the data without a full understanding of how the measurements are made. That incomplete understanding can encompass the processing of the actual measurements into the raw data provided by the data logging companies and to the interpretation methods that convert that data into usable information about the subsurface. It is this incomplete understanding of well log data that commonly produces conflicting interpretations from different sources, when the goal should be a single cohesive model of the subsurface that can be consistently applied by all disciplines. The course includes lectures in laboratory petrophysics and formation evaluation using modern well logging methods.

#### Course Prerequisites
Basic knowledge of Petroleum Geology and Reservoir Engineering, and its various components and their intrinsic connections.

The required information is being delivered within the framework of the "Introduction in Oil and Gas Engineering" course.

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### 2. Structure and Content

#### Course Academic Level
Master-level course suitable for PhD students

#### Number of ECTS credits
3
<table>
<thead>
<tr>
<th>Topic</th>
<th>Summary of Topic</th>
<th>Lectures (# of hours)</th>
<th>Seminars (# of hours)</th>
<th>Labs (# of hours)</th>
</tr>
</thead>
</table>
| Fundamentals of Petrophysics and Well Logging                       | Introduction to the course  
The key reservoir physical properties  
Well logging tools and operations.  
Introduction to Techlog application  
Menu, main functions, windows.                                                                 | 2                     | 2                     |                   |
| The main reservoir physical properties Natural gamma ray logging application | Porosity: definition, types, significance for reservoir characterisation, laboratory methods of measurements;  
Application of well logging for lithological stratification: Gamma Ray logging principles and tools.  
TechLog Data Import and loading                                                                 | 2                     | 2                     |                   |
| Rock permeability, Application of Spontaneous Potential logging     | Permeability: definition, types, significance for reservoir characterisation, laboratory methods of measurements;  
Application of well logging for lithological stratification: Spontaneous Potential logging principles and tools.  
Techlog TVD Computation and Index Data Set                                                                 | 2                     | 2                     |                   |
| Capillary pressure Application of electrical logging                | Capillary pressure and fluid saturation. Permeability: definition, types, significance for reservoir characterisation, laboratory methods of measurements;  
Application of well logging for rock saturation determination: electrical logging method and tools.  
TechLog Variable Management                                                                 | 2                     | 2                     |                   |
| The effect of clays on resistivity measurements                     | The effect of clays on resistivity measurements.  
TechLog LogView                                                                                                                                  | 2                     | 2                     |                   |
| Application of Caliper logging                                     | Caliper log: principles of measurements, application, tools.  
TechLog Cross-Plot                                                                                                                                | 2                     | 2                     |                   |
| Application of digital methods for core characterisation           | Application of digital methods for core characterisation  
TechLog Zonation                                                                                                                                    | 2                     | 2                     |                   |
| Techlog                                                             | Techlog classes revision  
TechLog DepthShift Tool and Variables Splice Tool                                                                                               | 2                     | 2                     |                   |
| Application of logging for formation density evaluation            | The formation density log: principles of measurements, application, tools.  
TechLog Depth Shift Tool and Variables Splice Tool                                                                                              | 2                     | 2                     |                   |
| Application of neutron logging                                     | The neutron log: principles of measurements, application, tools.  
TechLog Data management                                                                                                                             | 2                     | 2                     |                   |
| application of acoustic logging                                    | The acoustic log: principles of measurements, application, tools.  
TechLog acoustic data handling and interpretation.                                                                                               | 2                     | 2                     |                   |
3. Assignments

<table>
<thead>
<tr>
<th>Assignment Type</th>
<th>Assignment Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Labs</td>
<td>The course will include at least 12 computer classes. At each class, the students shall complete the corresponding set of tasks by means of the well logging interpretation software applied within the course.</td>
</tr>
<tr>
<td>Test/Quiz</td>
<td>The course includes two tests: the mid-term and final exams.</td>
</tr>
</tbody>
</table>

4. Grading

<table>
<thead>
<tr>
<th>Type of Assessment</th>
<th>Graded</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Grade Structure</th>
<th>Activity Type</th>
<th>Activity weight, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Computer Labs</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Test/Quiz</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Final Exam</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

A: Grading Scale

B: 86

C: 71

D: 61

E: 56

F: 51

0

5. Basic Information
### Attendance Requirements

- Mandatory

### Maximum Number of Students

<table>
<thead>
<tr>
<th></th>
<th>Maximum Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall:</td>
<td>15</td>
</tr>
<tr>
<td>Per Group (for seminars and labs):</td>
<td>5</td>
</tr>
</tbody>
</table>

### Course Stream

Science, Technology and Engineering (STE)

### Course Delivery Frequency

Every year

### Students of Which Programs do You Recommend to Consider this Course as an Elective?

<table>
<thead>
<tr>
<th>Masters Programs</th>
<th>PhD Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum Engineering</td>
<td>Petroleum Engineering</td>
</tr>
</tbody>
</table>

### Course Tags

- Math
- Physics
- Programming
- Engineering
- Geoscience

### 6. Textbooks and Internet Resources

#### Required Textbooks

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>ISBN-13 (or ISBN-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical Petrophysics, Volume 62 1st Edition</td>
<td>Martin Kennedy</td>
<td>9780444632708</td>
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#### Recommended Textbooks

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#### Web-resources (links)

<table>
<thead>
<tr>
<th>Description</th>
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</table>
The Oilfield Glossary: Where the Oil Field Meets the Dictionary

The Schlumberger Oilfield Glossary is an evergreen, instant reference that takes up no space on your bookshelf and offers many special features:

Comprehensive: definitions for major oilfield activities
Accessible: definitions for both the technical generalist and the expert
Accurate: definitions reviewed by technical experts
Illustrated: high-quality, full-color photographs and illustrations clarify many definitions
Thorough: citations of significant technical papers for further reading
Versatile: streamlined navigation, enhanced search capability and key resource links
Interactive: on-line capabilities allow for continual expansion and updating based on reader input.

Don’t just take our word for it. The Schlumberger Oilfield Glossary has received Awards of Excellence from the Business Marketing Association and the Society for Technical Communication. Launched in 1998, the Oilfield Glossary, which includes more than 4600 entries, continues to expand and improve. Drill into this reservoir of terminology!

Curve Mnemonic Dictionary
This evergreen database delivers descriptions of more than 50,000 Schlumberger logging tools, analytical software, and log curves and parameters. It also provides definitions of physical property measurements and relevant units of measurement. Special tables enumerate mineral properties and depositional environments.

The Curve Mnemonic Dictionary is the publicly accessible version of the Oilfield Services Data Dictionary (OSDD).
7. Facilities

**Software**

Microsoft Office 2013 or newer installed at each working PC

Schlumberger Techlog 2017 or newer

**Equipment**

Working PC

Marker white board + paper flip chart + new set of markers and brushes.

**Labs for Education**

Computer Lab (TPOC3: 404)

8. Learning Outcomes

**Knowledge**


**Skill**

Well logging data handling, displaying, analysis, correlation, comparison of petrophysical properties derived from well logs; integrated analysis of well data, obtain by means of different well logging tools.

Operational skills in Techlog enabling students to integrate data in the software, analyse and interpret the well logging data.

**Experience**

Abstract thinking, analysis, synthesis.

Ability to formulate and solve tasks arising from academic research and practical activities.

Ability to convert into a different academic and scientific and industrial focus of one’s professional activity.

Ability to assess prospects and possibilities for the use of scientific and technological progress achievements in the innovative development of the sector, come up with ways of their implementation.

Ability to perform calculations on projects, technical and economic and functional cost analysis to assess performance of the designed equipment, hardware, and technological processes.

Readiness to prepare petrophysical services for methods of prospecting and development of conventional reserves.

Interdisciplinary thinking, knowledge structure and their interaction.

Use of modern methods and tools.

Understanding the global public, environmental and business context.

Do you want to specify outcomes in another framework?  Knowledge-Skill-Experience is good enough
9. Assessment Criteria

Select Assignment 1 Type: Computer Lab

Input Example(s) of Assignment 1 (preferable):
At each well logging interpretation software class students shall complete a set of tasks, corresponding to the studied module.

Or Upload Example(s) of Assignment 1:
https://ucarecdn.com/7152e830-c698-4e18-8b50-73fcbd56292e/

Assessment Criteria for Assignment 1:
The students shall complete all software lessons and demonstrate an operational software project, integrating the well logging data, applied in the course.

Select Assignment 2 Type: Midterm Exam

Input Example(s) of Assignment 2 (preferable):
The students shall pass a midterm exam covering all the subjects studied by that moment.

Or Upload Example(s) of Assignment 2:
https://ucarecdn.com/4fb0b7fb-7c87-4e63-a7dc-34749b59b78a/

Assessment Criteria for Assignment 2:
Assessment of the written exam is based on the total number of correctly answered questions.

Select Assignment 3 Type: Final Exam

Input Example(s) of Assignment 3 (preferable):
The students shall pass the final examination covering all the subjects studied in frame of the course.

Or Upload Example(s) of Assignment 3:
https://ucarecdn.com/4fb0b7fb-7c87-4e63-a7dc-34749b59b78a/

Assessment Criteria for Assignment 3:
Assessment of the written examination is based on the total number of correctly answered questions.

Select Assignment 4 Type: Other

10. Additional Notes

Free Style Comments (if any):
PLEASE SEE GRADING POLICY AT THE ATTACHED FILE

Upload a File (if needs to be):
https://ucarecdn.com/4ba2bba6-6de8-40b7-8f20-c1c8509f1842/

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<td>Applied_Petrophysics_Best_Practices</td>
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