Master Studiengang
Petroleum Engineering

Modulhandbuch
Februar 2017
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Common compulsory subjects of both areas of study
# Module 1: Communication Skills

**Degree Programme:** Petroleum Engineering (M.Sc.)

**Module number:** 1

**Name of the module:** Communication Skills

**Courses:**
- Interpersonal Skills
- Technical Writing

**Term:** 1-2

**Person responsible for the module:** Prof. Oppelt

**Lecturers:** Prof. Kraus, Mrs. Schulze-Bentrop

**Language:** English

**Course type:** Compulsory subjects (PF) of the Reservoir Management and Drilling & Production areas of study

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**Prerequisites for attending:** No special prerequisites.

**Learning objectives / Skills:**
- Strengthening and improvement of the academic and professional writing skills and ability of interpersonal communication
- Ability of students to write scientific and technical reports and to present results as well as to work in international interdisciplinary teams will be developed

**Course outline:**
- **Interpersonal Skills:**
  - Understanding yourself
  - Building Trust: Emotional Intelligence at Work
  - Developing Successful Interactions: Empowerment and the Involvement of Others, Conflict Management, Team Facilitation Skills
  - Creating Learning Conversations: Providing Effective Performance Feedback, Listening and Diversity Issues

- **Technical Writing:**
  - Various writing exercises
  - Working with authentic written texts, which will improve writing style, coherency, vocabulary, and grammar.

**Course assignments / form of examination:**
- Partial examination.

**Interpersonal Skills:**
- Report and Presentation/ Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

**Technical Writing:**
- Homework Assignments/ Term paper
  - The module grade is evaluated as average grade from the both partial grades weighted by the credit point number.

**Media:**
- Powerpoint, White Board, Flipchart
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation slides to be provided on the Stud.IP directory of the course

**Literature:**
- Lecture notes
- Authentic text materials
- Training assignments

**Additional information:** Participants are requested to register for the attendance with the course directory at the Stud.IP.
Module 2: Advanced Reservoir Mechanics

Degree Programme: Petroleum Engineering
Module number: 2
Name of the module: Advanced Reservoir Mechanics
Courses: Thermodynamics and Phase Behavior of Hydrocarbons
Rock Mechanics II
Term: 1
Person responsible for the module: Prof. Leonhard Ganzer
Lecturers: Prof. Ganzer, Prof. Hou
Language: English
Course type: Compulsory subjects (PF) of the Reservoir Management and Drilling & Production areas of study

<table>
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<td>84/216</td>
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Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Ability to apply mass conservation and transfer laws as well as mathematical methods to describe phase behavior of hydrocarbons and mechanical behavior of reservoir rocks for solution of reservoir engineering problems should be developed. Students will become capable to acquire and evaluate physical properties of reservoir fluids and rocks needed for reservoir characterization and simulation and will develop a professional expertise in the application methods for solution of real reservoir engineering problems.

Course outline:
- Thermodynamics and Phase Behavior of Hydrocarbons
  - Basic Thermodynamics
  - Physical Properties of Real Gases / Gaseous Systems
  - Physical Properties of Liquid Systems
  - Chemistry and Properties of Organic Components
  - Two Phase Systems; Numerical Treatment of Real Systems
  - Chemistry of Brines, Equilibria with Water Phases
  - Interfacial Energy
- Rock Mechanics II
  - Poroelastic theory
  - Borehole stability
  - Sand production prediction
  - Reservoir engineering applications

Course assignments/ form of examination: Homework Assignments, Reports and presentation/ Partial examination. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam. The module grade is evaluated as average grade from the both partial grades weighted by the credit points number.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

Literature:
Thermodynamics and Phase Behavior of Hydrocarbons
Rock Mechanics II

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 3: Advanced Production and Well Planning

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 3
Name of the module: Advanced Production and Well Planning
Courses: Advanced Production, Well Planning
Term: 1
Person responsible for the module: Prof. Oppelt
Lecturers: Dr.-Ing. Perozo Baptista, Dr. Jürgen Schamp
Language: English
Course type: Compulsory subjects (PF) of the Reservoir Management and Drilling & Production areas of study

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Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
- Advanced Production:
  Acquisition of profound knowledge in production engineering and development the ability to apply it to handle practical engineering issues like improvement of productivity and dimensioning of sub-surface and surface production facilities. Students will became able to theoretically grasp and to practically handle sub-surface and surface petroleum production systems.
- Well Planning
  Acquisition of profound knowledge in drilling engineering and the ability to apply it to the well planning/ Skills of well planning based on the profound knowledge and ability to meet requirements and options

Course outline:
- Advanced Production:
  • Introduction to integrated production systems
  • Review of reservoir inflow characterization and modeling tools
  • Review of multiphase flow modeling in wells, risers and flowlines
  • Choke valves
  • Surface facilities
  • Review of production optimization techniques
  • Diagnosis of systems performance
  • Production allocation
  • Linking the reservoir, the near-wellbore, the wellbore and the surface facilities
  • Planning short-, medium- and long-term optimization of field management
- Well Planning
  • Fundamentals of Well Planning
  • Trajectory Planning
  • Casing and Drillstring Design
  • Cementing
  • BOP
  • Examples and Case Studies

Course assignments/ form of examination: Partial examination. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam. The module grade is evaluated as average grade from the partial grades weighted by the credit point number.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course
modulhandbuch Master Petroleum Engineering

- Video records of lectures available with the Stud.IP course directory

**Literature:**

**Advanced Production:**

**Well Planning**

**Additional information:**
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 11: Project Management

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 11
Name of the module: Project Management
Courses: Integrated Project Management and Development
Term: 3
Person responsible for the module: Prof. Oppelt
Lecturers: Prof. Reinicke
Language: Englisch
Course type: Compulsory subjects (PF) of the Reservoir Management and Drilling & Production areas of study

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Prerequisites for attending: No special requirements

Learning objectives / Skills: MSc candidates should develop the ability to carry out integrated project development studies.

Course outline:
- System analysis: linking the reservoir, the near-wellbore, the wellbore and the surface facilities
- Planning short-, medium and long-term optimisation of field management
- Fundamentals of integrated project management
- Economics (Discounted Cash Flow, Elements, Indicators, Use)
- Data (e.g. for Development Studies: Geophysical, Geological, Well, Test, Performance Data)
- Data acquisition, QCing and integration (G&G, petrophysical, reservoir, well and surface facilities data)
- Running production forecasts and estimating reserves
- Case studies
- Application of supporting Software

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number must be achieved to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory.
- Video records of lectures are available with the Stud.IP course directory

Literature:

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 13: Group Project

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 13
Name of the module: Group Project
Courses: Group Project
Term: 3
Person responsible for the module: Prof. Ganzer
Lecturers: Prof. Ganzer (responsible for the RM area of study), Prof. Oppelt (responsible for the DP area of study), Designated faculty and research staff members (concomitant)
Language: Englisch
Course type: Compulsory subjects (PF) of the Reservoir Management and Drilling & Production areas of study

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Prerequisites for attending:
For the RM area of study at least 47 CP to achieve in the Modules 1, 2, 3, 4, 5, and 10a.
For the DP area of study at least 48 CP to achieve in the Modules 1, 2, 3, 7, 8, 9 and 10b.
Admission requirements must be completed.

Learning objectives / Skills:
Consolidation of the acquired knowledge and preparation for common operational procedures of the petroleum industry by means of application of the acquired advanced knowledge to development of a solution of a real problem of the petroleum industry to be performed as interdisciplinary teamwork. Advanced professional expertise in the field of petroleum engineering will be established through the application of modern techniques of engineering, systematic and creative methods of working in an international and interdisciplinary environment.

Course outline:
Preparation of an integrated field development plan on the basis of real/realistic field data, spanning - if possible:
- the planning cycle from seismic surveying to reservoir description and characterization,
- reserves evaluation,
- production forecasting,
- evaluations of health, safety and environmental impact,
- well planning,
- field development,
- IOR, production,
- marketing and economic evaluations

Course assignments/ form of examination:
Group project report + Presentation/ The overall grade of the group project is evaluated as weighted average affected by 40% of the report grade, 40 % of the presentation grade and 20 % of the team work grade.

Media:
- 3 hard copies of the group project report (to submit to the group project coordinator in due time)
- MS PowerPoint presentation
- Data CD containing soft (pdf) copies of the group project report and the presentation to submit to the group project coordinator at the project end.

Literature:
- ITE Guidelines on the preparation of technical reports and principles of scientific writing.
- Technical reports on the group project subjects supplied by the group project sponsors.
- Special literature related to the group project issues should be collected from the open sources by the group project teams.
- Additional data required for the project work should be identified and acquired in cooperation with the group project sponsors and coordinators by the group project team.

Additional information:
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 14: M.Sc. Thesis + Presentation

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 14
Name of the module: M.Sc. Thesis + Colloquium
Courses: M.Sc. Thesis + Colloquium
Term: 4
Person responsible for the module: Prof. Ganzer
Lecturers: Prof. Ganzer (responsible for the RM area of study), Prof, Oppelt (responsible for the DP area of study), Designated faculty and scientific staff members (concomitant)
Language: English
Course: Compulsory subjects (PF) of the Reservoir Management and Drilling & Production areas of study

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Prerequisites for attending: More than 80 CP and all the admission requirements must be completed.

Learning objectives / Skills: The MSc candidates should acquire profound professional knowledge in the field of petroleum engineering and be able to resolve complex engineering problems by using of common scientific methods of petroleum engineering/ The MSc candidates have to develop skills to present and to defend the results of their studies.

Course outline: A problem assigned for the MSc thesis must be suited to proof the individual’s ability to address a practical problem independently and in depth within of a regular time of 5 Months.

Course assignments/ form of examination: Individual assignment to an engineering or scientific problem in the field of petroleum engineering and elaboration of master thesis/ The MSc candidate must present and defend the master thesis in colloquium in presence of at least one of two designated examiners. The overall MSc thesis grade is to evaluate as weighted average affected by 90 % of the written thesis grade and 10 % of the presentation and discussion grade.

Media: • 3 hard copies of the master thesis (to be submitted to the exam office not later than 1 week prior to the colloquium) • MS PowerPoint presentation • Data CD containing soft (pdf) copies of the master thesis and the presentation

Literature: Assessment of relevant literature sources should be carried out by the MSc candidate as part of the master thesis

Additional information: The MSc candidates are asked to agree the appointment for the colloquium with the secretary office in advance.
Compulsory subjects of Reservoir Management area of study
Module 4: Data Acquisition and Evaluation

Degree Programme: Petroleum Engineering
Module number: 4
Name of the module: Data Acquisition and Evaluation
Courses: Applied Well Test Analysis
Well Logging II
Term: 2
Person responsible for the module: Prof. Ganzer
Lecturers: Prof. Ostrowski, Prof. Weller
Language: English
Course type: Compulsory subjects (PF) of the Reservoir Management area of study

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Prerequisites for attending: No special prerequisites

Learning objectives / Skills: The MSc candidates should acquire the knowledge in the origination, validation, interpretation and uncertainty of engineering and geo-scientific data as well as the ability to handle, to interpolate and to extrapolate it. The students develop skills to acquire and to evaluate data required for reservoir characterization and simulation studies.

Course outline: Applied Well Test Analysis
- Objectives of Well Testing
- Downhole and Surface Equipment
- Well Test Principles, Reservoir Models, Inner & Outer Boundary Conditions
- Single Well Test Analysis: Drawdown, Build-Up (DST) Pulse Test, Minifrac Testing, Layered Reservoir, Vertical Interference and Horizontal Well Test
- Multiple Well Test Analyses: Interference Test, Pulse Interference Test; Gas Well Test Analysis Interpretation Methodology.

Well Logging II (cased hole logging)
- Introduction
- Radiometric methods
- Acoustic methods
- Electrical methods

Course assignments/ form of examination: Partial examination. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam. The module grade is evaluated as average grade from the both partial grades weighted by the credit points number.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory
- Computer aided exercises by using professional well test analysis and interpretation software

Literature: Applied Well Test Analysis
2. Earlougher R. C.: Advances in Well Test Analysis, Monograph Series, SPE, Dallas 1977
Well Logging II

Additional information: Participants are requested to register for the attendance with the course directory
Module 5: Reservoir Modeling and Simulation

Degree Programme: Petroleum Engineering
Module number: 5
Name of the module: Reservoir Modelling and Simulation
Courses: Geological Modeling
        Numerical Reservoir Simulation
Term: 1-2
Person responsible for the module: Prof. Ganzer
Lecturers: Prof. Groß, Dipl.-Ing. Schatzmann, Prof. Ganzer, Prof. Bremeier,
Language: English
Course type: Compulsory subjects (PF) of the Reservoir Management area of study

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Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Acquisition of advanced knowledge in the field of setting up of geological and dynamic reservoir simulation models, evaluation of model uncertainties, calibration of flow models, evaluation of forecasting accuracy. Ability of setting up and evaluate geological and dynamic reservoir simulation models as well as to approach the professional solution of real reservoir modelling and simulation problems on advanced methodical and systematical way.

Course outline:
Geological Modeling:
a) Theoretical part: Interpretation and basics to reconstruct deposition areas (depositional systems and facies models) with regards to set up 3D geological models:
   - Principles of generation of 3-D geological models
   - Sedimentary facies
   - Facial model
   - Facial sequences and stratigraphy, Sedimentary structures, Well logging and facies
   - Depositional environments: Terrestrial environments;
   - Fluvial systems
   - Marginal marines: Deltaic systems
   - Example cases relevant to the petroleum geology

b) Practical part: Introduction to Petrel software package (well correlation, static geological model)

Numerical Reservoir Simulation:
- History and classification of reservoir simulators
- Review of fluid properties for simulation
- Rock properties and saturation functions
- General purpose formulation and discretization methods used for black-oil and EOS compositional simulators
- Gridding - structured and unstructured gridding approaches, Cartesian, corner point and Voronoi grids
- Modelling structural elements in simulation
- Representing wells in the reservoir simulation model
- Compositional reservoir simulation
- Simulation of fractured reservoirs
- Upgridding and upscaling
- History matching

Course assignments/ form of examination: Continuous assessment and report, Project work/ Partial examination. Written (90 min) or oral exam (30-40 min). The mark of the course Geological Modelling consists of a) theoretical part -> final exam (written) and b) practical part -> continuous assessment and report.
The module grade is evaluated as average grade from the both partial grades weighted by the credit points number.

**Media:**
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Computer aided exercises using the application of the commercial reservoir modeling software PETREL (Schlumberger), Matlab and CMG
- Hard copy of lecture notes to be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides to be provided on the Stud.IP directory of the course.
- Video records of lectures is available with the course directory on the Stud.IP

**Literature:**

**Geological Modelling:**

**Numerical Reservoir Simulation:**

**Additional information:**
Participants are requested to register for the attendance with the course directory at the Stud.IP.
Module 6: Enhanced Hydrocarbon Recovery

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| Prerequisites for attending: | No special prerequisites |
| Learning objectives / Skills: | Acquisition of advanced knowledge in the analysis and computation methods of the processes and mechanisms of the oil recovery, production and storage/ Skills in the application of the fundamentals of material and phase behavior of hydrocarbons will be consolidated and established on an advanced level |
| Course outline: | • Basics of Waterflooding;  
• Chemical Flooding;  
• Gas Flooding;  
• Steam Flooding;  
• Well Treatment |
| Course assignments/ form of examination: | Module exam. Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number must be achieved to pass the written exam. |
| Media: | • Multimedia lecturing tools  
• PowerPoint presentation software and white board  
• Hard copy of lecture notes to be provided at the beginning of the course  
• A soft pdf copy of PowerPoint presentation with the Stud.IP directory  
• Computer aided exercises by using professional software |
| Additional information: | Participants are requested to register for the attendance with the course directory at the Stud.IP |
Module 10 a: Economics and Law

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 10 a
Name of the module: Management, Economics and Law
Courses: Energy Law I
Planning and Budgeting
Term: 2-3
Person responsible for the module: Prof. Oppelt
Lecturers: Prof. Wolkewitz, Dr. Schäfer
Language: English
Course type: Compulsory subjects (PF) of the Reservoir Management area of study

<table>
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Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
- Knowledge of the public law basics of oil and gas activities including the main elements of the legal framework
- Understand and Use Planning Tools and Decision Models

Course outline: Energy Law I:
- Public law as basis for oil and gas activities – a general introduction
- Typical legal systems for upstream oil and gas activities such as Licences/Concessions, Production Sharing Agreements and Service Contracts
- Fiscal regimes for oil and gas activities
- Environmental law
- The legal framework of mid- and downstream oil and gas activities
Planning and Budgeting:
- Basic Concepts and Definitions
- On Planning
- Vertical (Value Chain), Horizontal and Mixed Types of Business
- Types of Investment
- Evaluation of Prospects and Investments
- Search for and Screening of Investment Opportunities
- Establishing an Investment Portfolio
- From Portfolio to Budget Proposals
- The Capital Budget Decision
- Operational Budget and Realization
- Strategic Investment Plan
- Follow-up and Controlling

Course assignments/ form of examination: Partial examination. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number is to be collected to pass the written exam. The module grade is evaluated as average grade from the both partial grades weighted by the credit points number.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

Literature:
3. Respective texts of relevant laws and related documents that are provided in the Stud.IP
4. Scripts on selected topics that are provided in the Stud.IP
### Planning and Budgeting


### Additional information:
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 12: Seminar

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<td>Courses:</td>
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<td>Person responsible for the module:</td>
<td>Prof. Ganzer</td>
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<td>Lecturers:</td>
<td>All faculty and scientific staff members in the field of reservoir engineering</td>
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| Prerequisites for attending:           | No special requirements |
| Learning objectives / Skills:          | Development the ability to apply theoretical knowledge and state-of-the-art methods and technology for the individual problem solving in the field of petroleum engineering/ Strengthening of skills to report and to present results to an audience of peers |
| Course outline:                        | Students work on assigned special topics, report and present results obtained via individual efforts within of a regular time of 6-7 weeks. |
| Course assignments/ form of examination: | Soft (pdf) copies of the seminar report, poster and presentation to be uploaded to the Stud.IP seminar directory in due time/ Seminar report, poster, presentation to an audience of peers, faculty and scientific staff members and discussion. The overall seminar grade is evaluated as weighted average affected by 40% of the report grade, 40 % of the presentation grade, 10 % of the poster grade and 10% of the moderation grade. |
| Media:                                 | • DIN A3 Poster to be posted at a pin-board |
|                                       | • MS PowerPoint presentation |
|                                       | • White board |
| Literature:                            | Key literature sources should be provided by the supervisor. Assessment of further relevant literature sources should be carried out by the candidate as part of seminar study |
| Additional information:                | Participants are requested to register for the attendance with the seminar directory at the Stud.IP |
Compulsory subjects of Drilling & Production area of study
Module 7: Advanced Drilling and Completion

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 7
Name of the module: Advanced Drilling and Completion
Courses: Advanced Drilling Technology, Completion and Workover
Term: 1-2
Person responsible for the module: Prof. Oppelt
Lecturers: Prof. Thonhauser, Dr. Prohaska, Prof. Teodoriu, Dr. Bello
Language: English
Course type: Compulsory subjects (PF) of the Drilling & Production area of study

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Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
- Acquisition of profound knowledge in drilling engineering and the ability to apply it in the field of wellbore planning. Comprehension of advanced modern drilling technologies as well as merits and risks of special drilling technology to develop petroleum reservoirs efficiently
- Acquisition of special knowledge in the drilling, workover and completion technology to meet requirements of wellbore deliverability, safety and integrity. Skills of well planning based on the profound knowledge and ability to meet requirements and options will be extended to the advanced level and consolidated

Course outline:
- **Advanced Drilling Technology:**
  - Drilling concepts
  - Well design procedure
  - Drilling optimization
  - Drilling performance analysis
  - Drillstring dynamics
  - Drilling problems
  - HP/HT wells, horizontal and extended reach wells, multilaterals
  - Under balanced drilling
  - New developments in drilling operations
  - Offshore drilling
  - Blow out
  - Case studies
- **Completion and Workover:**
  - Completion objectives (definition, considerations, types)
  - Mechanical aspects of well testing
  - Completion fluids and perforation
  - Tubing string design
  - Packer and downhole tools
  - Flow control
  - Data acquisition & intelligent completion
  - Workover objectives & workover operations
  - Workover rigs & tools
  - Workover equipment (wire line, snubbing unit, coiled tubing)
  - Completion & workover design & execution

Course assignments/ form of examination: Partial examination. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam. The module grade is evaluated as average grade from the both partial grades weighted by the Credit point number.

Media: Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

**Literature:**

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**Sonstiges:**

Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 8: Directional Drilling and Logging

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 8
Name of the module: Directional Drilling and Logging
Courses:
- Directional Drilling
- Well Logging II
Term: 2
Person responsible for the module: Prof. Oppelt
Lecturers: Prof. Oppelt, Prof. Weller
Language: English
Course type: Compulsory subjects (PF) of the Drilling & Production area of study

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Prerequisites for attending:
No special prerequisites

Learning objectives / Skills:
- Understand merits and risks of this specialized Drilling Technology to be able to make efficient use in developing reservoirs
- Knowledge of Logging Methods in Cased Holes and Interpretation

Course outline:
**Directional Drilling:**
- Directional Drilling (Fundamentals, Planning and Design)
- Downhole Motors
- Directional Survey Methods
- BHAs for Well Steering
- Geosteering Methods
- Economic Aspects of Directional Drilling

**Well Logging II:**
- Fundamentals of geophysical well logging methods
- History – goals – technical equipment
- Radiometric methods
- Acoustic borehole measurements
- Electrical methods

Course assignments/ form of examination:
Partial examination. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam. The module grade is evaluated as average grade from the both partial grades weighted by the Credit point number.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory
- Computer aided exercises by using professional software

Literature:
**Directional Drilling:**

**Well Logging II**

Additional information:
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 9: Production

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 9
Name of the module: Production
Courses: Advanced Hydrocarbon Conditioning and Processing I
         Enhanced Production
Term: 2
Person responsible for the module: Prof. Oppelt
Lecturers: Dipl.-Ing. Waldvogel, Dr. Lungwitz
Language: English
Course type: Compulsory subjects (PF) of the Drilling&Production area of study

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Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
- Knowledge of techniques and design requirements for the conditioning & processing of oil & gas
- Knowledge of methodologies and technologies to enhance hydrocarbon production

Course outline:
Advanced Hydrocarbon Conditioning and Processing I:
- Oil & Gas Processing & Equipment
- Process Simulation
- Separation & Oil Treating Facilities
- Heat Transfer and Facilities
- Pumps, Compressors & Diverters
- Absorption
- Refrigeration Systems in Gas Processing
- Design of Gas Dehydration Facilities
- Advances Sour Gas Processing and Sulphur Recovery
- Operation of Surface Facilities
- Maintenance of Surface Facilities
- Safety, Environment and Human Factors in Design and Operations

Enhanced Production:
- Advanced artificial lift and gas well deliquification
- Multiphase pumps and wet gas compressors
- Subsea boosting
- Well Stimulation
- Real-time flow monitoring and control
- Production logging

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory
- Computer aided exercises by using professional software

Literature:
Advanced Hydrocarbon Conditioning and Processing I:
1. GPSA engineering data book 13th edition
Enhanced Production:
1. Economides, M.J., Hill, A.D. and Ehlig-Economides, C.: Petroleum Production
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Module 10 b: Management, Economics and Law

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 10 b
Name of the module: Management, Economics and Law
Courses: Energy Law I
Planning and Budgeting
Health, Safety and Environmental Management
Term: 2-3
Person responsible for the module: Prof. Oppelt
Lecturers: Prof. Wolkewitz, Dr. Schäfer, Dipl.-Ing. Söntgerath
Language: English
Course type: Compulsory subjects (PF) of the Drilling&Production area of study

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Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
- Knowledge of the public law basics of oil and gas activities including the main elements of the legal framework
- Understand and Use Planning Tools and Decision Models
- Impact of Health Safety and Environment issues on oil and gas activities and ways to deal with it

Course outline:
**Energy Law I:**
- Public law as basis for oil and gas activities – a general introduction
- Typical legal systems for upstream oil and gas activities such as Licences/Concessions, Production Sharing Agreements and Service Contracts
- Fiscal regimes for oil and gas activities
- Environmental law
- The legal framework of mid- and downstream oil and gas activities

**Planning and Budgeting**
- Basic Concepts and Definitions
- On Planning
- Vertical (Value Chain), Horizontal and Mixed Types of Business
- Types of Investment
- Evaluation of Prospects and Investments
- Search for and Screening of Investment Opportunities
- Establishing an Investment Portfolio
- From Portfolio to Budget Proposals
- The Capital Budget Decision
- Operational Budget and Realization
- Strategic Investment Plan
- Follow-up and Controlling

**Health, Safety and Environmental Management**
- Organization of Safety and Loss Management
- Risk and its Management
- Machinery and Equipment Safety
- Kyoto Protocol and beyond
- Clear Air for Europe (CAFE)
- Dangerous Substances
- Waste Management
- Water Management
- Offshore Regulations
- Audit - a new tool?
- Biodiversity - who cares?

Course assignments/ form: Homework assignments/Partial examination by disciplines. Written (90 min) or
**Form of examination:**
Oral exam (30-40 min). At least 50% of the maximal score number is to be collected to pass the written exam. The module grade will be evaluated as average from the partial grades weighted by the credit points number.

**Media:**
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

**Literature:**
- Energy Law I
  3. Respective texts of relevant laws and related documents that are provided in the Stud.IP
  4. Scripts on selected topics that are provided in the Stud.IP

- Planning and Budgeting

- Health, Safety and Environmental Management
  - Lecture notes
  - Handouts and authentic materials based on the EU and German national health, environmental and occupational protection laws

**Additional information:**
Participants are requested to register for the attendance with the course directory at the Stud.IP.
Module 12: Seminar

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<td>Person responsible for the module:</td>
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<td>Lecturers:</td>
<td>All faculty and scientific staff members in the field of drilling and production engineering</td>
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Prerequisites for attending: No special requirements

Learning objectives / Skills: Development the ability to apply theoretical knowledge and state-of-the-art methods and technology for the individual problem solving in the field of petroleum engineering/ Strengthening of skills to report and to present results to an audience of peers

Course outline: Students work on assigned special topics, report and present results obtained via individual efforts within a regular time of 6-7 weeks.

Course assignments/ form of examination: Soft (pdf) copies of the seminar report, poster and presentation to be uploaded to the Stud.IP seminar directory in due time/ Seminar report, poster, presentation to an audience of peers, faculty and scientific staff members and discussion. The overall seminar grade is evaluated as weighted average affected by 40% of the report grade, 40 % of the presentation grade and 10 % of the poster grade and 10% of the moderation grade.

Media: • DIN A3 Poster to be posted at a pin-board
• MS PowerPoint presentation
• White board

Literature: Key literature sources should be provided by the supervisor. Assessment of further relevant literature sources should be carried out by the candidate as part of seminar study

Additional information: Participants are requested to register for the attendance with the seminar directory at the Stud.IP
Compulsory optional subjects of Reservoir Management area of study
Module 15.1: Petrophysics

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 15.1
Name of the module: Petrophysics
Courses: Petrophysics I
Term: 1
Person responsible for the module: Prof. Ganzer
Lecturers: Prof. Weller
Language: English
Course type: Compulsory optional subjects (WPF) of Reservoir Management area of study

<table>
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Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Knowledge of geophysical rock properties and their application to the characterization of reservoirs.

Course outline:
- Introduction
  - Petrophysics in Geophysics
  - Classification of rocks
  - Structure and texture
- Pore space properties
  - Pore space, porosity , saturation
  - Tortuosity, constrictivity
  - Internal surface
  - Fractal dimension
- Density
  - Density of different rocks
  - Determination of density in laboratory, in situ and in wells
  - Different kinds of density
- Magnetic Properties
  - Para-, dia-, ferro-, and ferrimagnetism
  - Magnetic properties of minerals and rocks
  - Remanent magnetization
  - The influence of temperature and pressure

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number must be achieved to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory
- Computer aided exercises by using professional software

Literature:

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 15.2: Geostatistics

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 15.2
Name of the module: Geostatistics
Courses: Advanced Geostatistics
Term: 1
Person responsible for the module: Prof. Ganzer
Lecturers: Dr. Mueller
Language: Englisch
Course type: Compulsory optional subjects (WPF) of Reservoir Management area of study

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Contact hours/Self-study</td>
<td>CP</td>
</tr>
<tr>
<td>W 4635 Advanced Geostatistics</td>
<td>2V+1U</td>
<td>42/108</td>
<td>5</td>
</tr>
</tbody>
</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Vermittlung der Kenntnisse über ihre Herkunft, Validierung, Interpretation, Datenunsicherheit, räumliche Datenextrapolation und Dateninterpolation sowie über den Umgang mit ingenieur- und geowissenschaftlichen Daten./ Die Studierenden besitzen einen profunden Überblick über die Akquisition und die Evaluierung der für Reservoircharakterisierung und Simulation erforderlichen lagerstätentechmischen und geophysikalischen Daten.

Course outline: • Introduction and Basic Concepts;
• Univariate Analysis;
• Measures of Heterogeneity;
• Hypothesis Tests;
• Bivariate Analysis;
• Basics of Geostatistics: Variogramme calculation and interpretation, Kriging;
• Use of Statistics in Petroleum Geology

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam.

Media: • Multimedia lecturing tools
• PowerPoint presentation software and white board
• Hard copy of lecture notes to be provided at the beginning of the course
• A soft pdf copy of PowerPoint presentation with the Stud.IP directory
• Computer aided exercises by using professional software

Literature: 

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 15.3: Rock Physics

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 15.3
Name of the module: Rock Physics
Courses: Advanced Rock Physics
Term: 1
Person responsible for the module: Prof. Ganzer
Lecturers: Dr. Wegner
Language: Englisch
Course type: Compulsory optional subjects (WPF) of Reservoir Management area of study

<table>
<thead>
<tr>
<th>Courses</th>
<th>Workload [h]</th>
<th>Skills</th>
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</thead>
<tbody>
<tr>
<td>W 6118 Advanced Rock Physics</td>
<td>2V+0 42/108</td>
<td>CP 5, FK 60, MK 40</td>
</tr>
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</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
- Acquisition of advanced knowledge in the evaluation of physical properties of reservoir rocks
- Ability to understand and to apply the advanced techniques of reservoir rock characterization

Course outline:
- Review of rock properties and saturation functions
- Special and standard core analysis laboratory tests
- Introduction to the “Digital Rock Technology”
  - Imaging of rocks using CT, micro-CT, FIB, etc.
  - Generation of 3D models of rocks and single phase pore-scale simulation to derive petro physical properties of rocks such as porosity, absolute permeability, NMR, elastic properties, etc.
  - Multiphase pore-scale simulation to derive capillary pressure and relative permeabilities
  - Special topics: Carbonates and unconventional rocks
- Introduction to Microfluidic devices that resemble porous media
  - Micro-models and Micro-fluidics – Micro-model construction, experimental setup, wettability control, etc.
  - Investigation of EOR methods in micro-models that resemble porous media
  - Micro-fluidic measurement devices
- Discussion of advantages and disadvantages of the different characterization methods

Exercises:
- Calculation of permeability and porosity data from laboratory flooding experiments
- Conversion of mico-CT to 3D models and calculation of petrophysical parameters such as porosity, permeability, grain size distribution, pore-size distribution, etc. as well as multiphase flow properties such as relative permeability and capillary pressure using the software packages Matlab, Comsol and GeoDict
- Comparison of laboratory flooding experiments and results obtained by Digital Rocks
- Evaluation of micro-model experiments

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min). 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- Hard copy of lecture notes to be provided at the beginning of the course.
- Video records of lecture available with the Stud.IP directory of the course.
- A soft pdf copy of PowerPoint presentation slides to be provided on the Stud.IP directory of the course.
- Exercises with application of the GeoDict software in PC Pool

Literature: Authentic lecturing and training materials, Handouts

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 16.1: Data Interpretation

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 16.1
Name of the module: Data Interpretation
Courses: Applied Seismic Data Interpretation
Term: 2
Person responsible for the module: Prof. Ganzer
Lecturers: Dr. Haugwitz
Language: English
Course type: Compulsory optional subjects (WPF) of Reservoir Management area of study

Courses | HPW | Workload [h] | Skills |
---|---|---|---|
S 4008 Applied Seismic Data Interpretation | 2V+1U | 42/78 | CP FK MK SK SOK |

Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Theoretical knowledge about the propagation of seismic waves in the subsurface, seismic acquisition techniques and tools and main steps of seismic data processing/ Ability to understand and apply the advanced techniques of seismic data acquisition and interpretation

Course outline:
- Elements of solid earth physics;
- Acquisition: Seismic sources and receivers. Recording geometries, Traveltimes of refracted and reflected waves, true and apparent velocities, Moveout- and Normal Moveout-, Average-, RMS-, Stacking-,..., velocities.
- Processing: Signal to noise ratio, filtering, convolution and correlation, sorting in CMP-(CDP-) geometries (gathers), static corrections, NMO-corrections and stacking; signal-stretch. Zero-offset sections and the exploding reflector model.
- Elements of seismic migration: Migrator’s equation: ray-theoretical migration, diffractions in stacked sections; focussing diffractions to their origin.
- Elements of Seismic Interpretation: The theoretical (synthetic) seismogram: kinematical and dynamical aspects (traveltimes and amplitudes), vertical incidence, non-zero-offset seismograms, structural interpretation, “thin” -bed analysis; bright-, dim-, flat- spots. Elements of wavelet processing, resolution and recognition, basics of seismostratigraphy.
- Pitfalls in seismic interpretation: “the velocity-problem”& 2D-migration in a 3D-world.

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min). 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- Hard copy of lecture notes to be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides to be provided on the Stud.IP directory of the course.
- Exercises with application of the PETREL software in PC Pool

Literature:

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 16.2: Model Validation

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 16.2
Name of the module: Model Validation
Courses: Reservoir Model Validation
Term: 2
Person responsible for the module: Prof. Ganzer
Lecturers: Dr. Schulze-Riegert
Language: English
Course type: Compulsory optional subjects (WPF) of Reservoir Management area of study

<table>
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<tr>
<th>Courses</th>
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<td>2V</td>
<td>28/78</td>
<td>4</td>
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</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
Acquisition of advanced knowledge in the field of setting up of dynamic reservoir simulation models, evaluation of model uncertainties, calibration of flow models, evaluation of forecasting accuracy. / Ability to validate of dynamic reservoir simulation models as well as to approach the professional solution of real reservoir simulation problems on advanced methodical and systematical way.

Course outline:
- Principles of Model Validation,
- Subsurface Uncertainties,
- Multi-Dimensional Search and Solution Space,
- Foundations of Optimisation Methods;
- History Matching Inverse Problem Statement: Scope of History Matching, Bayesian Optimisation Framework;
- Challenges (Ill-posed problems, non-linearity of the solution space);
- Optimisation Approaches (manual, (semi-)automatic);
- Local and Global Optimisation Methods;
- Application of Optimisation Techniques;
- Model Predictions and Uncertainty Quantification.

Course assignments/ form of examination:
Module exam. Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Computer aided exercises using the application of the commercial reservoir modeling software MEPO and ECLIPSE (Schlumberger)
- Hard copy of lecture notes to be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides to be provided on the Stud.IP directory of the course.

Literature:
7. Further recommended literature is available with the lecture notes

Additional information:
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 16.3: Reservoir Modeling

<table>
<thead>
<tr>
<th>Degree Programme:</th>
<th>Petroleum Engineering (M.Sc.)</th>
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<tbody>
<tr>
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<tr>
<td>Courses:</td>
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<td>Term:</td>
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<td>Person responsible for the module:</td>
<td>Prof. Ganzer</td>
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<tr>
<td>Lecturers:</td>
<td>Dr. Mueller</td>
</tr>
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<td>Language:</td>
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<td>2V</td>
<td>28/78</td>
<td>4</td>
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<td>40</td>
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</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills:
- Acquisition of advanced knowledge in the field of setting up of geological and dynamic reservoir models, model uncertainties, calibration of flow models, evaluation of forecasting uncertainties/ Ability of setting up and evaluate of fractured reservoir models

Course outline:
- Deformation of reservoir rocks, tectonic styles;
- Classification, types and recording of fractures: Direct and indirect sources of information, mapping of Fracture properties;
- Origin of fractures, Stress field;
- Fracture model data base, data identification, methods of representation of fractures.

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min). 50% of maximal score number is to be collected to pass the written exam.

Media:
- PowerPoint presentation software and white board
- Computer aided exercises using the application of the commercial geological modeling and reservoir simulation software
- Hard copy of lecture notes will be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides will be provided on the Stud.IP directory of the course.

Literature:

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
# Module 17.1: Natural Gas Recovery

**Degree Programme:** Petroleum Engineering (M.Sc.)

**Module number:** 17.1

**Name of the module:** Natural Gas Recovery

**Courses:** Enhanced Natural Gas Recovery

**Term:** 2

**Person responsible for the module:** Prof. Ganzer

**Lecturers:** Dr. Reitenbach

**Language:** English

**Course type:** Compulsory optional subjects (WPF) of Reservoir Management area of study

<table>
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<th>Courses</th>
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<td>S 6104 Enhanced Natural Gas Recovery</td>
<td>2V</td>
<td>28/78</td>
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</table>

**Prerequisites for attending:** No special prerequisites

**Learning objectives / Skills:** Acquisition of advanced knowledge in principles of analysis and engineering computation of gas recovery processes and application of material laws and phase behavior of hydrocarbons

**Course outline:**
- Fundamentals and Methods of EGR Processes;
- Enhanced Gas Recovery of Conventional Gas Reservoirs;
- Enhanced Natural Gas Recovery by Dense Gas Flooding;
- Unconventional Gas Reservoirs: Tight Gas Formations;
- Coal Bed Methane Recovery;
- Gas Hydrate Recovery and Utilization

**Course assignments/ form of examination:** Module exam. Written (90 min) or oral exam (30-40 min). 50% of maximal score number is to be collected to pass the written exam.

**Media:**
- PowerPoint presentation software and white board
- Hard copy of lecture notes will be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides will be provided on the Stud.IP directory of the course.
- Authentic report materials and handouts

**Literature:**

**Additional information:** Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 17.2: Natural Gas Storage

**Degree Programme:** Petroleum Engineering (M.Sc.)

**Module number:** 17.2

**Name of the module:** Natural Gas Storage

**Courses:**
- Natural Gas Storage

**Term:** 2

**Person responsible for the module:** Prof. Ganzer

**Lecturers:** Dr. Reitenbach

**Language:** English

**Course type:** Compulsory optional subjects (WPF) of Reservoir Management area of study

### Courses

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
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<th>Skills</th>
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<td>CP FK MK SK SOK</td>
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<tr>
<td>S 6113 Natural Gas Storage</td>
<td>2V</td>
<td>28/78</td>
<td>4 60 40</td>
</tr>
</tbody>
</table>

**Prerequisites for attending:** No special prerequisites

**Learning objectives / Skills:** Acquisition of advanced knowledge in principles of analysis, application of material laws and fundamentals of phase behavior of hydrocarbons and engineering of natural gas storage processes

**Course outline:**
- Media for Storage and Operation Principles;
- Fundamentals and definition of terms;
- Gas Storage in Salt Caverns: Geological, Geomechanical and Thermodynamic Conditions and Design of Caverns;
- Operation Fundamentals;
- Characteristics, Optimization Strategies;
- Gas Reservoirs: Reservoir Mechanics, Storage Capacity and Productivity, Gas Mixing;
- Well Design and Completion, Surface Installations;
- Aquifer Storages;
- Field Cases.

**Course assignments/ form of examination:** Module exam. Written (90 min) or oral exam (30-40 min). 50% of maximal score number is to be collected to pass the written exam.

**Media:**
- PowerPoint presentation software and white board
- Hard copy of lecture notes will be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides will be provided on the Stud.IP directory of the course.
- Authentic report materials and handouts

**Literature:**

**Additional information:** Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 17.3: Enhanced Production

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 17.3
Name of the module: Enhanced Production
Courses: Enhanced Production
Term: 2
Person responsible for the module: Prof. Oppelt
Lecturers: Dr. Lungwitz
Language: Englisch
Course type: Compulsory optional subjects (WPF) of Reservoir Management area of study

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
<th>Contact hours</th>
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<tbody>
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<td>S 6169 Enhanced Production</td>
<td>2V</td>
<td>42/78</td>
<td>4</td>
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</table>

Prerequisites for attending: No special prerequisites
Learning objectives / Skills: Knowledge of methodologies and technologies to enhance hydrocarbon production
Course outline:
- Advanced artificial lift and gas well deliquification
- Multiphase pumps and wet gas compressors
- Subsea boosting
- Well Stimulation
- Real-time flow monitoring and control
- Production logging

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min) for each discipline. At least 50% of maximal score number must be achieved to pass the written exam.
Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory
- Computer aided exercises by using professional software

Literature:
2. Authentic training materials of the Schlumberger Co.

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
## Module 18.1: Energy Law

<table>
<thead>
<tr>
<th>Degree Programme:</th>
<th>Petroleum Engineering (M.Sc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module number:</td>
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<tr>
<td>Name of the module:</td>
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<td>Courses:</td>
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<tr>
<td>Person responsible for the module:</td>
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<td>Lecturers:</td>
<td>Prof. Wolkewitz</td>
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</table>

### Prerequisites for attending:
No special prerequisites

### Learning objectives / Skills:
Knowledge about the main contractual arrangements necessary along the value chain of oil and gas activities including the relevant regulatory framework

### Course outline:
- Joint Operation Agreements as contractual arrangement within a consortium of companies
- Drilling Contracts and related agreements for oil and gas subsurface activities
- Engineering Procurement and Construction Contracts as main legal feature of oil and gas surface activities
- Transportation and Processing Agreements upstream
- Third party access and regulation in the midstream part of the value chain
- Gas Sales Agreements and energy supply contracts

### Course assignments/ form of examination:
Homework assignments/ Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

### Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

### Literature:
4. Respective internationally relevant Model Agreements and Contracts that are provided in the Stud.IP
5. Respective texts of relevant laws and related documents that are provided in the Stud.IP

### Additional information:
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 18.2: Health, Safety and Environmental Management

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Skills</th>
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<td>SOK 25</td>
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</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Acquisition of Knowledge on Impact of Health Safety and Environment issues on oil and gas activities and ways to deal with it.

Course outline:
- Organisation of Safety and Loss Management
- Risk and its Management
- Machinery and Equipment Safety
- Kyoto Protocol and beyond
- Clear Air for Europe (CAFE)
- Dangerous Substances
- Waste Management
- Water Management
- Offshore Regulations
- Audit - a new tool?
- Biodiversity - who cares?

Course assignments/ form of examination: Homework assignments/ Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

Literature:
- Lecture Notes
- Handouts and authentic materials based on the EU and German national health, environmental and occupational protection laws

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Compulsory optional subjects of Drilling & Production area of study
Module 19.1: Energy Law

<table>
<thead>
<tr>
<th>Courses</th>
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Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Knowledge about the main contractual arrangements necessary along the value chain of oil and gas activities including the relevant regulatory framework

Course outline:
- Joint Operation Agreements as contractual arrangement within a consortium of companies
- Drilling Contracts and related agreements for oil and gas subsurface activities
- Engineering Procurement and Construction Contracts as main legal feature of oil and gas surface activities
- Transportation and Processing Agreements upstream
- Third party access and regulation in the midstream part of the value chain
- Gas Sales Agreements and energy supply contracts

Course assignments/ form of examination: Homework assignments/ Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

Literature:
4. Respective internationally relevant Model Agreements and Contracts that are provided in the Stud.IP
5. Respective texts of relevant laws and related documents that are provided in the Stud.IP

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 19.2: Materials Engineering

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 19.2
Name of the module: Materials Engineering
Courses: Materials Engineering and Corrosion
Term: 2
Person responsible for the module: Prof. Oppelt
Lecturers: Prof. Neubert
Language: English
Course type: Compulsory optional subjects (WPF) of Drilling & Production area of study

<table>
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<td>2V</td>
<td>28/62</td>
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Prerequisites for attending: No special prerequisites
Learning objectives / Skills: Ability to employ appropriate materials and to design petroleum equipment and facilities

Course outline:
- Petroleum Fluids & Corrosion (Oil, Gas, Water, Emulsions, Corrosion Mechanism/Forms);
- Materials and corrosion
- Materials selection
- Corrosion inhibition
- Hydrogen corrosion
- Petroleum fluid and corrosion testing
- Cathodic corrosion protection
- Other protection methods

Course assignments/ form of examination: Homework assignments/ Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory

Literature: Authentic lecturing materials and handouts
Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 19.3: Fluid Mechanics

Degree Programme: Petroleum Engineering (M.Sc.)
Module number: 19.3
Name of the module: Fluid Mechanics
Courses: Fluid Mechanics
Term: 1/3
Person responsible for the module: Prof. Brenner
Lecturers: Prof. Brenner
Language: English
Course type: Compulsory optional subjects (WPF) of Drilling & Production area of study

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<th>Courses</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 8040 Fluid Mechanics</td>
<td>2V</td>
<td>28/62</td>
<td>CP 60</td>
</tr>
</tbody>
</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Ability to employ appropriate materials and to design petroleum equipment and facilities

Course outline:
- Properties of fluids and flows
- Hydrostatics, aerostatics
- Kinematics and dynamics of inviscid fluids → Bernoulli equation
- Conservation equations of viscous fluids the Euler Equation and applications to laminar flow
- Conservation equations of viscous fluids the Navier-Stokes equation and applications to laminar flows
- Dimensional analysis
- Boundary layer theory
- Turbulent flows
- Experimental and measurement techniques

Course assignments/ form of examination: Homework assignments/ Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory

Literature: Authentic lecturing materials and handouts

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 19.4: Offshore Production and Structures

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Skills</th>
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</thead>
<tbody>
<tr>
<td>W 6124 Offshore Production and Structures</td>
<td>2V</td>
<td>28/62</td>
<td>CP 60</td>
</tr>
</tbody>
</table>

Prerequisites for attending:
No special prerequisites

Learning objectives / Skills:
- Verständnis und Bewertung der Gestaltung von Offshore Produktionssystemen

Course outline:
- International Offshore Activities and Trends
- Design Elements (Wind, Waves, Current, Ice Forces)
- Ocean Floor Surveying, Platform Foundation
- Design of Fixed Platform Systems (Piles, Gravity)
- Floating Systems Dry Tree (TLP, SPAR, etc)
- Floating Systems Wet Tree (FPSO, Semi, etc)
- Subsea Completions
- Logistics
- Offshore Pipelines
- Actual Development Projects and Case Studies
- Offshore Drilling overview: floating drilling units and special equipment, jack-ups, activities

Course assignments/ form of examination:
Homework assignments/ Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number is to be collected to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation available with the Stud.IP course directory
- Video records of lectures available with the Stud.IP course directory

Literature:

Additional information:
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 19.5: Numerical Reservoir Simulation

Degree Programme: Petroleum Engineering
Module number: 19.5
Name of the module: Numerical Reservoir Simulation
Courses: Numerical Reservoir Simulation
Term: 2
Person responsible for the module: Prof. Ganzer
Lecturers: Prof. Ganzer, Prof. Bremeier
Language: English
Course type: Compulsory optional subjects (WPF) of Drilling & Production area of study

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Contact hours/Self-study</td>
<td>CP</td>
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<tr>
<td>S 6102 Numerical Reservoir Simulation</td>
<td>2V+1U</td>
<td>42/108</td>
<td>5</td>
</tr>
</tbody>
</table>

Prerequisites for attending: Keine Voraussetzungen

Learning objectives / Skills:
Acquisition of advanced knowledge in the field of setting up of dynamic reservoir simulation models, evaluation of model uncertainties, calibration of flow models, evaluation of forecasting accuracy. / Ability of setting up and evaluate dynamic reservoir simulation models as well as to approach the professional solution of real reservoir modelling and simulation problems on advanced methodical and systematical way.

Course outline:
• History and classification of reservoir simulators;
• Review of fluid properties for simulation - black-oil properties, equation of state; modeling rock properties and saturation functions - porosity, permeability, compressibility, relative permeability, capillary pressure, compaction, correlations;
• general purpose formulation and discretization methods used for black-oil and EOS compositional simulators;
• Gridding: structured and unstructured gridding approaches, Cartesian grids, corner point grids, Voronoi grids;
• Modelling structural elements in simulation - vertical and sloping faults, channels, etc.;
• Representing wells in the reservoir simulation model; Compositional reservoir simulation;
• Simulation of fractured reservoirs - numerical model, matrix-fracture exchange, recovery processes;
• Upgridding and upscaling;
• History matching

Course assignments/ form of examination: Project work Assignments/ Written (90 min) or oral exam (30-40 min). 50% of maximal score number is to be collected to pass the written exam.

Media:
• Multimedia lecturing tools
• Computer aided exercises using the application of the commercial reservoir simulation software Matlab and CMG.
• Hard copy of lecture notes to be provided at the beginning of the course.
• Video records of lecture available with the Stud.IP directory of the course.
• A soft pdf copy of PowerPoint presentation slides to be provided on the Stud.IP directory of the course.

Literature:

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
## Module 19.6: Natural Gas Storage

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 6113 Natural Gas Storage</td>
<td>2V</td>
<td>28/78</td>
<td>CP: 4</td>
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</tbody>
</table>

### Prerequisites for attending:
No special prerequisites

### Learning objectives / Skills:
Acquisition of advanced knowledge in principles of analysis, application of material laws and fundamentals of phase behavior of hydrocarbons and engineering of natural gas storage processes

### Course outline:
- Media for Storage and Operation Principles;
- Fundamentals and definition of terms;
- Gas Storage in Salt Caverns: Geological, Geomechanical and Thermodynamic Conditions and Design of Caverns;
- Operation Fundamentals;
- Characteristics, Optimization Strategies;
- Gas Reservoirs: Reservoir Mechanics, Storage Capacity and Productivity, Gas Mixing;
- Well Design and Completion, Surface Installations;
- Aquifer Storages;
- Field Cases.

### Course assignments/ form of examination:
Module exam. Written (90 min) or oral exam (30-40 min). 50% of maximal score number is to be collected to pass the written exam.

### Media:
- PowerPoint presentation software and white board
- Hard copy of lecture notes will be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides will be provided on the Stud.IP directory of the course.
- Authentic report materials and handouts

### Literature:

### Additional information:
Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 19.7: Geological Modeling

<table>
<thead>
<tr>
<th>Courses</th>
<th>Workload [h]</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 4820 Geological Modeling</td>
<td>2V+1U</td>
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<td></td>
<td>42/108</td>
<td>CP 5</td>
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<td>MK 30</td>
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<td>SK 20</td>
</tr>
</tbody>
</table>

**Prerequisites for attending:** No special prerequisites

**Learning objectives / Skills:** Acquisition of advanced knowledge in the field of setting up of geological models / Ability of setting up and evaluate geological models on advanced methodical and systematical way.

**Course outline:**

Geological Modelling:

a) Theoretical part: Interpretation and basics to reconstruct deposition areas (depositional systems and facies models) with regards to set up 3D geological models:

- Principles of generation of 3-D geological models
- Sedimentary facies
- Facial model
- Facial sequences and stratigraphy, Sedimentary structures, Well logging and facies
- Depositional environments: Terrestrial environments;
- Fluvial systems
- Marginal marines: Deltaic systems
- Example cases relevant to the petroleum geology

b) Practical part: Introduction to Petrel software package (well correlation, static geological model)

**Course assignments/ form of examination:** Continuous assessment and report/ Written (90 min) or oral exam (30-40 min). The mark consists of a) theoretical part -> final exam (written) and b) practical part -> continuous assessment and report

**Media:**

- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Computer aided exercises using the application of the commercial reservoir modeling software PETREL (Schlumberger)
- Hard copy of lecture notes to be provided at the beginning of the course.
- A soft pdf copy of PowerPoint presentation slides to be provided on the Stud.IP directory of the course.

**Literature:**


**Additional information:** Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 19.8: Applied Well Test Analysis

<table>
<thead>
<tr>
<th>Courses</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Contact hours/Self-study</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 6109 Applied Well Test Analysis</td>
<td>2V+1U</td>
<td>42/108</td>
<td></td>
<td>CP 5  FK 60  MK 40  SK SOK</td>
</tr>
</tbody>
</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills: The MSc candidates should acquire the knowledge in the origination, validation, interpretation and uncertainty of engineering and geo-scientific data as well as the ability to handle, to interpolate and to extrapolate it. The students develop skills to acquire and to evaluate data required for reservoir characterization and simulation studies.

Course outline:
- Objectives of Well Testing
- Downhole and Surface Equipment
- Well Test Principles, Reservoir Models, Inner & Outer Boundary Conditions
- Single Well Test Analysis: Drawdown, Build-Up (DST) Pulse Test, Minifrac Testing, Layered Reservoir, Vertical Interference and Horizontal Well Test
- Multiple Well Test Analyses: Interference Test, Pulse Interference Test; Gas Well Test Analysis Interpretation Methodology.

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number must be achieved to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory
- Computer aided exercises by using professional well test analysis and interpretation software

Literature:
2. Earlougher R. C.: Advances in Well Test Analysis, Monograph Series, SPE, Dallas 1977

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
Module 19.9: Enhanced Oil Recovery

<table>
<thead>
<tr>
<th>Course</th>
<th>HPW</th>
<th>Workload [h]</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Contact hours/Self-study</td>
<td>CP</td>
</tr>
<tr>
<td>W 6103 Enhanced Oil Recovery</td>
<td>2V+1Ü</td>
<td>42/108</td>
<td>5</td>
</tr>
</tbody>
</table>

Prerequisites for attending: No special prerequisites

Learning objectives / Skills: Acquisition of advanced knowledge in the analysis and computation methods of the processes and mechanisms of the oil recovery, production and storage. Skills in the application of the fundamentals of material and phase behavior of hydrocarbons will be consolidated and established on an advanced level.

Course outline:
- Basics of Waterflooding;
- Chemical Flooding;
- Gas Flooding;
- Steam Flooding;
- Well Treatment

Course assignments/ form of examination: Module exam. Written (90 min) or oral exam (30-40 min). At least 50% of maximal score number must be achieved to pass the written exam.

Media:
- Multimedia lecturing tools
- PowerPoint presentation software and white board
- Hard copy of lecture notes to be provided at the beginning of the course
- A soft pdf copy of PowerPoint presentation with the Stud.IP directory
- Computer aided exercises by using professional software

Literature:

Additional information: Participants are requested to register for the attendance with the course directory at the Stud.IP
List of Abbreviations

Workload units:
HPW  Hours per week
CP   ECTS Credit Point

Course type:
(PF)  Compulsory subject
(WPF) Compulsory optional subject
(WF)  Elective (additional exam)

Teaching form:
V    Lecture
Ü    Exercise
V + Ü Lecture and exercise
P    Practical training
S    Seminar

Type of Exam:
(K)  Written exam
(M)  Oral exam
(Th) Term paper
(Ab) Master thesis + Colloquium
(SL) Seminar paper + Presentation

Skills:
FK   Professional skills
MK   Technical skills
SK   System expertise
SOK  Social skills