Curriculum for the Master's programme in GEOENERGY ENGINEERING

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- Amendment 2026, published in the Bulletin of 28 April 2026, Issue No. 163

At its meeting on 22 April 2026, the Senate of the Montanuniversität Leoben approved the decision taken by the Geoenergy Engineering Curriculum Commission – a decision-making body established in accordance with Section 25(8)(Z
3 and para. 10 of the Universities Act 2002, and which had not been prohibited by the Rectorate pursuant to Section 22(1)(12) of the Universities Act, in the following version of the fourth amendment pursuant to Section 25(10a) of the Universities Act.

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I. General Provisions

§1 Scope and Legal Basis

This curriculum governs the Master's programme in Geoenergy Engineering at the Montanuniversität Leoben on the basis of the University Act 2002 (UG) and the section of the Statutes entitled 'Provisions on Study Regulations' of the Montanuniversität Leoben, as amended from time to time.

§2 Admission Requirements

(1) Admission to the Master's programme in Geoenergy Engineering is subject to the completion of a relevant Bachelor's degree or another relevant degree programme of at least the same academic level at a recognised domestic or foreign post-secondary educational institution. Proof of general university entrance qualification is in any case deemed to have been provided by demonstrating fulfilment of this admission requirement

(2) The following Bachelor's programmes are in any case recognised as relevant: the International Study Programme in Petroleum Engineering (phasing out) and the Bachelor's programme in Geoenergy Engineering at the Montanuniversität Leoben.

(3) To compensate for significant differences in subject matter, supplementary examinations may be required, which must be taken by the end of the second semester of the Master's programme.

(4) Applicants whose first language is not English must demonstrate the level of English proficiency required for successful completion of the programme. For successful completion of the programme, English proficiency at level B2 of the Common European Framework of Reference for Languages is required. In particular, the language skills and certificates specified in Section 4(1) of the Montanuniversität Leoben Rectorate's Regulation on Admission to Full-time Studies, Official Gazette 53, Part 2023/2024, No. 91, as amended, shall be accepted as proof.

§3 Subject of the programme

The Master's programme in Geoenergy Engineering is an engineering degree programme within the meaning of Section 54(1)(Z) 2 of the University Act (UG). It serves to deepen and supplement the scientific professional training provided by the Bachelor's programme in Geoenergy Engineering.

§4 General Educational Objectives and Qualification Profile

The Master's programme in Geoenergy Engineering focuses on the sustainable use of the subsurface for energy purposes. Key areas include the extraction of geothermal energy, geological energy storage, the production and transport of liquid and gaseous energy carriers and raw materials, as well as decarbonisation in the energy sector, though the programme is not limited to these areas.

Graduates go on to work, amongst other places, in national and international companies within the energy sector, in public authorities and service providers, as well as in academia.

The Master's programme in Geoenergy Engineering has the following objectives:

- In-depth study and academic development of highly specialised knowledge in the field of Geoenergy Engineering, covering the specialist areas of Reservoir Engineering, Geoenergy Production Engineering, and Drilling and Completion Engineering, in line with a Master's degree programme in this subject at a recognised international university; consequently, general international recognition of the programme, including its accreditation in the major industrialised nations;
- In addition to imparting highly specialised technical knowledge, the programme offers students interdisciplinary problem-solving skills, social skills and leadership skills to prepare them for future work in an international environment .

§5 Allocation of ECTS credits

ECTS credits are awarded for all coursework completed by students. These credits are used to determine the relative proportion of the workload associated with individual course modules, whereby the annual workload must amount to 1,500 actual hours and 60 ECTS credits are allocated to this workload (Section 54(2) of the University Act). This results in a total workload of 25 working hours per ECTS credit.

§6 Types of courses

The following types of courses are offered:

a) Lectures (VO) are courses in which knowledge is imparted through a presentation by the lecturer. The examination takes place in a single examination session, which may be oral, written, or a combination of both.

b) In practical sessions (UE), specific tasks are to be worked on using calculations, design or experimentation.

c) Seminars (SE) are designed to facilitate academic discussion. Students are expected to make their own contributions.

d) Privatissima (PV) are specialised research seminars for students as part of their academic theses.

e) Seminars (KO) are teaching sessions that take the form of discussions and questions put to the lecturers.

f) Field trips (EX) help to illustrate and consolidate the knowledge, skills and competences acquired.

g) Revision courses (RE) are courses covering the entire syllabus of one or more modules. Students must be given the opportunity in revision courses to express their preferences regarding the specific topics to be covered.

h) Integrated courses (IV) are combinations of the teaching of theoretical content with courses as defined in paragraph 1(b) to (g), which are closely linked in terms of teaching methodology and assessed jointly. Integrated courses must be completed within a single semester.

i) Lectures with integrated seminars (VU) are courses comprising a seminar component that forms part of the assessment and a lecture component, both of which are assessed in a single examination. The seminar and lecture components are assessed jointly. Successful completion of the seminar component is a prerequisite for sitting the partial examination on the lecture component. The minimum proportion of lectures or seminars must not be less than one quarter of the total scope of the course.

§7 Courses or modules with a limited number of participants

(1) If, for modules or courses with a limited number of participants, more students who meet the entry requirements for that module or course register than there are places available, parallel modules or courses must be offered to the extent necessary, if need be even during periods when no other courses are normally held. It should be noted that students whose enrolment has been deferred as a result shall not incur an extension of their period of study.

(2) Admission to a module or course with a limited number of places is based on the following criteria:

(a) Students for whom this module or course is a core module or compulsory subject shall be ranked ahead of those for whom this module or course is a profile module or restricted elective; the latter, in turn, shall be ranked ahead of those for whom this module or course is an unrestricted elective.

(b) Within the categories specified in (a), priority is given according to the total number of ECTS credits achieved to date in the relevant degree programme. Where the number of credits is the same, priority is given according to the date of registration for the module or course.

(c) Students who have already been deferred once are to be given priority for admission when the module ‘ ’ or the course is next offered.

§8 Language of instruction and examination

(1) English is the language of instruction and examination.

(2) The Master’s thesis must be written in English.

II. Content and Structure of the Programme

§9 Duration and structure of the Master’s programme

The Master’s programme in Geoenergy Engineering comprises two specialisations: (1) Geoenergy Engineering and (2) Pipeline Engineering, each with a workload of 120 ECTS credits. Of these, the following apply:

Table 1: Structure of the Master’s programme: Geoenergy Engineering specialisation

	ECTS
Compulsory subjects/core modules	70
Restricted electives/profile modules	20
Master’s thesis	25
Seminar: Master’s Thesis in Geoenergy Engineering	3
Thesis defence	2
Total	120

Table 2: Structure of the Master's programme: Pipeline Engineering specialisation

	ECTS
Compulsory subjects/core modules	75
Restricted electives/profile modules	15
Master's thesis	25
Seminar: Master's Thesis in Geoenergy Engineering	3
Thesis defence	2
Total	120

§10 Compulsory subjects/core modules and restricted electives/specialisation modules for the Geoenergy Engineering specialization.

Students on the Geoenergy Engineering specialisation are required to complete compulsory subjects/core modules totalling 70 ECTS credits as set out in Table 3, and restricted electives/profile modules totalling 20 ECTS credits, which may be freely selected from Table 4. The corresponding courses and modules are listed, specifying the contact hours (KSt), the ECTS credits (ECTS) and the recommended semester allocation (rec. sem.). For courses, the course type (Type) is also specified. The odd numbers in the recommended semester refer to the winter semester, whilst the even numbers refer to the summer semester.

Table 3

Compulsory subject	Core module / Course	KSt	Type	ECTS	Recommended semester
Economics, Law and Management	Geoenergy Economics	4	M	5	1/3 WS
	Project Management	4	M	5	1/3 WS
Sustainability and Field Development	Field Development Project	1	SE	5	3 WS
Reservoir Engineering	Reservoir Simulation Methods	4	M	5	2 SS
	Geological CO_2 and H_2 Storage	4	M	5	3 WS
	Geothermal Reservoir Engineering	4	M	5	2 SS
Geomechanics	Analytical and Numerical Methods in Geomechanics	3	M	5	1 WS
Production Engineering	Geoenergy Modelling	4	M	5	1 WS
	Artificial Lift	4	M	5	2 SS
Well Construction	Advanced Well Construction	4	M	5	2 SS
	Well Lifecycle Integrity and Abandonment	4	M	5	3 WS
Energy Geosciences	Applied Sedimentology I: Reservoir Description	4	M	5	2 SS
	Petroleum/Geoenergy Systems I: Modelling	5	M	5	1 WS
	Hydrogeology and Geothermal Systems	4	M	5	1 WS

Table 4

Elective	Profile module/course	KSt	Type	ECTS	Recommended semester
Economics, Law and Management	Business Administration	4	M	5	2/4 SS
	Mining Law	2	Regulation	2	1 WS
Sustainability and Field Development	Improving Sustainability through Reliability Management	2	IV	3	1 WS
	Health, Safety and Environment	2	IV	2	1 WS
	Integrated Energy Landscape and Decarbonisation	2	IV	3	1 WS
	Carbon capture, utilisation and sequestration as climate protection measures	2	VO	3	1 WS
	Reservoir Management	3	M	5	1 WS
Reservoir Engineering	Reservoir Characterisation and Modelling	4	M	5	2 SS
	Digital Rock Analysis	4	M	5	3 WS
	Hydrocarbon Recovery: Methods, Energy Security and Environmental Aspects	2	SE	5	2 SS
	Reservoir Engineering Laboratory	5	UE	5	2 SS
Geomechanics	Mechanical Earth Modelling	3	M	5	2 SS
	Wellbore and Reservoir Geomechanics	2	IV	3	3 WS
Production Engineering	Underground Energy Storage	3	M	5	2 SS
	Data Acquisition and Management	4	M	5	2 SS
	Well Testing	3	M	5	2 SS
Well Construction	Well Construction Engineering Equipment	3	IV	4	2 SS
	Well Control Engineering and Operations	2	UE	3	2 SS
	Advanced Well Monitoring and Analysis	3	M	5	3 WS
	Drilling Process Evaluation and Planning	3	M	5	3 WS
	Advanced Well Placement	3	M	5	2 SS
Energy Geosciences	Applied Sedimentology II: Storage Integrity	4	M	5	3 WS
	Advanced Borehole Geophysics	3	IV	4	1 WS
	Petroleum/Geoenergy Systems II: Geochemical Analysis	5	M	5	2 SS
	Environmental Geology	4	M	5	3 WS

§11 Compulsory subjects/core modules and restricted electives/profile modules for the Pipeline Engineering specialisation

Students on the Geoenergy Engineering programme are required to complete compulsory subjects/core modules totalling 75 ECTS credits, as set out in Table 5, and restricted electives/profile modules totalling 15 ECTS credits, which may be freely selected from Table 6yz. The corresponding courses and modules are listed, specifying the contact hours (KSt), the ECTS credits (ECTS) and the recommended semester allocation (rec. sem.). For courses, the course type (Type) is also specified. The odd numbers in the recommended semester refer to the winter semester, whilst the even numbers refer to the summer semester.

Table 5

Compulsory subject	Core module/course	KSt	Type	ECTS	Recommended semester
Economics, Law and Management	Geoenergy Economics	4	M	5	1/3 WS
Sustainability and Field Development	Field Development Project	1	SE	5	3 WS
Pipeline Design	Basics of Pipeline Engineering and Design Fundamentals	3	M	5	1 WS
	Pipeline Materials and Mechanical Design	6	M	5	1 WS
	Pipeline System Design	6	M	5	2 SS
	Pipeline Routing and Civil Design	3	M	5	2 SS
	General Aspects of Station and Terminal Design and Equipment Selection	6	M	5	2 SS
Pipeline Systems	Pipeline Systems for Water Transmission and Similar Fluids	3	M	5	2 SS
	Energy Pipeline Systems	6	M	5	2 SS
	Pipeline Construction	3	M	5	3 WS
	Pipeline Operation, Integrity Management and Maintenance	6	M	5	3 WS
	Pipeline Project Management	3	M	5	3 WS
Subsurface Engineering	Reservoir Characterisation and Modelling	4	M	5	2 SS
	Geological CO_2 and H_2 Storage	4	M	5	3 WS
	Underground Energy Storage	3	M	5	2 SS

Table 6

Elective	Profile module/course	KSt	Type	ECTS	Recommended seminar
Economics, Law and Management	Project Management	4	M	5	1/3 WS
	Business Administration	4	M	5	2/4 SS
	Mining Law	2	Regulation	2	1 WS
Sustainability and Field Development	Improving Sustainability through Reliability Management	2	IV	3	1 WS
	Health, Safety and Environment	2	IV	2	1 WS
	Integrated Energy Landscape and Decarbonisation	2	IV	3	1 WS
	Carbon Capture, Utilisation and Sequestration as Climate Protection Measures	2	Lecture	3	1 WS
Pipeline Design	Pipeline Instrumentation and Automation	6	M	5	2 SS
Pipeline Systems	Special Pipeline System	6	M	5	3 WS
Subsurface Engineering	Geothermal Reservoir Engineering	4	M	5	2 SS
	Reservoir Management	3	M	5	1 WS
	Hydrocarbon Recovery: Methods, Energy Security and Environmental Aspects	2	M	5	2 SS
	Geoenergy Modelling	4	M	5	1 WS

	Artificial Lift	4	M	5	2 SS
	Data Acquisition and Management	4	M	5	2 SS

§12 Master's Thesis Seminar in Geoenergy Engineering

The 'Master's Thesis Seminar in Geoenergy or Pipeline Engineering' must be completed alongside the Master's thesis. The seminar is to be conducted by the Master's thesis supervisor and assessed at the same time as the ' ' Master's thesis

§13 Master's Thesis

In the Master's programme in Geoenergy Engineering, a Master's thesis must be completed. This serves to demonstrate the ability to work on academic topics independently and in a manner that is sound in terms of both content and methodology. The topic must be chosen in such a way that it is possible and reasonable for the student to complete the thesis within six months. The Master's thesis is awarded 25 ECTS credits.

(1) The topic of the Master's thesis must be chosen from a compulsory subject or core module. The student is entitled to propose the topic of the Master's thesis and the supervisor, or to select from a number of proposals. The topic and the supervisor of the Master's thesis are deemed to have been accepted unless the academic governing body objects to the topic or the proposed supervisor within one month.

(2) The Master's thesis must be assessed within five weeks. The assessment must be documented by means of a certificate.

(3) It is recommended that the Master's thesis be written in the fourth semester.

Table 7: Seminar, oral defence and Master's thesis in Geoenergy Engineering

Course	KSt	Type	ECTS	Recommended semester
Seminar on the Master's Thesis in Geoenergy Engineering	2	SE	3	4 SS
Thesis defence			2	4 SS
Master's thesis			25	4 SS
			30	

Table 8: Seminar, thesis defence and Master's thesis in Pipeline Engineering Course	KSt	Type	ECTS	Recommended semester
Seminar: Master's Thesis in Pipeline Engineering	2	SE	3	4 SS
Thesis defence			2	4 SS
Master's thesis			25	4 SS
			30	

Section 14: Study Abroad

Examinations successfully completed whilst studying abroad shall be recognised in accordance with the provisions of § 78 of the University Act (UG) upon application by the student. Reference is made to the possibility of a preliminary decision within the meaning of § 78(5) of the University Act (UG).

III. Examination Regulations

§15 Examinations

a) Oral examinations are examinations in which the examination questions must be answered orally.

b) Written examinations are examinations in which the questions must be answered in writing.

c) Individual examinations are examinations conducted by individual examiners.

d) Panel examinations are examinations conducted by examination boards.

e) Subject examinations are examinations designed to assess knowledge and skills in a particular subject.

f) Comprehensive examinations are examinations designed to demonstrate knowledge and skills in more than one subject.

g) Course examinations are examinations designed to demonstrate the knowledge and skills acquired through a single course.

h) Module examinations are examinations designed to assess the learning outcomes (knowledge, skills and competences) of a module. A module is completed once all parts of a module examination have been passed. Module examinations must be conducted and marked by the module co-ordinator. Where necessary, the academic governing body must appoint another examiner with the appropriate subject expertise. A module examination may take the form of an examination integrated into the course (MI) and/or a single examination session (MN).

For courses that are not assessment-integrated, the examination takes place in a single examination session, which may be oral, written, or a combination of both.

i) For courses with an integrated assessment structure, assessment is not based on a single examination at the end of the course, but on regular written and/or oral contributions from the participants.

j) All courses, with the exception of lectures (VO), are assessment-integrated. The respective assessment method can also be found in the course tables.

k) Lectures with integrated seminars (VU) are courses comprising a seminar component with an integrated assessment element and a lecture component, which is assessed in a single examination.

l) Successful completion of examinations and academic work is graded as ‘very good’ (1), ‘good’ (2), ‘satisfactory’
(3) or ‘sufficient’ (4); a fail is assessed as ‘unsatisfactory’ (5). A successful completion of field trips is assessed as ‘participated successfully’, whilst a failure is assessed as ‘participated unsuccessfully’.

§16 Recognition of Examinations

The recognition of examinations is governed by § 78 of the University Act (UG) in conjunction with the section of the Statutes on Academic Regulations.

§17 Retaking Examinations

(1) Exams in which a fail mark has been awarded may be retaken four times (5 attempts). All attempts at the same exam at Montanuniversität Leoben count towards the permitted number of attempts.

(2) If a lecture with integrated tutorial (VU) has been failed because the partial examination covering the lecture component was not passed, students are entitled to sit only the lecture component when retaking the relevant VU. This rule applies to the first and second retakes of the VU, which must be taken within three semesters of successfully completing the seminar component. From the third retake (fourth attempt) onwards, the entire VU (seminar and lecture components) must be retaken. From the fourth semester onwards following successful completion of the practical component, the entire course unit (practical and lecture components) must be retaken in any case.

(3) If a component of a module examination at the Montanuniversität Leoben, the mark for which accounts for at least 40 per cent of the overall mark, has been marked as a fail, the student has the right to retake that component

once, whereby the retake does not count as a further attempt at the examination. At least two retake dates must be offered. Retakes of component assessments for a module from the winter semester are possible until the following 30 September; retakes of component assessments for a module from the summer semester are possible until the following 28 or 29 February. If the module is successfully completed by 31 October or 31 March, students must be allowed to enrol on a subsequent module within this period.

Furthermore, Section 43 of the 'Provisions on Study Regulations' section of the Statutes applies to retakes of examinations.

§18 Thesis Defence and Graduation

(1) Admission to the thesis defence is conditional upon the successful completion of all prescribed modules from the compulsory, core and free-choice subjects, the successful completion of the 'Master's Thesis in Geoenergy Engineering' seminar, and a positive assessment of the Master's thesis.

(2) The final examination of the Master's programme takes the form of a thesis defence. This is an examination before a committee, comprising the defence of the Master's thesis and a discussion of the academic context of the thesis.

(3) The thesis defence is awarded 2 ECTS credits.

(4) Successful completion of the defence marks the completion of the Master's programme.

§19 Examination Procedure

(1) The provisions of §§ 30 ff of the 'Academic Regulations' section of the Statutes of the Montanuniversität Leoben, as amended, apply to the examination procedure.

(2) Before the start of each semester, course leaders/module coordinators must inform students via the MUonline study information system about the objectives, content and methods of their courses, as well as the content, methods, assessment criteria and assessment standards for the course examinations (Section 76(2) of the University Act).

(3) The results of oral examinations must be communicated to students orally immediately after the examination.

(4) The results of written examinations must be communicated to students via MUonline no later than four weeks after the work to be assessed has been submitted.

§20 Assessment of academic achievement

(1) Upon successful completion of the Master's programme, a subject mark must be determined for each examination subject.

(2) Examination subjects within the meaning of paragraph 1 are:

Geoenergy Engineering specialisation
Economics, Law and Management
Sustainability and Field Development
Reservoir Engineering
Geomechanics
Production Engineering
Well Construction
Energy Geosciences

Pipeline Engineering
Economics, Law and Management
Sustainability and Field Development
Pipeline Design
Pipeline Systems
Subsurface Engineering

IV. Academic degree

§21 Academic Degree

Graduates of the Master's programme in Geoenergy Engineering are awarded the academic degree
'Diplom-Ingenieurin' or 'Diplom-Ingenieur', abbreviated to 'Dipl.-Ing.' or 'DI' respectively, shall be awarded. Where the academic title is used in the form ' ', it must precede the name.

V. Entry into force

§22 Entry into force

(1) This Regulation shall enter into force on 1 October 2022.

(2) The amendment to the curriculum, as set out in the Bulletin of 12 June 2023, Issue No. 149, shall come into force on 1. October 2023.

(3) The amendment to the curriculum, as set out in the Bulletin of 12 June 2024, Issue No. 169, shall come into force on 1. October 2024.

(4) The amendment to the curriculum, as set out in the Bulletin dated 5 June 2025, Issue No. 117, shall come into force on 1. October 2025.

(5) The amendment to the curriculum, as set out in the Bulletin of 28 April 2026, Issue No. 163, shall come into force on 1. October 2026.

Section 23 Transitional Provisions

(1) Equivalence list relating to the 2023 amendment to the curriculum:

An examination listed in the left-hand column, successfully passed in accordance with the original version of the curriculum (2022), will be recognised for students as fulfilling the examination listed in the same row of the right-hand column in Annex 1.

(2) Equivalence list relating to the 2024 curriculum amendment:

An examination listed in the left-hand column, successfully passed under the original version of the curriculum (2023), shall be recognised for students in lieu of the examination listed in the same row of the right-hand column in Annex 2.

(3) Equivalence list relating to the 2025 curriculum amendment:

Students who have successfully passed an examination listed in the left-hand column in accordance with the standard version of the curriculum (2024) will have this recognised as fulfilling the examination listed in the same row of the right-hand column in Annex 3.

(4) Equivalence list relating to the amendment to the 2026 curriculum:

Compulsory modules and restricted elective modules successfully completed before 1 October 2026, as set out in the curriculum (2025), may be used towards the completion of the Master's degree in Geoenergy Engineering until 30 September 2029.

Appendix 1: Equivalence lists
Appendix 2: Module descriptions

On behalf of the Senate:
The Chair:
Prof. Markus Lehner, Dipl.-Ing., Dr.-Ing.

Appendix 1: Equivalence Lists

List of equivalences relating to Point 1, Section 23

Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2022/2023					**Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2023/24**				
Course	Type	SSt.	ECTS	Recommended semester	Course	Type	SSt.	ECTS	Recommended semester
COMPULSORY SUBJECT					COMPULSORY SUBJECT				
Crisis Management in the Geoenergy Industry	VO	2	2	1	Asset Performance and Analysis	VO	2	3	3
Advanced Oil, Gas and Geothermal Energy Recovery	VO	2	2	3	Underground Energy Storage Operations	IV	2	3	3
Flow Assurance, Well Intervention and Workover	IV	2	3	3	Well Testing and Wellbore Heat Transfer	IV	3	4	2
Computational Solid Mechanics	IV	2	3	3	Mechanical Earth Modelling				
Fluid Storage Facilities	SE	2	2	3		IV	3	6	2
Green Hydrogen Technology	VO	2	3	3	Hydrogen Technology	VO	2	3	3

List of equivalents relating to point 2. Section 23

Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2023/2024					**Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2024/25**				
Course	Type	Credit hours	ECTS	Recommended semester	Course	Type	SSt.	ECTS	Recommended semester
Asset Performance and Analysis	Course description	2	2	1	Improving Sustainability through Reliability Management	IV	2	3	3

List of equivalents for point 3. Section 23

Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2024/2025					**Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2025/26**				
Course	Type	Credit points	ECTS	Recommended semester	Course	Type	SSt.	ECTS	Recommended semester
Hydrogen Technology	Course description	2	3	3	Natural Gas and CO_2 Technology	VO	2	3	3
Mechanical Earth Modelling	IV	3	6	2	Mechanical Earth Modelling	IV	3	5	2

List of equivalents for point 4, Section 23

Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2025/2026					Equivalent modules for the Master's programme in Geoenergy Engineering from the winter semester 2026/27				
Course	Course code	Type	ECTS	Recommended Semester	Course	Course code	Course	ECTS	Recommended semester
COMPULSORY SUBJECT					COMPULSORY SUBJECT				
Field Development Project	1	SE	3	3	Field Development Project	1	SE	5	3 WS
Introduction to the Field Development Project	1	SE	1	2					
Well Placement	IV	2	2.5	2	Advanced Well Placement	3	M	5	2 SS
Advanced Well Monitoring and Analysis	3	IV	4	3	Advanced Well Monitoring and Analysis	3	M	5	3 WS
Advanced Well Construction	4	IV	6	2	Advanced Well Construction	4	M	5	2 SS
Underground Energy Storage Operations	2	IV	3	3	Underground Energy Storage	3	M	5	2 SS
Lab in Energy Storage Project Evaluation	2	IV	2	2					
Well Integrity	2	IV	3	3	Well Lifecycle Integrity and Abandonment	4	M	5	3 WS
Reservoir Simulation Methods	5	IV	6	2	Reservoir Simulation Methods	4	M	5	2 SS
Reservoir Characterisation and Modelling	3	IV	4	2	Reservoir Characterisation and Modelling	4	M	5	2 SS
Geothermal Reservoir Engineering	2	IV	3	2	Geothermal Reservoir Engineering	4	M	5	2 SS
CO_2 Capture, Storage and Utilisation	2	IV	3	1	Geological CO_2 and H_2 Storage	4	M	5	3 WS
Geological Carbon and Hydrogen Storage	2	IV	3	3					
Well Testing and Wellbore Heat Transfer	3	IV	4	2	Well Testing	3	M	5	2 SS
Computational Continuum Mechanics	2	IV	3	1	Mechanical Earth Modelling	3	M	5	3WS
Mechanical Earth Modelling	3	IV	5	2					
Introduction to Geomechanics	2	IV	3	1	Analytical and Numerical Methods in Geomechanics	3	M	5	1 Winter Semester
Numerical Methods in Geomechanics	5	IV	6	2					

Geomodelling	2	IV	3	1	Petroleum/Geoenergy Systems I: Modelling	4	M	5	2 SS
Advanced Geoenergy Economics	3	IV	4	1	Geoenergy Economics	4	M	5	1/3 WS
Project Management	2	SE	3	3	Project Management	4	M	5	1/3 WS
Geoenergy Exploration	2	IV	2.5	1	Applied Sedimentology I: Reservoir Description	4	M	5	2 SS
Advanced Geochemistry A	3	IV	4	1	Petroleum/Geoenergy Systems II: Geochemical Analysis	5	M	5	2 SS
Natural Gas and CO_2 Technology	2	VO	3	3	Underground Energy Storage	3	M	5	2 SS
Pore Scale & Digital Rock Physics	2	IV	3	3	Digital Rock Analysis	4	M	5	3 WS
Special Core Analysis	3	IV	4	3					
Geothermal Energy Facilities	2	IV	3	3	Geoenergy Modelling	4	M	5	1 WS
Artificial Lift Systems and EOR Production Technology	5	IV	6	2	Artificial Lift	4	M	5	2 SS
Automated Data Acquisition	3	IV	4	2	Data Acquisition and Management	4	M	5	2 SS

Appendix 2: Module Descriptions **Geoenergy**

Economics: 5 ECTS *Content:*

This module deepens scientifically grounded economic knowledge whilst fostering a practical understanding of cost and investment accounting in industrial and commercial settings. It equips students with the necessary analytical and decision-support skills to evaluate business activities using financial and operational data, and to present the results in structured reports, visualisations and relevant performance indicators.

Learning objectives:

Upon completion of the module, students will be able to:

- understand patterns, trends and deviations in cost-benefit analyses and
- assess alternative scenarios.
- carry out cost analyses for pricing, budgeting, forecasting, cost reduction and profitability, and
- apply advanced methods such as CVP and break-even analysis, marginal and standard costing, activity-based costing, investment appraisal, and sensitivity and risk analysis.

Prerequisites:

- Cost Accounting and Investment Calculation

Project Management: 5 ECTS

Content:

This module covers the methodological skills required in engineering disciplines for the structured analysis, resolution and implementation of complex technical and organisational problems. Building on systematic problem-solving approaches, it teaches methods for situation analysis, decision-making and the implementation of measures. In addition, the module covers the fundamentals of classical, agile and hybrid project management, including project planning, stakeholder management, risk analysis and project organisation in digitalisation and transformation projects. The focus is on interdisciplinary collaboration, facilitated problem-solving processes and the successful implementation of projects in complex technical and organisational environments.

Learning objectives:

Upon successful completion of the course, students will be able to:

- systematically identify and structure complex technical and organisational problems,
- apply standardised problem-solving methods (e.g. PDCA, DMAIC or facilitation cycles),
- select and apply suitable analysis, decision-making and implementation methods for sustainable problem-solving,
- to plan and manage projects using classical, agile and hybrid project management approaches,
- to assess project objectives, risks, resources and stakeholders in interdisciplinary project environments,
- to facilitate group processes and guide solution-finding processes in a goal- and results-oriented manner.

Prerequisites:

Basic skills in teamwork, presentation techniques and analytical thinking are also expected. A grounding in engineering and basic knowledge of technical or organisational processes are recommended. Prior knowledge of business administration, quality management or process management is an advantage, but not essential.

Reservoir Simulation Methods: 5 ECTS

Content:

The course begins with an introduction to concepts in reservoir simulation, including the structure of simulators, modelling workflows and input data requirements. The fundamental equations of multiphase flow are formulated as partial differential equations describing fluid transport in porous media. The course then covers their numerical discretisation and solution using finite volume and finite element methods. A key focus is on the numerical treatment of non-linear multiphase flow processes, as well as on the algorithms of classical black-oil reservoir simulators. Furthermore, wellbore models and boundary conditions are introduced to simulate realistic reservoir operating conditions. Using MATLAB MRST, students develop simplified simulation models and carry out numerical experiments to investigate key subsurface processes. The results are analysed and compared with reference cases and analytical solutions, thereby illustrating the relationships between reservoir physics, mathematical formulation and numerical implementation. Furthermore, students gain experience in using commercial reservoir simulators and apply these to realistic reservoir models.

Learning objectives:

This course covers the fundamentals of numerical reservoir simulation based on black-oil formulations. Students will develop an understanding of the underlying physical processes in reservoirs, as well as the non-linear partial differential equations that describe multiphase flow in porous media. In addition, they will acquire practical skills in implementing and analysing numerical simulation models.

Prerequisites:

Basic knowledge at Bachelor’s level in Geoenergy Engineering, Petroleum Engineering or a related engineering or geoscience discipline. In particular, a sound grounding in reservoir engineering, the phase behaviour of hydrocarbons, the mathematical description of flow processes and their application to multiphase flow in porous media is expected. Basic knowledge of programming in MATLAB is also an advantage.

Reservoir Management: 5 ECTS

Content:

The course covers the principles of reservoir management as a strategic approach spanning the entire life cycle of a reservoir – from discovery and exploration through development and production to decommissioning. Particular emphasis is placed on the integration of geological, geophysical, engineering and economic information for effective reservoir management. Topics covered include data acquisition and integration, reservoir characterisation and modelling, uncertainty analysis, and methods of reservoir monitoring and production monitoring. Furthermore, methods for forecasting future reservoir performance and for economic evaluation are presented to demonstrate how integrated workflows support informed decision-making in reservoir management.

Learning objectives:

This course provides an understanding of integrated reservoir management and the interdisciplinary approaches required to optimise the economic production of oil and gas reservoirs. Participants will learn how technical, operational and economic aspects are interlinked to enable informed decision-making throughout the entire life cycle of a reservoir. Originally designed for

Concepts of reservoir management developed for hydrocarbon reservoirs are expanded upon in this course and applied to other uses of the subsurface, such as geothermal systems, underground thermal storage facilities and potential CO_2 storage sites.

Prerequisites:

Basic knowledge at BSc level in *Geoenergy Engineering*, *Petroleum Engineering* or a related engineering or geoscience discipline.

Geothermal Reservoir Engineering: 5 ECTS

Content:

The course provides an overview of types of geothermal reservoirs and key geothermal operation and utilisation concepts. Geothermal systems are classified according to their geological setting and thermodynamic conditions, for example as hydrothermal or Enhanced Geothermal Systems, as well as low- and high-enthalpy systems. In this context, geological potential, heat extraction technologies, heat transport via pipeline systems and economic aspects are also discussed. The course focuses on reservoir engineering, including the development of geothermal reservoirs, strategies for increasing heat extraction, and the prediction of long-term heat production. The scientific fundamentals cover the thermodynamic properties of water–vapour systems and alternative working fluids, as well as models for fluid flow and heat transfer in porous media. Participants apply these concepts in numerical simulations using modern simulation models. In doing so, they analyse the performance of different reservoir types and develop strategies for heat extraction and underground heat storage, including ATES (Aquifer Thermal Energy Storage).

Learning objectives:

This course covers the fundamentals of geothermal reservoir engineering. Participants will learn to evaluate geothermal reservoirs, quantify geothermal potential and heat extraction, and develop strategies for heat extraction and underground thermal energy storage.

Prerequisites:

Basic knowledge at BSc level in *Geoenergy Engineering*, *Petroleum Engineering* or a related engineering or geoscience discipline.

Geological Carbon & Hydrogen Storage: 5 ECTS

Content:

The course covers the fundamental principles of reservoir engineering and extends these to include the mechanisms of CO_2 and H_2 storage in various geological formations. Particular emphasis is placed on the thermodynamic properties and multiphase flow in CO_2–brine, H_2–brine and CO_2–brine–hydrocarbon systems, as well as on the relationship between molecular and pore-scale processes and behaviour at the reservoir scale. Students analyse fluid–fluid and rock–fluid interactions triggered by gas injection and integrate these into reactive transport models. These models form the basis for assessing storage safety, containment and remobilisation mechanisms, the efficiency of injection and withdrawal cycles, and effective storage capacity.

Building on this, the course covers advanced and innovative approaches, including the integration of CCS with geothermal energy utilisation, hydrogen storage and potential in-situ gas conversion processes, as well as negative emissions strategies such as bioenergy with CCS (BECCS).

Drawing on these perspectives, students learn to critically evaluate underground storage concepts in terms of capacity, efficiency and operational safety. Case studies of current CCS and hydrogen storage projects provide a practical context, whilst theoretical content is reinforced through analytical and numerical exercises and the critical discussion of current scientific literature.

Learning objectives:

This course provides an introduction to the challenges posed by climate change and the role of carbon and energy storage, with a particular focus on the Carbon Capture and Storage (CCS) technology chain and underground hydrogen storage. Key elements such as CO_2 capture, transport and geological storage are covered, with the emphasis on the processes of underground storage and circulation of CO_2 and H_2.

Prerequisites:

Basic knowledge at BSc level in *Geoenergy Engineering*, *Petroleum Engineering* or a related engineering or geoscience discipline. In particular, a sound understanding of reservoir engineering, the mathematical formulation of flow problems and physical chemistry is expected

Reservoir Characterisation and Modelling: 5 ECTS

Content:

The course demonstrates how information from hydrocarbon fields at different spatial scales can be integrated to create reservoir models. At the field scale, structural and stratigraphic seismic attributes are calibrated against well data. In addition, AVO analyses and seismic inversion results are used to characterise rocks and fluids. Geostatistical methods are introduced for the analysis and interpolation of reservoir properties. Deterministic methods such as kriging and co-kriging, as well as stochastic methods such as Gaussian simulation, are used to model continuous reservoir properties. For discrete properties, methods such as object-based modelling, indicator simulation and multi-point statistics are covered. Furthermore, techniques for averaging and upscaling geocellular reservoir models are presented, in order to make them suitable for reservoir simulations. Concepts and workflows are illustrated using modern reservoir modelling software and through exercises with real field data.

Learning objectives:

The course covers the fundamentals of geophysical characterisation and modelling of reservoirs. Students learn how to integrate sparse data from various disciplines to create and parameterise reservoir models. In doing so, they develop an understanding of geological information at different scales and its application to rock and fluid characterisation, as well as to the modelling of reservoir properties.

Prerequisites:

Basic knowledge at BSc level in *Geoenergy Engineering*, *Petroleum Engineering* or a related engineering or geoscience discipline.

Digital Rock Analysis: 5 ECTS

Content:

The course combines established methods of Special Core Analysis (SCAL) with approaches from Digital Rock Physics (DRP). It begins by covering the fundamentals of fluid–fluid and rock–fluid interactions, as well as their influence on relative permeability and capillary pressure functions. The industrial SCAL workflow is then presented, including core retrieval, core handling and sample preparation. Experimental methods for determining relative permeability and capillary pressure, as well as methods for data and uncertainty analysis, are discussed.

Building on this, methods of digital rock physics are introduced, in which flow functions are derived from digitised rock structures using numerical simulations. Topics include flow in simplified pore network models, as well as direct (full-physics) simulation methods for multiphase flow in digital twins of real samples. X-ray tomography imaging, image processing, the determination of petrophysical properties and network modelling are covered.

Practical exercises include the planning of SCAL programmes, the analysis of experimental data, and simulations of pore-scale-based multiphase processes. Students will develop an understanding of drainage and imbibition processes, relative permeability and capillary pressure functions—including hysteresis—as well as mechanisms of fluid mobilisation and trapping. The course also covers the linking of pore-scale processes with continuum models, taking uncertainties into account.

Learning objectives:

Multiphase flow lies at the heart of many challenges in reservoir engineering and requires both experimental and numerical characterisation methods. The course provides fundamental and in-depth knowledge on the determination and interpretation of relative permeability and capillary pressure saturation functions. These functions determine both the initial fluid distribution in reservoirs and the efficiency of the displacement of immiscible fluids.

Prerequisites:

Basic knowledge at Bachelor's level in Geoenergy Engineering, Petroleum Engineering or a related engineering or geoscience discipline. In particular, a sound grounding in reservoir engineering, the mathematical description of flow processes and their application to multiphase flow in porous media is expected

Analytical and Numerical Methods in Geomechanics: 5 ECTS

Content:

This module provides fundamental knowledge and practical skills for solving geomechanical problems associated with geoenergy extraction. Key topics include ground subsidence, fault stability, borehole stability, caprock integrity and hydraulic fracturing.

The course begins with an introduction to the fundamental concepts of mechanics, including stress, strain, displacement and linear elasticity, which form the basis for subsequent discussions. Building on these principles, the module then covers poroelasticity (hydromechanical coupling) and plasticity. Students examine how stresses develop in the subsurface and how they change in response to the removal of mass and heat. Analytical solutions and examples such as borehole stability analyses and ground subsidence are used in this context.

In the second half of the module, students focus on the numerical solution of geomechanical problems using the finite element method. Course examples and assignments include basic programming exercises using a high-level language such as Python or Julia.

Learning outcomes:

Upon completion of the module, students will be able to:

- understand and explain the role of geomechanical processes in geoenergy production systems.
- identify potential geomechanical risks associated with geoenergy applications.
- assess and select appropriate geomechanical analyses for the development and safe operation of geothermal energy projects.

Prerequisites:

Knowledge of mechanics at Bachelor's level

Mechanical Earth Modelling: 5 ECTS

Content:

This module covers the fundamental concepts and methods required for the creation of mechanical earth models, including log-based one-dimensional models and numerical three-dimensional models, which are illustrated using practical examples. The methods for creating mechanical earth models include the estimation of mechanical properties (e.g. density, Poisson's ratio, modulus of elasticity) and pore pressure for log-based models. For numerical models based on the finite element method, the workflow comprises pre-processing (e.g. mesh generation), the development of the constitutive model, and the post-processing and interpretation of the simulation results.

The theoretical section covers the fundamentals of geomechanics and the finite element method. Examples of applications of mechanical soil modelling include the analysis of borehole stability, the simulation of hydraulic fracturing, the prediction of ground subsidence, the assessment of fault reactivation, and the evaluation of the integrity of overburden layers in the context of geoenergy applications.

Learning objectives:

Upon completion of the module, students will be able to:

- develop an in-depth understanding of the concepts and components of mechanical earth models (MEMs).
- apply fundamental methods and workflows to create mechanical earth models independently.

Prerequisites:

Knowledge of geomechanics at Bachelor's level

Underground Energy Storage: 5 ECTS

Content:

This module provides an overview of the current state of the art in underground energy storage technologies, as well as fundamental knowledge for understanding geomechanical risks and assessing operational feasibility. The course begins with a presentation of current applications of underground energy storage worldwide, including mechanical, chemical and thermal energy storage systems. It then discusses potential geomechanical challenges and the associated risks.

Building on this, the module covers the theoretical foundations of poroelasticity and fracture mechanics to provide students with an understanding of how geo-energy operations can trigger geomechanical processes and potential problems in the subsurface.

With a focus on thermal energy storage projects, students learn about various concepts for utilising thermal energy and apply established open-source numerical software to carry out feasibility analyses for thermal energy storage solutions.

Learning outcomes:

Upon completion of the module, students will be able to:

- understand and explain the functional and operational mechanisms of various underground energy storage projects.
- analyse and assess geomechanical problems and potential risks.
- carry out numerical simulations and prepare feasibility studies for underground energy storage projects.

Prerequisites:

Knowledge of mechanics and numerical computation at Bachelor's level.

Artificial Lift: 5 ECTS

Content:

This course provides participants with knowledge of the most important artificial lift systems in the oil, gas and geothermal industries, including sucker rod pumps, gas lift systems, electrical submersible pumps, progressive cavity pumps, hydraulic pumps and line-shaft pumps. Operating principles, operational limits, areas of application and practical industrial aspects are covered in detail. Furthermore, the design and optimisation of these systems are explained and practised through exercises using manual calculations and the latest specialist software. Laboratory equipment is also used for training purposes. An overview of new technologies and developments provides students with an understanding of the current state of the art and potential avenues for future research and development work. Both applications in conventional reservoirs and in unconventional deposits are covered.

The course also includes an introduction to various types of wellbore tests, including drawdown tests, build-up tests and drill-stem tests. In addition, the selection of suitable testing equipment and aspects of practical field application are covered.

Learning objectives:

Successful participants will be able to understand how common artificial lift systems work and apply design and optimisation methods both with and without commercial software. Furthermore, they will be able to diagnose pump operation, identify weak points and propose suitable solutions or alternative measures. Participants will understand the fundamentals of well testing and the equipment used for this purpose, and will be able to carry out simple analyses.

Prerequisites:

Basic knowledge of chemistry, mechanical engineering, physics, geoenergy production systems and numerical methods.

Geoenergy Modelling: 5 ECTS

Content:

This course focuses on the fundamental principles of geothermal installations, borehole design and numerical modelling approaches for geoenergy systems, including boreholes, surface installations and energy transmission networks.

It provides an introduction to the chemistry of geothermal fluids and to technical solutions for operational challenges. It also includes a detailed analysis of heating and cooling systems and power stations, including the preliminary design of steam- and ORC-based power stations, pressure vessels, pipework and heat pump systems. Various wellbore layouts and wellbore components are presented, and design and operational challenges are discussed. Furthermore, the course covers the legal framework governing the construction and operation of geothermal energy systems.

The course covers the key equations for multiphase flow and heat transfer in porous media, the modelling of transient heat transfer in the borehole, and the performance assessment of surface facilities. Students learn about coupled thermohydraulic processes, the interaction between the reservoir and the borehole, and the basic modelling of district heating networks. Practical exercises include numerical implementation and simulation using modern open-source tools such as OpenGeoSys and TESPy.

Learning objectives:

Students who successfully complete this course will be able to understand the composition of geothermal fluids and the associated technical challenges. They will be familiar with various methods of utilising geothermal energy and with wellbore structures and the necessary wellbore equipment. They will also be familiar with the layout and design of surface facilities for heat and electricity generation.

Successful participants will be able to design and optimise surface facilities for geothermal energy extraction. They will understand and apply regulatory requirements as well as maintenance and operational aspects. Furthermore, students will develop a sound understanding of thermohydraulic processes in boreholes, derive the relevant equations for coupled mass and energy transport, and interpret them. They are able to integrate underground and surface components into a unified geothermal energy system and to evaluate the performance and fundamental energy transfer efficiency of the surface installations.

Prerequisites:

Basic knowledge of chemistry, mechanical engineering, physics, geoenergy production, numerical methods and MATLAB, Python or another programming language

Data Acquisition and Management: 5 ECTS

Content:

The world is full of data, and the volume of data is growing exponentially. At the same time, there is often a lack of capacity to utilise this data effectively. The course begins with data acquisition and an understanding of the measurement chain. It covers the fundamentals of sensors, measurement technology and data acquisition and monitoring systems as used in the oil and geothermal industries, with a focus on key concepts, practical applications, accuracy and reliability.

The aim of the course is to equip participants with the knowledge and skills required for effective measurement technology and measurement, including the validation of equipment in pipeline systems. Theoretical modules are supplemented by practical exercises in which participants work with sensors, programmable logic controllers and a data server to understand the principles of data acquisition and data quality. The second part of the course covers the fundamentals of data processing and data management.

Learning objectives:

Successful candidates will be able to implement, manage and provide consultancy support for digitalisation measures in industrial processes.

Prerequisites:

Fundamentals of electrical engineering, statistics and mathematics.

Applied Sedimentology I: Reservoir Description: 5 ECTS

Contents:

This module focuses on applied sedimentological techniques for the identification, exploration and experimental characterisation of potential reservoir environments. The module comprises a lecture component, laboratory experiments and a field trip involving extensive outcrop visits.

Students are first familiarised with the reservoir geological requirements for all geo-energy applications (e.g. geothermal energy and geological storage). A fundamental understanding of sedimentary environments and their specific reservoir characteristics (including petrophysical reservoir parameters) is established. Concepts of sedimentological reservoir characterisation are explained and applied in laboratory exercises. Students will carry out practical work on reservoir rocks and interpret comprehensive datasets, including sedimentological, petrophysical and borehole geophysical (wireline logging) information.

The field trip component offers students the opportunity to deepen their understanding of sedimentary depositional environments through field observations.

Learning outcomes:

Upon completion of the module, students will be able to:

- Identify sedimentary depositional environments in outcrops and drill cores
- Relate depositional conditions to reservoir properties
- Determine reservoir quality using well log, petrophysical and other exploration data

Prerequisites:

Bachelor’s level in general earth sciences and sedimentology

Applied Sedimentology II: Storage Integrity: 5 ECTS

Content:

The module comprises a lecture component on the fundamentals of cap rock characterisation ('Fault and Top Seal Analysis'), including the evaluation criteria for the various barrier mechanisms (hydraulic vs. membrane seals). In the practical component, students are introduced to experimental investigation procedures for geological barriers, including the design and interpretation of rock-fluid interaction tests, microstructural analyses, etc., which can help to define static and dynamic barrier properties. Finally, dynamic leakage risks are discussed and potential solutions are presented.

Learning objectives:

Upon completion of the module, students will be able to:

- Describe the various types of barrier rock found in geological storage complexes
- Apply established techniques of 'fault and top seal analysis', including the calculation of retention capacity for different fluid and barrier types (hydraulic vs. membrane seals)
- Identify geological leakage risks and quantify dynamic leakage rates, as well as develop risk management strategies for barrier integrity

Prerequisites:

Bachelor's level in general earth sciences, sedimentology, petroleum geology and hydrogeology

Petroleum/Geoenergy Systems I: Modelling: 5 ECTS

Content:

Students are introduced to fundamental basin modelling techniques, including thermal modelling, static geological modelling and hydrochemical modelling of reactive transport processes. Required input data, modelling steps, expected results and model limitations are discussed using literature and research examples.

Petroleum:

Students learn to construct a simple geological model based on seismic and well log data, to correlate boreholes using well log data, to interpret reservoir horizons and to create a static reservoir model.

Geoenergy:

Students learn to construct a simple geological model based on seismic and borehole geophysical data. In addition, exemplary hydrochemical models are created and used to evaluate the interaction between a secondary storage fluid (e.g. CO_2) and the rocks in the storage complex.

Learning objectives:

Upon completion of the module, students will be able to:

- Select appropriate basin modelling techniques to address questions relating to hydrocarbon or geoenergy systems (thermal history of source rocks, reservoir geometry, hydrochemical interactions in storage scenarios, etc.).

Petroleum:

- Construct a basic geological model and interpret reservoir horizons based on seismic and well data, as well as correlate wells using well log data
- Construct a simple static reservoir model Geoenergy:
- Develop a basic geological model based on seismic and borehole geophysical data

- Identify and quantify rock-fluid interactions in reservoir complexes using hydrochemical models

Prerequisites:

Bachelor's level in general earth sciences, sedimentology, petroleum geology and hydrogeology

Petroleum/Geoenergy Systems II: Geochemical Analysis: 5 ECTS

Content:

Petroleum:

Students will learn about the specific requirements of conventional versus unconventional hydrocarbon systems, as well as the criteria for the successful extraction of unconventional oil and gas reserves. The application of organic geochemical and isotope geochemical analyses in studies of hydrocarbon systems will be discussed, and examples of geochemical fingerprinting will be presented.

In a practical component, students are introduced to organic geochemical analysis techniques, including the isotope geochemical characterisation of organic compounds. They learn to apply oil/gas–source rock correlation techniques independently (under supervision), including sample preparation and organic geochemical analysis, as well as data validation and interpretation.

Geoenergy:

Students are introduced to the geochemical investigation of new geo-energy systems, including both the exploration of new energy sources (e.g. geogenic hydrogen) and secondary geostorage applications. Geochemical fingerprinting tools based on (organic) geochemical and isotope geochemical analyses are introduced and linked to their practical application in innovative geoenergy fields (e.g. changes in geochemical parameters as indicators of storage losses or fluid migration in the subsurface, etc.).

Learning objectives:

Upon completion of the module, students will be able to:

- Select appropriate geochemical analytical techniques to address questions relating to hydrocarbon or geoenergy systems
- Independently carry out organic geochemical analyses for the exploration of hydrocarbon/geoenergy systems, including sample preparation

Prerequisites:

Bachelor's level in petroleum geology and hydrogeology

Hydrogeology and Geothermal Systems: 5 ECTS

Content:

In the first part of this module, students are introduced to advanced aspects of hydrogeology with a focus on deep geothermal utilisation. The topics covered include reactive transport mechanisms in shallow and deep aquifers, the effects of hydrochemical processes on reservoir properties, the use of natural (e.g. stable isotope systems) and artificial tracers, and aquifer testing. The processes described are illustrated using real-world examples from geothermal and geostorage research projects (e.g. CO_2 storage).

The second part presents a field development workflow for hydrothermal energy utilisation in low-enthalpy systems, incorporating real-world data and interpretations from industrial projects. The focus is on risk assessment in relation to the individual elements of hydrothermal systems; the risk factors are discussed in the context of traditional concepts from petroleum exploration.

Learning objectives:

Upon completion of the module, students will be able to:

- Understand and evaluate the effects of groundwater utilisation on the geomechanical and hydrochemical properties of shallow and deep aquifers (contaminant transport, reservoir diagenesis, etc.)

- Use natural and artificial tracers to characterise groundwater flow systems
- Assess hydrothermal potential and plan a simple hydrothermal well in accordance with standard industry workflows.

Prerequisites:

Bachelor's level in petroleum geology and hydrogeology

Environmental Geology: 5 ECTS

Content:

This module introduces fundamental aspects of environmental geology and soil science. These include:

- The analysis of endogenous (earthquakes, etc.) and exogenous (landslides, atmospheric processes, etc.) processes and their potential environmental risks
- The potential risks associated with geotechnical projects, geo-energy applications and the extraction of critical resources, as well as risk mitigation strategies
- Methods of geological environmental analysis that link shallow and deep sources of contamination with their geological environmental implications

Learning outcomes:

Upon completion of the module, students will be able to:

- Understand and assess the geological impacts of endogenous and exogenous processes and their interactions
- Assess risks associated with geoenergy utilisation and raw material extraction
- Plan environmental geological investigations for underground applications

Prerequisites:

Bachelor's level in general earth sciences and sedimentology

Fundamentals of Pipeline Engineering and Design: 5 ECTS

Learning outcomes:

By the end of this module, participants will be able to

(1) to describe the development of pipeline systems, with a focus on key technological advances and the importance of complying with current construction and maintenance standards

(2) to distinguish between different types of pipelines and components and to relate their design principles to operational requirements

(3) to analyse the economic and strategic value of pipelines, compare them with other transport methods, and assess their wider economic implications

(4) to assess the properties of fluids and make appropriate decisions regarding design and material selection to ensure the safe and efficient operation of pipelines.

(5) Develop hydraulic design strategies and take environmental and construction aspects into account during route planning.

(6) promote ethical engineering practices, with a focus on safety, sustainability and responsible project management.

Prerequisites:

Recommended for participants with prior technical knowledge of fluid mechanics or the fundamentals of engineering. There are no formal prerequisites.

Pipeline Materials and Mechanical Design: 5 ECTS

Learning outcomes:

Upon successful completion of this module, participants will be able to

(1) to understand and evaluate the pipeline materials used in technical applications – including metals, plastics, concrete and composites – on the basis of mechanical, environmental and economic criteria.

(2) to describe and compare manufacturing techniques for steel, plastic and concrete pipelines and to assess their impact on the quality, durability and performance of the pipes.

(3) to apply design principles for determining the design pressure, wall thickness and maximum allowable operating pressure (MAOP) using relevant industry regulations and standards (e.g. ASME B31.4, B31.8).

(4) To analyse the load and stress conditions of pipework, including internal/external pressure, thermal expansion and soil interaction, and to carry out basic stress and flexibility assessments.

(5) Demonstrate knowledge of corrosion mechanisms relating to pipework systems and assess their impact on long-term structural integrity.

(6) Select and evaluate suitable corrosion protection methods tailored to specific operating and environmental conditions, including coatings, cathodic protection systems and chemical inhibitors.

(7) To understand pipeline inspection and monitoring techniques, including in-line inspection (ILI) tools and corrosion monitoring methods, and to interpret basic inspection data for integrity management.

Prerequisites:

Recommended for participants with prior technical knowledge of fluid mechanics or the fundamentals of engineering. No formal prerequisites are required.

Pipeline System Design: 5 ECTS

Learning objectives:

Upon successful completion of this module, participants will be able to

(1) to describe and apply the fundamental principles of fluid mechanics relevant to pipeline systems, including fluid behaviour, flow regimes and thermodynamic effects.

(2) to carry out steady-state hydraulic calculations for liquid and gas pipelines, including pressure loss and flow analysis under various operating conditions.

(3) to analyse and interpret pressure profiles and flow distributions in pipeline networks, taking into account terrain, temperature and system layout.

(4) Apply methods for optimising pipeline systems, including diameter selection, route evaluation and performance assessment.

(5) To evaluate pipeline designs on the basis of technical feasibility, cost-effectiveness (CAPEX/OPEX), safety and environmental sustainability.

(6) Integrate technical, environmental and stakeholder-related factors into the decision-making process for the design of efficient and reliable pipeline systems.

Prerequisites:

Recommended for participants with prior technical knowledge of fluid mechanics or the fundamentals of engineering. No formal prerequisites are required.

Pipeline Routing and Civil Design: 5 ECTS

Learning objectives:

Upon successful completion of this module, participants will be able to

(1) apply the principles of route selection and alignment to design efficient and sustainable pipeline corridors.

(2) to assess environmental, topographical and infrastructural factors that influence the selection and alignment of routes.

(3) to use GIS tools and digital mapping for the planning and optimisation of pipeline routes.

(4) to design crossings and coordinate pipeline routes with existing infrastructure using open-cut and trenchless methods.

(5) Understand the behaviour of soils and rocks and assess ground conditions through geotechnical investigations.

(6) to incorporate geotechnical data into pipeline planning in order to ensure structural stability and constructability across different types of terrain.

(7) to identify and mitigate geotechnical risks such as slope instability, settlement and seismic hazards.

(8) Components of civil infrastructure, including foundations, stations, offshore installations and erosion protection systems.

(9) to ensure compliance with relevant regulations, and to document technical findings and involvement in approval procedures and processes for engaging with stakeholders.

Prerequisites:

Recommended for participants with prior technical knowledge of fluid mechanics or the fundamentals of engineering. No formal prerequisites are required.

General Aspects of Station and Terminal Design and Equipment: 5 ECTS

Learning objectives:

Upon successful completion of this module, participants will be able to

(1) to describe the roles and functions of various stations and terminals within a pipeline system.

(2) to interpret and apply the design principles of stations and terminals, taking into account process flows, safety and site-specific factors.

(3) Select suitable rotating equipment, such as pumps, compressors and drives, based on performance, reliability and operational requirements.

(4) To identify and evaluate the function and selection of ancillary equipment such as valves, filters, pressure regulators and instruments.

(5) Apply relevant industry standards and regulatory requirements in the design of stations and terminals.

(6) Understand the integration of mechanical, electrical, structural and control systems in the design of stations and terminals.

(7) Analyse system-related considerations regarding operational efficiency, safety and ease of maintenance in pipeline infrastructure.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipework engineering and the fundamentals of pipework materials and mechanical design.

Pipeline Instrumentation and Automation: 5 ECTS

Learning objectives:

Upon successful completion of this module, participants will be able to

(1) explain the role and function of sensors and instruments in pipeline systems.

(2) select and configure suitable sensors for monitoring flow, pressure, temperature and other key parameters.

(3) to design and implement reliable data acquisition systems and signal processing techniques for pipeline applications.

(4) to develop and deploy PLC- and DCS-based automation systems tailored to pipeline operations.

(5) Apply and fine-tune control strategies (PID, MPC) for regulating pipeline processes.

(6) Integrate automation systems into SCADA platforms, field communication networks and HMI interfaces.

(7) Use real-time data visualisation and analysis to optimise performance and enable predictive maintenance.

(8) Ensure compliance with safety integrity standards and the implementation of best practices for cyber security in pipeline control environments.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipeline engineering and the fundamentals of pipeline materials and mechanical design.

Energy Pipeline Systems: 5 ECTS

Learning objectives:

Upon successful completion of this module, participants will be able to

(1) to describe the design, operation and safety principles of crude oil and natural gas pipeline systems, including the associated storage infrastructure.

(2) to understand the specific challenges of hydrogen transport, including material compatibility, safety and storage technologies.

(3) to analyse offshore pipeline systems in terms of route selection, installation, environmental factors and structural integrity.

(4) compare and evaluate the technical and regulatory aspects of various energy pipeline systems.

(5) Assess how new technologies and trends in the energy transition are influencing the development of pipeline infrastructure.

(6) Apply systems thinking to identify opportunities for integration between oil, gas, hydrogen and offshore systems within energy networks.

(7) to analyse key case studies in order to gain practical insights into the performance, challenges and best practices of energy pipeline projects.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipeline engineering and the fundamentals of pipeline materials and mechanical design.

Pipeline Systems for the Transmission of Water and Similar Fluids: 5 ECTS

Learning objectives:

Upon successful completion of this module, participants will be able to

(1) to design and evaluate pipeline systems for water, wastewater and sludge using advanced hydraulic analyses.

(2) select suitable materials and equipment based on fluid properties and operational requirements to ensure durability and efficiency.

(3) Integrating storage, pumping and control systems into comprehensive pipework networks.

(4) To address the operational and maintenance challenges specific to each type of fluid, including abrasion, sedimentation, corrosion and odours.

(5) Apply safety, environmental and regulatory standards in the design and operation of non-hydrocarbon pipeline systems.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipeline engineering and the fundamentals of pipeline materials and mechanical design.

Special Pipeline Systems: 5 ECTS

Learning objectives:

By the end of this module, participants will be able to:

(1) To analyse and design upstream gathering systems for multiphase flows, addressing flow reliability and site-specific operational challenges.

(2) To evaluate and implement best practices in the design of CO_2 pipelines, with a focus on corrosion protection, containment and regulatory compliance in CCS applications

(3) Understand and apply safety and design standards for ammonia pipelines, including leak prevention, pressure control and material compatibility.

(4) Hot fluid transport systems taking into taking into account of insulation, thermal expansion and high-temperature materials.

(5) to overcome technical and safety-related challenges associated with specialised pipelines and to ensure reliable operation under demanding physical and environmental conditions.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipeline engineering and the fundamentals of pipeline materials and mechanical design.

Pipeline Construction: 5 ECTS

Learning objectives:

By the end of this module, participants will be able to

(1) to understand the entire life cycle of onshore and offshore pipeline construction, from planning through to commissioning.

(2) select and apply appropriate construction techniques based on the geographical location, environmental conditions and scope of the project.

(3) Manage compliance with HSE regulations and risk management during construction works.

(4) Coordinate construction activities amongst multiple stakeholders and within regulatory frameworks.

(5) Develop solutions to construction challenges in complex terrain and underwater environments.

(6) Ensure pipeline integrity and quality assurance through appropriate testing and documentation procedures.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipework engineering and the fundamentals of pipework materials and mechanical design.

Pipeline Operation, Integrity Management and Maintenance: 5 ECTS

Learning objectives:

Upon completion of this module, participants will be able to:

(1) to operate pipeline systems efficiently using best practice and monitoring technologies.

(2) to apply integrity management techniques to assess, maintain and improve the condition of pipelines.

(3) to apply structured maintenance strategies (preventive, predictive and condition-based).

(4) to use tried-and-tested and innovative repair methods to restore pipeline functionality.

(5) to ensure compliance with health and safety and environmental regulations during operation and repairs.

(6) To develop and manage contingency plans for operational disruptions.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipework engineering and the fundamentals of pipework materials and mechanical design.

Pipeline Project Management: 5 ECTS

Learning objectives:

By the end of this module, participants will be able to

(1) prepare the project implementation plan.

(2) to understand the fundamental principles and processes of project management in pipeline projects.

(3) To develop and manage project schedules, budgets and resources effectively.

(4) Carry out risk assessments and implement risk management strategies for pipeline projects.

(5) Ensure quality management and compliance with regulatory requirements at all stages of pipeline projects.

(6) Manage stakeholders and communicate effectively to achieve project objectives.

(7) Apply techniques for performance monitoring, reporting and progress measurement, and manage plant data and project documentation efficiently.

Prerequisites:

Recommended for participants with prior knowledge of the fundamentals of pipework engineering and the fundamentals of pipework materials and mechanical design.

Advanced Well Placement: 5 ECTS

Learning objectives:

By the end of this module, participants will have achieved the following learning objectives:

- Develop a comprehensive understanding of directional drilling, including its principles and applications.
- Acquire a basic knowledge of horizontal well construction and sidetracking techniques in horizontal drilling.
- Gain an insight into how Measurement While Drilling (MWD) systems work.
- Become familiar with the fundamentals of telemetry systems used in directional drilling operations.
- Understand the operating principles of various Rotary Steerable Systems (RSS) and learn how to select the most suitable system for specific drilling challenges.
- To understand the methods used to construct the ellipsoid of uncertainty for various surveying tools in directional drilling.
- Learn how to calculate the separation factor, a crucial parameter in directional drilling.

- Develop problem-solving skills to tackle critical challenges when applying advanced directional drilling techniques.
- Develop strategies for reducing risk and improving the accuracy of well placement in complex reservoirs.

Prerequisites:

Students must have prior knowledge of the fundamentals of drilling engineering. This includes a sound understanding of well construction processes, drilling mechanics, fundamental principles of petroleum engineering, and the calculation of wellbore trajectories. Knowledge of drilling fluids, bottom-hole assemblies (BHA) and basic geomechanics is recommended. Students should also have a basic understanding of reservoir engineering.

Drilling and Well Construction Lab: 5 ECTS

Learning outcomes:

Upon successful completion of this module, students will be able to:

- Design, prepare and optimise drilling fluids for different sections of the wellbore, including productive zones (pay zones), in order to minimise formation damage, improve wellbore cleaning and control wellbore stability.
- To evaluate and compare water-based and oil-based drilling fluid systems, and to select suitable fluid systems in accordance with wellbore conditions and operational requirements.
- To carry out and interpret standard laboratory tests on drilling fluids, including rheological, filtration and density measurements, as well as treatment procedures in line with on-site drilling practices.
- Carry out rock mechanics laboratory tests (e.g. UCS tests, triaxial tests, tensile strength tests and point-load tests) and analyse the results to optimise the rate of penetration (ROP) and evaluate drill-off tests.
- Apply principles of drilling process optimisation, including drill-off tests and performance analyses, to improve drilling efficiency and operational performance.
- Design cement slurries by calculating slurry compositions, selecting suitable additives and adapting formulations to specific borehole requirements.
- Carry out standard laboratory tests on cement and interpret the results to validate and optimise the design of cement slurries for various cementing operations.
- Carry out cementing calculations and evaluate the performance of cementing operations, including an understanding of cementing equipment, chemicals, cementing methods and cement evaluation techniques.

Prerequisites:

A sound foundation in petroleum engineering, particularly in the areas of drilling fluids, the fundamentals of cementing and basic rock mechanics, is required. Students should understand stress–strain relationships and the mechanical behaviour of rocks, and be familiar with standard laboratory testing methods. A basic knowledge of completion engineering is recommended, including concepts relating to completion fluids, mechanisms of formation damage and aspects of well integrity. In addition, a basic knowledge of petrophysics is expected, including porosity, permeability, basic formation evaluation and the properties of reservoir rocks, as these parameters influence the selection of fluid systems, cement design and decisions regarding drilling process optimisation.

Well Lifecycle Integrity and Abandonment: 5 ECTS

Learning outcomes:

Upon successful completion of this module, students will be able to:

- Explain the principles of integrity throughout the entire life cycle of a well, including barrier philosophy, well integrity management systems and relevant regulatory frameworks.
- To analyse the function, design and potential failure mechanisms of primary and secondary barrier elements, and to assess their technical and economic implications for well operations.
- To design fit-for-purpose barrier systems to ensure safe and economically sustainable energy production from the subsurface.
- To assess technical risks and uncertainties associated with plug-and-abandonment (P&A) operations, including their impact on costs and scheduling.
- To assess conventional and new P&A technologies, including rig-based and rigless abandonment solutions for onshore and offshore applications.
- To interpret current European P&A standards and regulations, identify their limitations and discuss potential areas for improvement.
- To assess the technical and regulatory requirements for the repurposing of oil and gas wells for alternative energy applications, taking into account necessary infrastructure changes and long-term integrity challenges.
- Apply industrial software tools for assessing well integrity, P&A design and the analysis of barrier systems.

Prerequisites:

Students should have prior knowledge of the fundamentals of well construction and drilling technology, including casing design, the basics of cementing and fundamental well hydraulics. A sound understanding of key petroleum engineering concepts, including reservoir behaviour, the fundamentals of production engineering and completion engineering, is required. Knowledge of the well-barrier philosophy, well-control principles and subsurface pressure regimes is recommended. In addition, students should have a basic understanding of rock mechanics and geomechanics, as well as the fundamental principles of risk analysis in relation to subsurface operations.

Measurement Control, Monitoring, and Analysis: 5 ECTS

Learning outcomes:

Upon successful completion of this module, students will be able to:

- Explain the operating principles of rig sensors and surface data acquisition systems, including measurement uncertainties and system-related limitations.
- To assess data quality and apply appropriate quality assurance procedures to ensure the reliable interpretation of drilling and mud-logging data.
- Interpret real-time drilling data and carry out monitoring and analysis tasks as typically performed in Real-Time Operation Centres (RTOCs).
- Hydraulic performance, torque and drag behaviour, pore pressure trends and indicators of borehole stability based on field data.
- To evaluate drilling performance and identify deviations from expected trends in order to support operational decision-making.
- The role of mud-logging systems in safety, geological interpretation, hydrocarbon evaluation and the avoidance of drilling hazards.
- Integrate multiple data streams to identify critical information for reservoir identification, determining casing points and mitigating operational risks.
- Understand data management, storage requirements and industry-standard data exchange formats such as WITS and WITSML, as well as their significance for digital drilling processes.

Prerequisites:

A solid understanding of fundamental drilling parameters, such as weight on bit (WOB), torque, rate of penetration (ROP), circulation systems and basic well-control principles, is required. Knowledge of mud-logging concepts, the fundamentals of formation evaluation and pore pressure basics is recommended. In addition, students should have a basic knowledge of data analysis and engineering calculations, including basic statistics, unit conversions and the interpretation of time-based operational data.

Drilling Process Evaluation and Planning: 5 ECTS

Learning outcomes:

Upon successful completion of this module, students will be able to:

- Develop a comprehensive well plan, including technical design aspects, time-depth planning and the preparation of an Authorisation for Expenditure (AFE).
- To distinguish between and analyse productive time, non-productive time (NPT), flat time and invisible lost time, and to assess their impact on well performance and costs.
- Apply methods for estimating drilling time in order to produce time–depth curves using statistical data and offset well data.
- Estimate well costs and draw up detailed cost structures, taking technical and operational uncertainties into account.
- To evaluate different types of drilling contracts and tendering strategies and analyse their impact on costs and risk allocation.
- Select and apply appropriate Key Performance Indicators (KPIs) to measure drilling efficiency and operational performance.
- Apply risk management techniques, including Monte Carlo simulations, to quantify uncertainties and predict probability ranges for drilling duration and costs.
- Develop strategies for optimising drilling costs and continuous improvement programmes, incorporating learning curve analyses and performance benchmarking.

Prerequisites:

Students should have prior knowledge of the fundamentals of drilling technology, including well construction processes, basic casing design, drilling hydraulics and the operational sequence of drilling activities. A sound understanding of drilling processes, time-tracking concepts and basic cost components in well construction is required. Knowledge of drilling performance parameters, the analysis of offset well data and fundamental concepts of petroleum economics is recommended. Furthermore, students should have a basic knowledge of engineering mathematics and statistics, including probability concepts and basic data analysis techniques relevant to time and cost estimates.

Advanced Well Monitoring and Analysis: 5 ECTS

Learning outcomes:

Upon successful completion of this module, students will be able to:

- Organise and manage large volumes of well and reservoir life-cycle data (geological, drilling, production-related, economic and operational data) to support systematic monitoring and analysis.
- To validate and interpret operational data and convert it into actionable information, whilst recognising the importance of timely analysis for maintaining well and reservoir performance.

- Apply time-series analysis methods to identify trends, oscillations and unusual signals in production data (oil, water, gas) and diagnose underlying operational issues.
- To develop and apply Key Performance Indicators (KPIs) to quantify the performance of wells, reservoirs and fields, and to assess operational efficiency.
- Use data mining and diagnostic tools to recognise symptoms, establish functional relationships between events and performance declines, and identify the causes of production problems.
- Prioritise wells for workover and stimulation measures based on technical selection criteria, operational history and performance indicators.
- Apply economic evaluation methods to justify technical interventions and estimate potential production increases and cost savings.
- Integrate technical, operational and economic analyses to support data-driven decision-making and optimise production from both mature fields (brownfields) and new developments (greenfields).

Prerequisites:

Students should have comprehensive knowledge of well lifecycle operations, including drilling technology, formation evaluation and logging, well testing, completion engineering, well servicing, reservoir management and production engineering. A solid understanding of production systems, artificial lift methods, workover operations and reservoir performance analysis is required. Familiarity with day-to-day well surveillance practices, the interpretation of production data and operational reporting is strongly recommended. Students should also be familiar with key concepts in reservoir engineering, such as mass balance, decline curve analysis, pressure behaviour and fluid flow in porous media.

Furthermore, a basic knowledge of data analysis, time-series interpretation and economic evaluation methods relevant to decision-making in relation to field development and technical interventions is expected.