

THE IMPLEMENTATION REGULATIONS

2017-2018

**MASTER OF SCIENCE
APPLIED EARTH SCIENCES**

DELFT UNIVERSITY OF TECHNOLOGY

Section 1 – Compiling the study programme

Article 1 – The study load

The study load for the Master's degree course is 120 credits. None of the components of the course may have formed part of the Bachelor's degree course in Applied Earth Sciences ("Technische Aardwetenschappen").

Article 2 – Tracks, specialisations and profiles

1. The course comprises the following tracks:

- Petroleum Engineering and Geosciences, as laid down in Article 4
 - Specialisations:
 - Petroleum Engineering
 - Reservoir Geology
- Geo-Engineering, as laid down in Article 5A
- Geoscience and Remote Sensing, as laid down in Article 5B
- Environmental Engineering, as laid down in Article 5C
- Applied Geophysics, as laid down in Article 6
- Resource Engineering, as laid down in Article 7
 - Specialisation:
 - European Mining Course (EMC)
 - Structured exchange:
 - Mineral and Recycling Process Engineering Course (EMREC)

2. Within a track or within a specialisation the student may opt for the annotations, mentioned in Articles 8 and 9:

- Technology in Sustainable Development
- Entrepreneurship.

Article 3 – Registering the tracks and compiling the examination programme

1. When students register for the Master's degree course, they need to indicate their track and specialisation of interest.
2. At the start of the programme the students need to determine their examination programme in cooperation with the relevant MSc-track coordinator.
3. Prior to the start of the Final Thesis students need to present their examination programme together with the title, a short abstract, a time schedule and the chairman and members of the assessment committee of the Final Thesis for approval. In case the examination programme satisfies the rules as laid down in these Implementation Regulations, then it can be approved by the MSc-track coordinator only; in case the programme does not satisfy the rules as laid down in these Implementation Regulations, then it also needs to be approved by the Board of Examiners, with a motivation for the deviation from these Regulations.
4. Any amendments made to the previously approved examination programme or to the previously approved assessment committee should be presented to the MSc-track coordinator and in the case of the program not satisfying the rules as laid down in these Implementation Regulations also to the Board of Examiners for final approval, with a motivation for the deviation from these Regulations.
5. Students who opt for the annotations Technology in Sustainable Development or Entrepreneurship need the approval of their examination programme from the referee of the chosen annotation prior to presenting their examination programme to the MSc-track coordinator and/or Board of Examiners according to section 2 and 3 of this article.

Article 3A – Rules for Free Master of Science electives

The student may choose:

- all subjects offered in conjunction with the degree course,
- all subjects offered in conjunction with other Master's degree courses at a Dutch university or at an international university which TU Delft has an exchange contract with,
- An internship (CIE4040-09, 10 EC), Additional Master Thesis (10 EC) or Multidisciplinary Project (10 EC)

- interfaculty Master's-level electives at Delft University of Technology with a "WM-code" to a maximum of 6 credits, however language and skills subjects are **not** allowed within the examination programme. Language and skill subjects can only be part of the extracurricular section of the diploma supplement.¹

Article 4 – The Petroleum Engineering and Geosciences track

1. The study programme of the Petroleum and Geosciences track is compiled in the following way:

- track-linked compulsory core programme
44 credits, laid down in subsection 2
- specialisation-linked subjects:
65 credits for the specialisation Petroleum Engineering, laid down in subsection 3
67 credits for the specialisation Reservoir Geology, laid down in subsection 4
- electives:
11 credits for the specialisation Petroleum Engineering, as laid down in subsection 5
9 credits for the specialisation Reservoir Geology.

2. Compulsory core programme Petroleum Engineering and Geosciences track:

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES0102	Image Analysis	1
AES1011	Matlab / Programming	2
AES1300	Properties Reservoir Fluids	3
AES1310-10	Rock Fluid Physics	3
AES1320	Modelling of fluid Flow in porous Media	3
AES1340	Reservoir Engineering	2
AES1510	Geologic Interpretation of Seismic Data (practical included)	3
AES1520	Log Evaluation	2
AES1802	Geological Fieldwork	3
AES1820-09	Reservoir Characterisation and Development	4
AES1890	Sedimentary Systems	3
AES1920	Geostatistics	2
AES1930	Quantification of Rock Reservoir Images	1
AES2009	Field Development Project	9
AES3820 ²	Petroleum Geology	3

3. Subjects linked to the specialisation Petroleum Engineering:

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES1304	Introduction to Petroleum Engineering and NAM Visit	3
AES1330	Drilling and Production Engineering (lab. exp. included)	4
AES1350	Reservoir Simulation	2
AES1360	Production Optimization	3
AES1500	Fundamentals of Borehole Logging	4
WI4012TA	Mathematics, Special Subjects	4
AESM2006	Final Thesis Petroleum Engineering	45

4. Subjects linked to the specialisation Reservoir Geology:

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES1800	Exploration Geology	3
AES1830	Reservoir Sedimentology	3
AES1840	Advanced Structural Geology	3
AES1850	Geological Modelling	4
AES1860-05	Analysis of Sedimentological Data	3
AES1902	Reservoir Geological Fieldwork	6
AESM2006	Final Thesis Reservoir Geology	45

5. The following optional electives are offered within the specialisation Petroleum Engineering:

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES1370-12	Non-Thermal Enhanced and Improved Oil Recovery	3

¹ This means that subjects like writing, oral presentation, English and Dutch are not allowed within the examination programme.

² Not if AES3820 has been completed in the Bachelor's fase

3AES1460	Heavy Oil	2
AES1470	Geothermics	2
AES1490	Advanced Reservoir Simulation	2
AES1760	Introduction to Log Evaluation	1
AESM1805	Regional Geology Field Trip	1
AESM	Geothermal Field Trip	2
Free Master of Science electives		

Article 5A – The Geo-Engineering track

1. The study programme for the Geo-Engineering track consists of:

- a common compulsory Geo-Engineering block
74 credits, laid down in subsection 2
- Geo-Engineering electives
adding up to a total of 100 track-linked credits, as laid down in subsections 2 and 3
- electives
20 credits, as laid down in subsection 4.

2. Common compulsory block Geo-Engineering

All students opting for the track Geo-Engineering must complete the following subjects adding up to 74 credits:

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES1630	Engineering Geology	4
CIE4361	Behaviour of Soils and Rocks	6
CIE4365-16	Modelling Coupled Processes for Engineering Applications	5
CIE4366	Numerical Modelling in Geo-Engineering	6
CIE4395	Risk and Variability in Geo-Engineering	4
CIE5320	Site Characterisation, Testing and Physical Modelling	6
AESM1700	Consolidation of Soils	3
AESM2606	Final Thesis Geo-Engineering	40

3. Geo-Engineering electives

If the Bachelor's phase did not include WM0325TA, Technics and Responsibility, students shall choose one out of two:

CIE 4510	Climate Change: Science and Ethics	4
WM0312CIE	Philosophy, Technology Assessment and Ethics	4

If the Bachelor's phase did not include the contents of the following subjects, these subjects are compulsory on the advice of the master graduation coordinator:

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES1730	Introduction to Geotechnical Engineering	4
CIE4420	<i>for students without soil mechanics and geotechnical engineering background</i> Geohydrology 1 <i>for students who did not pass CTB3390 or AESB3340</i>	4

Students are required to complete a selection of the following subjects adding up to a total of 100 track-linked credits.

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES1640-11	Environmental Geotechnics	4
AES1720-11	Rock Mechanics Applications	5
AES1730 ³	Introduction to geotechnical Engineering	3
AESM2901-16	Geoscience and Engineering Fieldwork	10
CIE4353	Continuum Mechanics	6
CIE4362	Soil-structure Interaction	3
CIE4363	Deep Excavations	4
CIE4367-16	Embankments and Geosynthetics	3
CIE4390	Geo-risk Management	3
CIE4420 ⁴	Geohydrology 1	4
CIE4780	Trending Topics in Geo-Engineering	4
CIE5305	Bored and Immersed Tunnels	4
CIE5340	Soil Dynamics	3

³ Students who passed CTB2310 (Soil Mechanics) or an equivalent course cannot take this course.

⁴ Students who passed CTB3390, AESB3340 or an equivalent course cannot take this course.

CIE5741	Trenchless Technologies	4
OE44030	Offshore Geotechnical Engineering	4

4. Electives

Choose two out of:

<u>code</u>	<u>subject</u>	<u>ECs</u>
	Any Master's degree course subject Applied Earth Sciences or Civil Engineering	10
	Free Master of Science electives	10

Article 5B – The Geoscience and Remote Sensing track

1. The study programme for the Geoscience and Remote Sensing track consists of:

- a common compulsory Geoscience and Remote Sensing block
73 credits, as laid down in subsection 2
- Geoscience and Remote Sensing electives
27 track-linked credits, as laid down in subsection 3
- electives
20 credits, as laid down in subsection 4.

2. Common compulsory block Geoscience and Remote Sensing

All students opting for the track Geoscience and Remote Sensing must complete the following subjects adding up to 73 credits:

<u>code</u>	<u>subject</u>	<u>ECs</u>
CIE4510 ⁵	Climate Change: Science & Ethics	4
CIE4601	Physics of the Earth and Atmosphere	5
CIE4603-16	Geo-signal Analysis	6
CIE4604	Simulation and Visualization	5
CIE4606	Geodesy and Remote Sensing	5
CIE4611	Geo-measurement Processing	5
CIE4615	GRS Fieldwork	3
AESM2640	Final Thesis Geoscience and Remote Sensing	40

3. Geoscience and Remote Sensing electives

Students are required to complete a selection of the following subjects adding up to a total of 27 credits.

Choose at least 12 credits out of:

<u>code</u>	<u>subject</u>	<u>ECs</u>
CIE4522-15	GPS for Civil Engineering and Geosciences	4
CIE4602	Ice, Snow and Climate Change: Observation and Modelling	4
CIE4605	Atmospheric Science	4
CIE4607	Ocean topography and sea-level change	4
CIE4608	Atmospheric Observation	4
CIE4609	Geodesy and Natural Hazards	4
CIE4610	Mass Transport in the Earth's System	4
CIE4614	3D Surveying of Civil and Offshore Infrastructures	4

and choose adding up to a total of 27 credits out of:

<u>code</u>	<u>subject</u>	<u>ECs</u>
CIE4612	Research Seminar Geoscience and Remote Sensing II	1
CIE5601	Advanced topics in Geoscience and Remote Sensing	3
CIE5602	Research Seminar Geoscience and Remote Sensing I	1
CIE5603	Advanced Project on GRS	3
CIE5604	Journal club on climate change and geoscience	3

Any Master's degree course subject Applied Earth Sciences or Civil Engineering

4. Electives

Choose two out of:

<u>code</u>	<u>subject</u>	<u>ECs</u>
	Any Master's degree course subject Applied Earth Sciences or Civil Engineering	10
	Free Master of Science electives	10

⁵ Not compulsory if Bachelor's phase did include WM0325TA Technics and Responsibility

Article 5C – Environmental Engineering

The Environmental Engineering track has two specialisations:

- Environmental Technology
- Environmental Science

The compulsory programme for each specialisation consists of a common compulsory Environmental engineering block of 21 credits and 4 credits compulsory Ethics course. Depending on your specialisation profile you have an additional block of 36 credits (Environmental Technology) or 34 credits (Environmental Science).

Common compulsory block Environmental Engineering

All students opting for the track Environmental Engineering must complete the following subjects adding up to 21 credits:

<u>code</u>	<u>subject</u>	<u>ECs</u>
CIE4701	Transport processes in Environmental Science and Engineering	4
CIE4495-13	Fundamentals of Water Treatment	4
CIE4440	Hydrological Processes and Measurements	4
CIE4702	Integrated Project: Leapfrog Environmental Degradation	4
CIE4365-16	Modelling Coupled Processes for Engineering Applications	5

All students must complete the compulsory Ethics course of 4 credits:

CIE4510	Climate change: Science & Ethics	4
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In addition to the presented programme students must meet the following requirements:

- Students who have not done Introduction to water Treatment in the Bachelor's phase are strongly advised to take CIE3365 Introduction to Water Treatment as an elective subject.

Additional block Environmental Technology

Students who have opted for the specialisation Environmental Technology must complete the following subjects adding up to 36 credits:

<u>code</u>	<u>subject</u>	<u>ECs</u>
CIE4703	Water Treatment	6
CIE4704	Chemical Processes in Water Technology	5
CIE4705	Environmental Biotechnology & Microbiology	6
CIE4710	Materials separation in Waste Processing	5
CIE5421	Water and Health	4
CIE5704	Water Treatment Research	5
CIE5702	Conceptual Process design	5

Additional block Environmental Science

Students who have opted for the specialisation Environmental Science must complete the following subjects adding up to 34 credits:

<u>code</u>	<u>subject</u>	<u>ECs</u>
CIE5450	Hydrology of Catchments, Rivers and Deltas	4
CIE4707	Air Quality	5
CIE4706	Introduction into Meteorology	5
CIE4709	Remote Sensing for Environmental Monitoring	5
CIE4708	Water in the Atmosphere	5
CIE5703	Urban Climate & Hydrology	5
CIE5701	From Field Observations to Modelling	5

Environmental Engineering electives

All subjects listed above and not part of the chosen specialisation can be chosen as electives. In addition other electives can be chosen as specified in article 3. Students who have opted for the specialisation Environmental Technology can choose electives with a minimum of 19 credits. Students who have opted for the specialisation Environmental Science can choose electives with a minimum of 21 credits.

Article 6 – The Applied Geophysics track

The Applied Geophysics programme is taught at three partner universities:

- TU Delft
- ETH Zürich
- RWTH Aachen

The study programme is compiled in the following way:

First year

Delft

A minimum of 25 credits should be passed from TU Delft subjects, whereby two of the following three blocks must be passed:

- Geology and Interpretation: AES1510 and AES1890 and AES3820
- Electromagnetic Methods: AES1540-11
- Seismic Wave Propagation and Imaging: AES1560.

<u>code</u>	<u>subject</u>	<u>ECs</u>
AES1011	Matlab / Programming	2
AES1501	Methods of Exploration Geophysics	3
AES1510	Geologic Interpretation of Seismic Data	3
AES1540-11	Electromagnetic Exploration Methods	6
AES1550-06	Geophysics Special Subjects	6
AES1560	Advanced Reflection Seismology and Seismic Imaging	6
AES1590-12	Seismic Resolution	5
AES1890	Sedimentary Systems	3
AES3820	Petroleum Geology	3
CIE4606	Geodesy and Remote Sensing	5

Zürich

A minimum of 25 credits should be passed from the ETH Zürich subjects, whereby two of the following three blocks must be passed:

- Reflection seismology processing: 651-4079-00L
- Geophysical Fieldwork and Processing: 651-4104-00L and 651-4106-03L
- Modelling and Inverse Theory for Applied Geophysics: 651-4094-00L and 651-4096-00L.

<u>code</u>	<u>subject</u>	<u>ECs</u>
651-4079-00L	Reflection Seismology Processing	6
651-4087-00L	Case Studies in Engineering and Environmental Geophysics I	3
651-4087-02L	Case Studies in Engineering and Environmental Geophysics II	3
651-4094-00L	Numerical Modelling for Applied Geophysics	3
651-4094-02L	Numerical Modelling for Applied Geophysics II	3
651-4096-00L	Inverse Theory for Applied Geophysicists	3
651-4096-02L	Inverse Theory for Applied Geophysicists II	3
651-4104-00L	Geophysical Fieldwork and Processing: Methods	2
651-4106-03L	Geophysical Field Work and Processing: Preparation + Field Work	7
102-0448-00L	Groundwater II	6
701-0106-00L	Mathematics V: Applied Deepening of Mathematics I – III	3

Second year

Aachen

A minimum of 25 credits should be passed from the RWTH Aachen subjects, whereby two of the following five blocks must be passed:

- Geophysics Special Methods: 16ws-29463 and 16ws-14238
- Geophysical Logging and Log Interpretation: 16ws-14570
- Geothermics: 16ws-13943
- Hydrogeophysics and Data Analysis in Geoscience: 16ws-18482 and 16ws-18162
- Numerical Reservoir Engineering + Numerical Methods and Programming: 16ws-42235 and 16ws-42487

<u>code</u>	<u>subject</u>	<u>ECs</u>
16ws-18667	Applied Structural Geology	3
16ws-29463	Geophysics special Methods: NMR	3
16ws-14238	Geophysics Special Methods: Spectral IP	3
16ws-14570	Geophysical Logging and Log Interpretation	5
16ws-13943	Geothermics	5
16ws-18482	Hydrogeophysics	3
16ws-18162	Data Analysis in Geoscience	3
16ws-18598	Mineral Exploration (if Energy Resources Management not taken)	3
16ws-32124, 23301	Petroleum System Modelling/Sedimentary Basin Dynamics	6
16ws-29469	Engineering Geophysics	3

16ws-33690, 16689	Remote Sensing of Sedimentary Basins	3
16ws-24349	Planning-Realization-Optimization in Georesources Management	3
16ws-24537	Prospect Evaluation and Risk Analysis	3
16ws-45471	Portfolio Management	3
16ws-24346	Energy Resource Management (if Mineral Exploration not taken)	3
16ws-42235	Numerical Reservoir Engineering: Geophysics, Uncertainties and optimal experimental Design	3
16ws-42487	Numerical Methods and Programming for Reservoir Engineering3	
16ws-14775	Introduction to scientific Computing Languages	6
16ws-24760	Microstructural Analysis	6
16ws-12379	Einführung in Geographische Informationssysteme (GIS)	3
153ss-00086	Coal Geology	3
16ws-47549,47550	Numerical Methods for Geophysical Flows	3
16ws-00220,28046	Finite Elements in Fluid Dynamics	3

Delft/Aachen/Zürich

<u>code</u>	<u>subject</u>	<u>ECs</u>
AESM2506	Final Thesis Applied Geophysics	30

Article 7 – The Resource Engineering track

1. The study programme for the Resource Engineering track consists of:

- a common compulsory Resource Engineering block adding up to 80 credits, as laid down in subsection 2
- 20 credits of resource engineering track-linked electives, as laid down in subsection 3
- a research driven project or free electives adding up to 15 credits, as laid down in subsection 4.

2. Common compulsory block Resource Engineering

All students opting for the track Resource Engineering must complete the following subjects adding up to 80 credits:

Code	subject	ECs
AESM1026	Economic Geology & Mineral Exploration: Introduction for Geo-Resource Engineers	5
AESM1025	Data analysis and Resource Modelling	5
AESM1024	Legal, Health and Safety	5
AESM1023	Computer aided mine design and optimization	5
AESM1022	Principles of mine design	5
AESM1021	Mine Operational Management	5
AESM1020	Mine Feasibility Case Study	5
AESM2023	Thesis Proposal	5
AESM2025	Final Thesis	40

3. Resource engineering electives

Students are required to complete track linked electives of the following subjects, adding up to a total of 25 credits (see a and b). Students are required to opt for a focus on mining, geo or environmental engineering.

Choose at least one of the following three focusses and complete the course(s) linked to the focus to a total of 5EC:

Focus Geo-engineering:

Code	subject	ECs
AES1720-11	Rock Mechanics Applications	5

Focus Mining-engineering:

Code	subject	ECs
AES1720-11	Rock Mechanics Applications	5

Focus Environmental-engineering:

Code	subject	ECs
MS43997	Recycling Engineering Materials	3
AESM4151-2	Additional Assignment for Geo-Resource Engineers (for MS43997)	2

Choose a focus and select electives based upon that focus. A list of approved electives for each focus is given below. Students can choose all of the electives in this list. Students can also opt for other electives that are not in the list, but these electives need to be

approved of beforehand by the MSc coordinator (dr. Mike Buxton). Students complete a selection of electives adding up to a total of 20EC.

Focus Geo-engineering (approved electives):

<u>code</u>	<u>subject</u>	<u>ECs</u>
OE44030	Offshore Geotechnical Engineering	4
CIE4366	Numerical Modelling in Geo-Engineering	6
AES1470	Geothermics	2

Choose electives from the Focus Mining-Engineering, Environmental Engineering or other approved electives;
Adding up to a total of 20 EC

Focus Mining-engineering (approved electives):

<u>code</u>	<u>subject</u>	<u>ECs</u>
ME44200	Intelligent Control for Transport Technology	3
AES1470	Geothermics	2

Choose electives from the Focus Mining-Engineering, Environmental Engineering or other approved electives;
Adding up to a total of 20 EC

Focus Environmental-engineering (approved electives):

<u>code</u>	<u>subject</u>	<u>ECs</u>
CIE4420	Geohydrology	4
CIE4365-16	Modelling Coupled Processes for Engineering Applications	5

Choose electives from the Focus Geo-Engineering, Mining Engineering or other approved electives;
Adding up to a total of 20 EC

Other approved electives:

<u>code</u>	<u>subject</u>	<u>ECs</u>
WM0320TU	Ethics and Engineering	3
SPM8000	Project management	7
Geo1009	Geo-information organisation & legislation	5
SPM4416	Strategic management of large engineering projects	6
CME2200	Dynamic control of projects	4

4. Research driven project or free electives

In the 2nd year students can opt for completing a research driven project for 15 credits or can opt for completing a selection of free Master of Science electives adding up to a total of 15 credits.

5. European Mining Course

The specialisation European Mining Course (**EMC**), as laid down in this subsection, is taught at three partner universities:

- Helsinki University of Technology
- RWTH Aachen
- TU Delft

The study programme of the specialisation European Mining Course (EMC) is compiled in the following way:

First year

1st semester: Helsinki

<u>code</u>	<u>subject</u>	<u>ECs</u>
CHEM-E6140	Fundamentals of Minerals Engineering and Recycling	5
CHEM-E6225	Technical Innovation Project	10
GEO-E2030	Rock Mechanics	5
GEO-E3010	Economic Geology & Mineral Economics	5
GEO-E3020	Field Experience and Project in Hard Rock Mining	5

2nd semester: Aachen

<u>code</u>	<u>subject</u>	<u>ECs</u>
17ss-49733	Feasibility Studies, Project Management and Financial Modelling	5
17ss-49767	Reserve Modelling and Estimation	4
17ss-49735	Underground Mine Design	4
17ss-49769	Surface Mine Design	4
17ss-49732	Mine Ventilation	6

Choose option 1:

17ss49768 OR Choose option 2: 17ss-49734	Case Study Underground Mining Project Case Study – Surface Mining Project	7 7
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Second year

3rd semester: Delft

<u>code</u>	<u>subject</u>	<u>ECs</u>
AESM1023	Computer aided mine design and optimization	5
AESM1024	Legal, Health and Safety	5
AESM1025	Data Analysis and resource modelling	5
AESM2022	Project execution and mine startup planning	10
AESM2300-1	Investment Scenarios	1
CME2300	Financial Engineering	4

4st semester :

<u>code</u>	<u>subject</u>	<u>ECs</u>
AESM2010	Final Thesis	30

6. Mineral and Recycling Process Engineering Course

The structured exchange Mineral and Recycling Process Engineering Course (**EMREC**), as laid down in this subsection, is taught at two partner universities:

- Helsinki University of Technology
- TU Delft

The study programme of the structured exchange Mineral and Recycling Process Engineering Course (EMREC) is compiled in the following way:

First year

1st semester: Delft

<u>code</u>	<u>subject</u>	<u>ECs</u>
AESM1022	Principles of mine design	5
AESM1023	Computer aided mine design and optimization	5
AESM1024	Legal, Health and Safety	5
AESM1025	Data analysis and Resource Modelling	5
AESM1026	Economic Geology & Mineral Exploration: Introduction for Geo-Resource Engineers	5

Depending on focus

for Geo-Engineering and for Mining-engineering:

AES1720-11	Rock Mechanics Application	5
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for Environmental-engineering:

MS43997	Recycling Engineering Materials	3
AESM4151-2	Additional Assignment for Geo-Resource Engineers (for MS43997)	2

2nd semester : Helsinki

<u>code</u>	<u>subject</u>	<u>ECs</u>
CHEM-E6145	Unit Operations in Mineral Processing and Recycling	5
CHEM-E6155	Minerals Engineering Project Work	5
CHEM-E6125	Environmental Management in Industry	5
CHEM-E6135	Planning Exercise in Sustainable Metals Processing	5
CHEM-E6200	Materials processing and synthesis	10

Second year

3rd and 4st semester:

<u>code</u>	<u>subject</u>	<u>ECs</u>
Choose core subjects in consultation with the graduation coordinator from one field: <i>Material Science or Resources and Recycling</i>		
Free Master of Science electives		5
AESM2023	Thesis Proposal	5
AESM2025	Final Thesis	40

Section 2 – Annotations and Honours Programme

Article 8 – The Technology in Sustainable Development annotation

1. The examination programme for students who have opted for the annotation known as Technology in Sustainable Development must at least include the following:
 - a. A sustainable development colloquium totalling 5 credits: WM0939TU, Engineering for Sustainable Development,
 - b. Subjects within or outside the realm of the programme adding up to a total of at least 10 credits to be selected from the two clusters:
 - Design, Analysis and Tools
 - Organisation and Society.At least 3 credits should derive from each of the clusters.
Further information on the subjects to be selected and on the clusters is available from the programme coordinator, from the study guide and from the website of Delft University of Technology.
 - c. The Final Thesis must partly focus on the topic of sustainable development. The referent will test the hypothesis of the Final Thesis and the way in which it has been tackled against the extent to which sustainable development issues have been integrated into the project.
2. Students who complete the annotation successfully, receive an annotation Technology in Sustainable Development with their degree certificate.

Article 9 – The Entrepreneurship annotation

1. The examination programme for students who have opted for the annotation Entrepreneurship must at least include the following:
 - a. Electives related to entrepreneurship adding up to a total of 15 credits, 10 of which are extracurricular,
 - b. The Final Thesis must partly focusing on the topic of entrepreneurship.
2. The examination programme for the Entrepreneurship annotation needs the prior approval by the Programme director and a coordinator of Delft Centre for Entrepreneurship.
3. Students who complete the annotation successfully, receive an annotation Entrepreneurship with their degree certificate.

Article 10 – Honours Programme Master

1. Motivated students who have finished their Bachelor's degree course with a weighed averaged mark of 7.5 or higher, and students who have excelled during the first semester (no fails and a weighed average of 7.5 or higher) are eligible for a special individual programme of 20 credits on top of the Master's degree course: the Honours Programme Master.
2. The content of the Honours Programme Master should be thematically consistent. The subject WM0355HT, Critical Reflection on Technology, 5 credits, is compulsory to the Honours Programme Master.
3. Students who fulfil, or will fulfil, the requirements laid down in subsection 1, and are interested in the Honours Programme Master can send their application to the programme coordinator together with an essay in English, containing their motivation and a proposal for the programme. The programme has to be approved by a scientific staff member and the programme coordinator.
4. The Honours Programme Master has to be completed during the course of the student's Master's programme. None of the results may be lower than 6,0.
5. The various parts of the programme will be assessed by the respective examiner(s). The fulfilment of all criteria to the Honours Programme Master will be assessed by the board of examiners.
6. Students who have successfully completed the Honours Programme Master will receive a special certificate from the university with their degree certificate.

Section 3 – Transitional programme

Article 11 – Transitional programme for students with a Dutch higher vocational institute Bachelor degree

Students who want to be admitted to the Master's degree course on the basis of a relevant Dutch higher vocational institute Bachelor degree have to complete the following transitional programme first.

<u>code</u>	<u>subject</u>	<u>ECs</u>
AESB1130	Geology 1: Basics	5
AESB1230	Geology 2: North West Europe	5
AESB1420-15	Mechanics 2	5
AESB2320	Physical Transport Phenomina	5
AESB2330	Soil Mechanics <i>(only for Geo-Engineering)</i>	5
AESB2440	Geostatistics and Remote Sensing	5
AESB3340	Mechanics and Transport by flow in porous Media	5
WI1708TH1	Analysis 1	3
WI1708TH2	Analysis 2	3
WI1708TH3	Analysis 3	3
WI1808TH1	Linear Algebra (part 1)	3
WI1909TH	Differential Equations	3
CTB2400	Numerical Methods for Differential Equations	3

Section 4 – Deviate from examination programme

Article 12 – The free study programme

1. Students are free to compile examination programmes that are rounded off with a final exam. Such a programme needs prior approval by the Board of Examiners and it must consist entirely or mainly of subjects given in conjunction with the degree course but it can be complemented with subjects provided by or given in other courses.
2. The preliminary approval referred to in subsection 1 must be presented to the Board of Examiners by the student in the form of a justified request.

Section 5 – Examinations and practicals

Article 13 – Practical and/or exercises

1. The course teaching takes the form of lectures, practicals and/or exercises.
2. Practical and/or exercises must be completed before students participate in the examination unless otherwise indicated in the study guide.

Article 14 – The types of examinations

1. The examinations linked to the different subjects are to be completed in the way laid down in the study guide pertaining to the subject in question.
2. Examinations pertaining to subjects given by other programmes are to be completed in the way stipulated by or on behalf of the Teaching and Examination Regulations laid down by the relevant programme.

Article 15 – The frequencies, times and sequences of the exams

1. Written or oral examinations are to be completed in principal at the end of the teaching period in which the subject was taught.
2. The resit periods for any of the written exams referred to in subsection 1 are at the end of the next teaching period. For subjects taught in the fourth teaching period the resit period is in August.
3. Practical and/or exercises may be completed in the way laid down in the relevant timetables.

Section 6 – Access to Field Development Project, Geoscience and Engineering Fieldwork and Final Thesis

Article 16 – Access to Field Development Project

Students may not embark on the Field Development Project (AES2009) until they have completed the following subjects:

- AES1300, Properties of Hydrocarbons
- AES1310 or AES 1310-10, Rock Fluid Interaction 1
- AES1320, Rock Fluid Interaction 2
- AES1340, Applied Reservoir Engineering and Simulation 1
- AES1510, Geologic Interpretation of Seismic Data
- AES1520, Log Evaluation
- AES1820 or AES1820-09, Reservoir Characterisation and Development
- AES1870, Sequence Stratigraphy, or AES1890, Sedimentary Systems
- AES1920, Geostatistics.

Additionally, students with the specialisation Petroleum Engineering are advised to have completed the subjects:

- AES1330, Drilling and Production
- AES1360, Production Optimisation.

Article 17 – Access to Geoscience and Engineering Fieldwork

Students may not embark on the Geoscience and Engineering Fieldwork (AESM2901) until they have completed the subjects Engineering Geology (AES1630) and Site Characterisation and Testing (CIE5320).

Article 18 – Access to Final Thesis

1. Students may embark on the Final Thesis only when they have no more than 15 credits of uncompleted subjects of the Master's degree course from all their other subjects of the course.
2. In addition to subsection 1, students resource engineering must also have completed the course Thesis proposal (AESM2023).
3. Students are only allowed to present their Final Thesis if they have successfully completed all other obligations.

Section 7 – Extracurricular Certificate

Artikel 19a – Certificate

1. Students can receive a certificate for organising the Delft University Fund supported excursion focused on the Master Choice together with the student association for AES students (*Mijnbouwkundige Vereeniging*). This certificate is worth 1 credit.
2. A student who wants to obtain this certificate must submit a request to the Director of Studies.

Artikel 19b – Administrating the credit

1. Students are allowed to take this certificate as an extracurricular subject on their diploma supplement, and not as a part of the examination programme stipulated in this Implementation Regulation.
2. A student who wants to obtain the credit on his diploma must send the approval of the Director of Studies (see art. 12A section 2) to the Secretary of the Board of Examiners.

Section 8 – Transition Rulings

Article 20 – Transition Ruling

Students who started the Master's degree course before September 1, 2008 and who have a delay in their study progress, have to request the coordinator of the track programme to define a contract in which is stated which new subjects replace former subjects. The contract needs the approval of the Board of Examiners.

Article 21 – Transition Ruling

1. In principle, students who have already received a passing mark in one or more of their Master's degree programme subjects of the track European Geotechnical and Environmental Course (EGEC) before September 1 2016 must complete the degree programme of the track in accordance with the study programme applicable for the academic year in which they began the degree programme (the old programme).
2. The first year of the EGEC-track (1th and 2nd semester) will be no longer offered starting September 1, 2016. Students who did not pass all the exams at the university of Miskolc of Wroclaw can request the Board of Examiners to replace the not obtained subjects with as closely as possible similar MSc level subjects from the TU Delft. Students to whom this applies should mention this as soon as possible to the graduating coordinator.
3. The second year of the EGEC-track (3th and 4th semester) will be offered for the last time in the academic year 2016-2017 conform the implementation regulations 2015-2016.

If the student did not receive a passing mark before September 1, 2017 for the subject:

- | | |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - D-IP, Integrated Project (15 EC) | this project is based on group work which is based on a minimum number of students. If the student does not pass this course, a special program will be made consisting of courses from the MSc track Environmental Engineering and a 5EC individual project to be decided with the course coordinator and discussed with the Board of Examiners. |
| - D-SR-14, Material Models for Soil and Rocks (6 EC) | follow CIE4361, the same subject with a different code |
| - D-RMA, Rock Mechanics Applications (5 EC) | follow AES1720-11, the same subject with a different code |
| - D-EG-14, Environmental Geotechnics (4 EC) | follow AES1640-11, the same subject with a different code |

4. The study programme must in any case encompass at least 120 credits. Any inconsistencies in credits arising as a result of the transitional measures will be compensated for with free Master of Science electives.
5. In the event that this is not possible to complete the degree programme or that finishing the degree programme causes study delay, the student – after consultation with the graduation coordinator – can request the Board of Examiners to convert the degree programme into a free study programme.