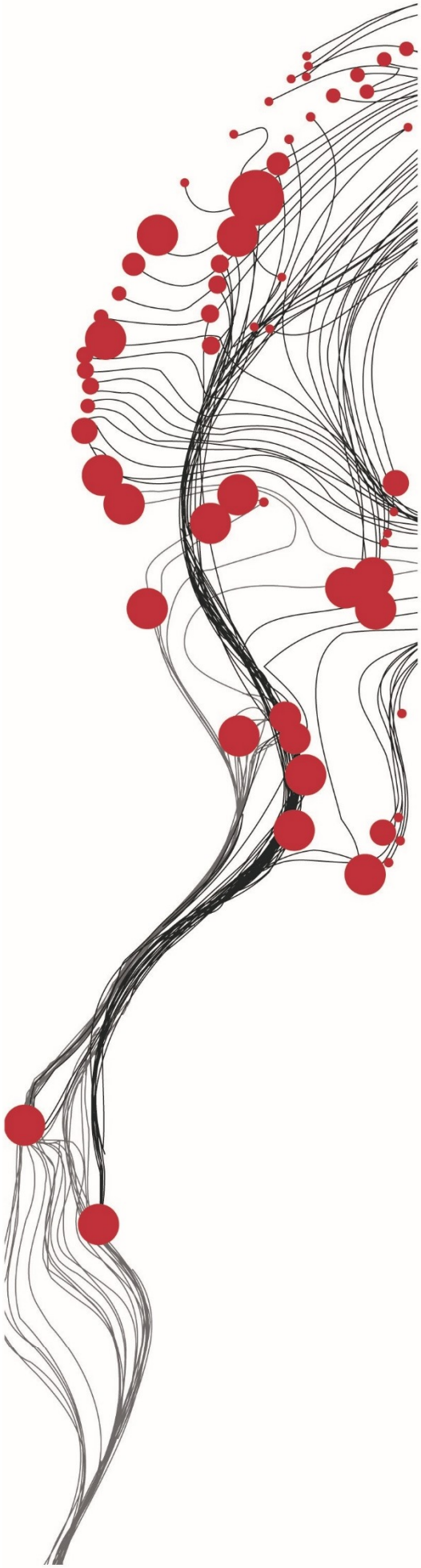

STUDY GUIDE

Master of Science Degree Programme in Spatial Engineering

Academic year 2024-2025

University of Twente, Faculty ITC
Bureau Education and Research Support

UNIVERSITY OF TWENTE.

ITC

COLOFON

UNIVERSITY OF TWENTE
FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
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PREFACE

This study guide provides an overview of the Master's programme Spatial Engineering and the study units of the programme for academic year 2023. In this study guide you find an overview of the learning outcomes and the structure of the programme as well as an overview of the various roles within the programme.

Each study unit of the study programme is described in terms of its study load, learning outcomes, contents, teaching and learning approach, test plan and entry requirements.

Through this study guide we hope to provide you insight in what you can expect from the education we offer. The programme manager can be contacted for further general information about the programme. For further information about a specific study unit, the coordinator of that study unit can be contacted.

Success with your studies!

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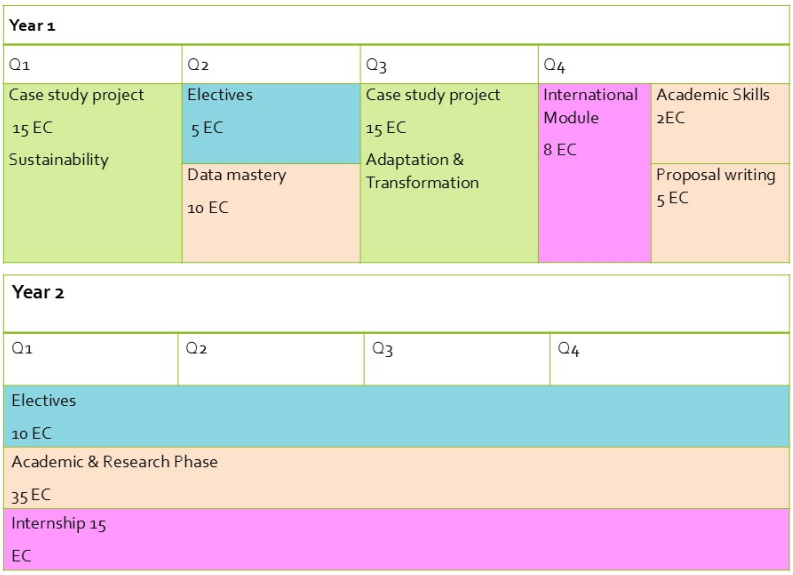
INTRODUCTION

PROGRAMME STRUCTURE



First year - case study projects, data mastery, electives, International Module and MSc Research proposal
In the first year of the Master's programme Spatial Engineering students will work on two case study projects to develop (in a scientific way) sustainable interventions to help solve certain problems. During the case study projects students will encounter the need for more knowledge. This can be obtained during the case study projects - in specialized lectures on choice topics, skill learning line workshops and of course self study – as well as after using the 2nd quartile data mastery and electives courses. At the end of the first year the international module offers insights in how wicked problems are dealth with by organisations in the workfield. Also at the end of the first year the individual MSc Research proposal has to be defended.
r

Second year - Electives, MSc research and internship
The second year of Spatial Engineering allows students to further pursue a personally oriented more flexible curriculum. The main part is the individual MSc research, on a topic of choice. At ITC, the MSc research topics are integrated with the main research themes at ITC, which are the responsibility of the professors and associate professors. There are six main research themes at ITC, each of which has multiple sub-themes that are very well suited for Spatial Engineering: urban development, climate change, disasters, resource extraction, agriculture etc.

Moreover, in view of the capacity development mission of ITC, a large number of projects is available for students to participate in. These can be NWO and EU research projects, but also capacity development projects that are more consultancy type activities and offer training and advice. Examples are water management projects in Kenya and Ethiopia, urban development research in Rwanda, disaster management research in the Caribbean, Thailand, Indonesia and Nepal, but also agricultural research in Spain or dike strength research in the Netherlands. In these type of large projects, there is a close cooperation with local counterparts from governments and academic institutes, and they are often funded by UN level organizations (with their own policy and coordination requirements). It is relatively common for MSc students to participate in these projects, keeping in mind that the MSc research work should be of a high scientific standard. An overview of current project services can be found at the ITC website.

- Case studies
- Common
- Academic and research phase
- Internship project

Q1	Q2	Q3	Q4
Food and Water Security in Iran	Data Mastery	Climate transition in the IJssel delta	Academic and Research Phase
Skill Learning Lines: Academic skills	Data Mastery Challenge *3 EC*		International Module Y1
Skill Learning lines: International and Intercultural skills	Scientific Geocomputing *7 EC*		Academic Skills
Skill Learning Lines: Project management and team building			

55 EC / 60

Q5	Q6	Q7	Q8
Internship Project	Internship Project	Internship Project	Internship Project
Academic and Research Phase	Academic and Research Phase	Academic and Research Phase	Academic and Research Phase

55 EC / 60

TEACHING PERIOD

The two-year programme (120 EC), is built up out of 4 quartiles per year of each 10 weeks (15 EC). The programme starts around the 1st of September and the 4th quartile ends in July.

Period	**Time**
1st period	08:45 - 10:30
	Coffee/tea break
2nd period	10:45 - 12:30
	Lunch break
3rd period	13:45 - 15:30
	Coffee/tea break
4th period	15:45 - 17:30

EVENTS, HOLIDAYS AND BREAKS

ACADEMIC CALENDAR 2024-2025

FIRST & SECOND SEMESTER BSC AND MSC

Centre for Educational Support
July 2024

	week number	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5
	week type	ML	ML	ML	ML	ML	ML	ML	ML	ME	MAE	ML	ML	ML	ML	ML	ML	H	H	ML	ML	ME	MAE
	Quartile-week	1-01	1-02	1-03	1-04	1-05	1-06	1-07	1-08	1-09	1-10	2-01	2-02	2-03	2-04	2-05	2-06			2-07	2-08	2-09	2-10
1E SEMESTER	Monday	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	Bridging Day 30	6	13	20	27
	Tuesday	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	Bridging Day 31	7	14	21	28
	Wednesday	4	11	18	25	2	9	16	23	30	6	13	Online OD 20	27	4	11	18	Public Holiday 25	Public Holiday 1	8	15	22	29
	Thursday	5	12	19	26	3	10	17	24	31	7	14	Master OD 21	28	5	12	19	Public Holiday 26	2	9	16	23	30
	Friday	6	13	20	27	4	11	18	BSC OD 22	1	8	15	22	29	6	13	20	Bridging Day 27	3	10	17	24	31
	Saturday	07-09	14-09	21-09	28-09	05-10	12-10	19-10	26-10	02-11	09-11	16-11	23-11	30-11	07-12	14-12	21-12	28-12	04-01	11-01	18-01	25-01	01-02
	Sunday	08-09	15-09	22-09	29-09	06-10	13-10	20-10	27-10	03-11	10-11	17-11	24-11	01-12	08-12	15-12	22-12	29-12	05-01	12-01	19-01	26-01	02-02

	week number	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	week type	ML	ML	H	ML	ML	ML	ML	ML	ML	ME	MAE	ML	ML	ML	ML	ML	ML	ML	ML	X	ME	MAR
	Quartile-week	3-01	3-02		3-03	3-04	3-05	3-06	3-07	3-08	3-09	3-10	4-01	4-02	4-03	4-04	4-05	4-06	4-07	4-08	4-09	4-10	4-11
2E SEMESTER	Monday	Kick In 3	10	17	24	3	10	17	24	31	7	14	Public Holiday 21	28	Public Holiday 5	12	19	26	2	Public Holiday 6	16	23	30
	Tuesday	Kick In 4	11	18	25	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1
	Wednesday	5	12	19	26	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2
	Thursday	6	Region WD Day 13	20	27	6	13	Master OD 20	27	3	10	17	24	1	8	15	22	Public Holiday 25	5	12	19	26	3
	Friday	7	14	21	28	7	14	BSC OD 21	28	4	11	Public Holiday 18	25	2	9	16	23	Bridging Day 26	6	13	20	27	4
	Saturday	08-02	15-02	22-02	01-03	08-03	15-03	22-03	29-03	05-04	12-04	19-04	26-04	03-05	10-05	17-05	24-05	31-05	07-06	14-06	21-06	28-06	05-07
	Sunday	09-02	16-02	23-02	02-03	09-03	16-03	23-03	30-03	06-04	13-04	20-04	27-04	04-05	11-05	18-05	25-05	01-06	08-06	15-06	22-06	29-06	06-07

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ACADEMIC CALENDAR 2024-2025

FIRST & SECOND SEMESTER BSC AND MSC

Centre for Educational Support
July 2024

SUMMERPERIOD

	week number	28	29	30	31	32	33	34	35
	week type	SAS	SAS	SAR	H	H	H	H	H
SUMMER	Monday	7	14	21	28	4	11	18	25
	Tuesday	8	15	22	29	5	12	19	26
	Wednesday	9	16	23	30	6	13	20	27
	Thursday	10	17	24	31	7	14	21	28
	Friday	11	18	25	1	8	15	22	29
	Saturday	12-07	19-07	26-07	02-08	09-08	16-08	23-08	30-08
	Sunday	13-07	20-07	27-07	03-08	10-08	17-08	24-08	31-08

BSc	MSc
M = Module education including exams	L = Lectures and other
X = extra week compensation for holidays	E= exam
H = Holidays	
X = extra week compensation for holidays	
Faculty Day Kick-In education free	
Open Day/ No lectures	
A= Addition for finishing modules	R = Resits MSc
S/A = Self-study for Addition or Resits for finishing modules	S = Self-study for resits

For examinations and resits in Q4 and summer the following applies

- Week 26: regular Msc examinations for courses in the fourth quartile.
- Week 27: resits for courses in the third quartile (and possible sooner) for (4TU-) master courses & regular Bsc examinations & project grading.
- Week 30: resits for courses in the quartiles and finishing Bsc modules.

Summer holiday region North: 12 July until 24 August 2025

N.B. This Academic calendar is the basis for the annual planning. The dean can by exception decide to make a change in the weeks 28 - 35. The involved students must be timely informed about this—no written or digital examinations during the Kick-In in week 35.

UNIVERSITY OF TWENTE.

ROLES WITHIN THE CURRICULUM

Confidential Advisor
The Faculty ITC is a strong, vibrant community that consists of people from all over the world. We expect all members of our community to respect the diversity of all students and staff. The Confidential Advisor plays an essential role in the faculty's response to harassment concerns. If you are affected by undesirable behaviour, such as bullying, aggression and unwanted sexual advances, you can turn to the confidential advisor for help, support and advice. The advisor is authorized to receive complaints and will treat information discreetly and privately. You can find the Confidential Advisor, Ms. Annemarie Arets-Meulman, in room 1-164 from Monday - Friday 09:00-14:00 and/or you can send an e-mail to confidentialadvisor- itc@utwente.nl

Education Support Office
The Education Support Office provides administrative and logistic support during the execution of the programme and courses and assists the Programme Management and Study Unit Coordinators. The Education Support Office is the first point of contact for students requiring information regarding the course.

Examination Board
The Examination Board is the body which determines autonomously and objectively whether a student satisfies the conditions that the Education and Examination Regulations set on the knowledge, understanding and skills needed to obtain an MSc degree or Certificate.

Examiner
The individual who has been appointed by the Examination Board in accordance with Article 7.12c of the WHW to hold exams and tests and determine their results.

Mentor
The faculty member who offers academic guidance to a student.

Personal Development Plan and Portfolio
The digital environment in which the student keeps his/her personal plans, progress and reflections during the study in the M-SE (abbreviated as PDP).

Programme Committee
As referred to in Article 9.18 of the WHW; the Programme Committee is composed of both teacher and student members and approves the EER on specific topics and offers advice on other academic matters (Article 9.18, WHW, and article 12, Faculty Regulations).

Programme Director
Person appointed by the Dean to be the governing head of a Master's programme as defined in Article 9.17 of the WHW. The Programme Director is responsible for the development and quality of the programme (in Dutch this person is called Opleidingsdirecteur or OLD).

Programme Manager
The person who is responsible for the planning and organization of the development and implementation of the Master's programme and derived courses and who assumes the role of study adviser.

Proposal Assessment Board
The Proposal Assessment Board is responsible for the assessment of the MSc Research Proposal.

Student Affairs Officers
ITC Student Affairs Officers provide ITC students with information, advice, and assistance on social, cultural, and medical issues. Occasionally, a student may have a serious problem. Student Affairs officers can help by listening and can advise and guide you on where best to seek assistance. Everything you tell them is treated with strict confidentiality.

Study Adviser
Faculty member appointed by the Dean of the Faculty to act as contact between the student and the programme, and in this role represents the interests of the students, as well as fulfilling an advisory role. The role of Study Adviser is put with the Programme Manager.

Study Unit Coordinator
Each study unit is coordinated by a staff member of the Scientific Department. He is responsible for the organization and execution of the entire study unit, and is first point of contact for staff and students when questions arise.

Supervisor
All Master's programme students will be assigned to a Supervisor for the development of their MSc Research proposal and the execution of their MSc Research.

Tutor
A staff member who coaches a student group during the case study project.

Thesis Assessment Board
The Thesis Assessment Board is responsible for the assessment of the MSc Research exam at the end of the Master's programme.

PROGRAMME LEARNING OUTCOMES (FINAL QUALIFICATIONS)

The worldwide challenges that are the work field of the Spatial Engineer are often called ‘wicked’ problems because at face value, they seem unsolvable. The programme wants to enable the graduate addressing ‘wicked’ problems by, using the core knowledge areas of Technical Engineering, Spatial Information Sciences and Spatial Planning and Governance, applying scientifically sound spatio-temporal analysis and the development of models, taking into account socio-environmental drivers of system Earth and conducting research projects in an international and multidisciplinary team. At successful completion of the Master’s programme Spatial Engineering, the student has reached the following final qualifications:

Is an expert in integrated knowledge development of technical engineering, spatial information science and spatial planning for governance.

1. The graduate has a sufficient knowledge of the theory and principles of technical engineering and environmental processes, spatial information science and spatial planning and governance related to policy goals of resilience, sustainability and legitimacy. The graduate is capable of creating added value by combining the disciplines in analysis. The graduate can independently identify his/her knowledge gaps and can revise and extend his/her own knowledge through study.

Does research in a purposeful and methodological way.

2. The graduate can independently develop new knowledge in a purposeful and methodical way while dealing with ‘wicked’ societal problems and take into account the system boundaries. He/she can contribute to scientific knowledge in the Spatial Engineering knowledge base by collecting, processing, analysing and visualising data to produce and validate information in a logical way. The graduate can assess research on its scientific value taking into account scientific quality issues

Can design context specific and appropriate interventions for sustainable development

3. The graduate can design interventions and scenarios that balance possible solutions between technical possibilities and genuine interests of the parties involved. He/she can adapt and steer the design process taking into account changing external requirements and new information, involving stakeholders in various stages in this process. The graduate can evaluate and justify design decisions, in a systematic and reproducible manner.

Has an academic approach to the development, justified use and validation of theories and models.

4. The graduate can compare, justify choices and identify possible improvements in state-of-the-art knowledge, theories and methods. He/she can use, develop and validate models; consciously choosing between different modelling techniques for spatiotemporal processes, while accounting for socio-environmental drivers. The graduate can evaluate the impact of scientific and quality issues on the suitability of interventions. He/she can document, reproduce and publish the results of research and design according to scientific standards

Is competent in reasoning, reflection, and judgment.

5. The graduate can reflect on his/her own arguments and decisions and adjust these on the basis of this reflection. The graduate can operationalise theoretical concepts and develop research questions. The graduate can analyse the completeness, uncertainty and lineage of data

Is competent in cooperation and communication.

6. The graduate can function in different disciplinary contexts; communicate on different levels and has awareness of different perspectives from different scientific backgrounds. He/she can engage effectively in productive teamwork in a variety of roles in diverse teams, applying project management methods. The graduate can convey information and ideas effectively using written, oral, visual and graphical tools. The graduate can present the results of scientific work, including the underlying knowledge, choices and considerations, to peers and to different audiences.

Can work internationally as a global citizen and as an empathic engineer.

7. The graduate can evaluate the impact and sustainability of an intervention and/or design in various governance contexts. The graduate has professional skills and awareness of ethical values needed to work in international and multicultural teams and environments and as an empathic engineer who aspires to social justice

TEACHING AND LEARNING APPROACH

Spatial Engineering is special in various ways. Throughout the programme students will notice the student-centeredness; the road towards achieving the MSc degree will be designed by the student. There is a large group of dedicated and highly motivated teachers to support the student during their journey. Any student will have lots of opportunities to develop not only the multidisciplinary knowledge for designing a sustainable future but also to acquire the skills to be able to work in international projects with team members from different backgrounds and nationalities.

A multidisciplinary approach is required, because worldwide challenges require an acute awareness of the way technological and engineering solutions function within diverse and increasingly complex societal, political, economic and cultural contexts. Rapid developments in the world demand a sustainable approach in how we plan and change our living environment. Good engineers need to be able to design multiple solutions together with stakeholder groups, while at the same time they must be flexible and creative in searching and obtaining data, information, and resources to ensure the success of their project. Drawing from multiple disciplines enables the Spatial Engineer to structure and redefine problems beyond the obvious frames and reach solutions based on a new understanding of complex situations and 'wicked' problems. Moreover, engineers today cannot wait for problems to be formulated for them to solve. They need the skills to engage with various stakeholders to help them frame and define the problems in a way that allows successful solution design. Not only that, many organizations that drive developments, such as the World Bank, UN organizations and national governments, promote and foster capacity development with a focus on analytical, reflective and interactional skills in diverse environments.

Therefore, a curriculum is designed where four elements are brought together:
Integrated approach
- Integration of knowledge, tools and methods of different sciences
- Multidisciplinary group composition

Student-centred learning
- Self-direct learning, learning by doing, learning by questioning

Lifelong learning
- Work-related learning skills
- Flipped classroom, e-learning, virtual learning environment

Internationalization
- International learning environment, diversity in student and teachers

In the first year of the Master's Programme Spatial Engineering, students will work on three case study projects to develop (in a scientific way) sustainable interventions to help solve a certain problem.

The core teaching concept is project-led education (PLE); all four vision elements mentioned above are applied in case study projects. This is achieved by a deliberate design of the projects and scaling between completely student-centred learning and project-driven teaching. The final qualifications guide this process. We see a project as an activity in which a group of students collaborate to develop and apply new knowledge, skills and attitudes by solving a (design) problem within a set of boundaries and conditions. In project-led education the project is central and leading in the study units. Project-led education will be partly assessed as a group effort and partly based on individual performance. Both concepts, project-led education as well as group learning, require from the student the ability to pose questions and learn by questioning, to go beyond the obvious and find out what is causing the problem and how scientific knowledge can help to solve the problem.

The Personal Development Portfolio shows how the student integrates the student-centred and lifelong learning in the international environment towards achieving their vision for being a Master in Spatial Engineering. Students provide insight into their study choices, participation and progress. The Personal Development Portfolio contains the personal development plan for the different study units, the choices they made on courses to follow, specific knowledge gained in courses and project execution, development on skills learning lines, and reflection on project and learning process. The mentor and tutor will guide the student in developing the Personal Development Portfolio and keep track of progress and completeness. Students become eligible to take the oral test when the Personal Development Portfolio is assessed complete and forwarded to the assessors. After the oral test, the students receive feedback on the Personal Development Portfolio and the case study project assessment.

SOURCES OF INFORMATION

STUDY GUIDE IN DIGITAL FORMAT
www.itc.nl/studyguide

EDUCATION AND EXAMINATION REGULATIONS AND RULES AND REGULATIONS OF THE EXAMINATION BOARD
www.itc.nl/regulations

FACULTY ITC
www.itc.nl

UNIVERSITY OF TWENTE
www.utwente.nl/en

CASE STUDIES

FOOD AND WATER SECURITY IN IRAN

Course	**202300031**
Period	02 September 2024 - 08 November 2024
EC	15
Course coordinator	dr. Y. Dou

INTRODUCTION

How to provide enough food and water to everyone in a sustainable and resilient way remains a grand challenge. In recent years, many people, particularly vulnerable people's food and water security have been hit by major shocks ranging from pandemic, conflicts, erratic weather patterns, earthquakes, droughts, and floods. Climate change is threatening food and water security and intensifying global inequities. Building resilience means helping people to prepare, cope with and recover from shocks and moreover, thrive from the shocks. The terms "food and water security" refer to sustainable access to sufficient food and water to meet the needs and personal/cultural preferences for sustaining livelihoods at all times. For part of the population, this access can be ascertained by buying food, which is sometimes transported over large distances. For example, in the Netherlands we can buy fruits year-round that are sourced from places as far as New Zealand and Chile, and even our livestock enjoys South-American soy. However, the demands of a growing global population are increasingly hard to meet by the finite natural resources. Unsustainable use of resources may result in land degradation or groundwater depletion while global challenges like climate change puts food and water security for the global population in jeopardy. Particularly in regions with limited water availability, and where people rely largely on locally-produced food, competing claims and conflicts may arise between stakeholders on how to share resource access and use. Weather impacts may intensify such conflicts, as for example water availability and food production will be lower in years of drought.

During this quartile you will explore the sustainability and resilience concepts using food and water security in detail in a case study. It will be the group's task to first understand the challenges related to food and water security in the chosen area. This comprises an analysis of the various stakeholders and how these are affected by the identified challenges. Based on this overview, and using a Problem-tree framework, the group then chooses to focus on a specific challenge/problem and develops an intervention. A good rationale is required of how the envisaged intervention improves the food and/or water security for specific stakeholders (*that is: how will the intervention help solve the problem*), and assess the social/economic/technical feasibility of the intervention

CONTENT

The content that will be offered in this project consists of group work, keynote lectures, choice topics, and tutorials. Regarding the choice topics, three out of six available choice topics need to be selected. The students need to identify if and how the acquired knowledge can be used for the project. It is encouraged that different members of a group follow different choice topics, although not each topic needs to be covered by the group. Furthermore we note that the choice topics may be considered as a starting point (introduction), but as part of the group project and self-study, students are encouraged to apply and deepen their knowledge/skills. This can be reflected in the Personal Development Plan, and will be an element of the oral test.

Six choice topics are provided:

Week 1:

- SIS 1 Intro to remote sensing
- SPG 1 Spatial financing

Week 2:

- SIS 2 Fundamentals of Geospatial Science
- TE 1 Crop suitability modeling

Week 3:

- TE 2 Drought monitoring and statistics
- SPG 2 Spatial Multi-criteria evaluation

The tutorials on offer in case study project 1 provide complementary knowledge that can be applied to the case studies. Mini-lectures and self-explanatory exercises are typical educational formats of the tutorials. Student groups are themselves largely responsible for the application to their case. The following tutorials have been selected:
TU1: Stakeholder analysis
TU2: Visualization
TU3: Video making skills

TEACHING AND LEARNING APPROACH

The teaching and learning approach will follow the general approach as described for the case study projects in the Spatial Engineering programme. Student groups are expected to become independent and put a strong effort themselves to search for literature and spatial data. For the case study there will be a short description, and ITC staff can help to identify and contact resource persons. Students are encouraged to partially rely on freely-available global data layers. In that sense, we specifically encourage the use of multi-temporal satellite data in the projects.

TESTS

The final grade for case study project 1 is composed of four separate summative assessments. These include two group-based assessments (no resit) and two individual assessments (one resit possible), which contribute for respectively 40 % and 60 % to the final grade.

The two group-based assessments are:

- the *mid-term proposal* (weight: 15 % of the final grade) submitted by student teams in week 6;
- the *final video* (weight: 25 % of the final grade) submitted by student teams at the end of week 9.

Detailed instructions for the mid-term proposal and the final video can be found in the Assignment document. Both the mid-term proposal and the final video can be "repaired"; this means that if the initial mark is below 6 it is possible to improve the submission. If this is the case, the maximum grade will be 6.

The two individual assessments are:

- A *written test* (weight: 20 % of the final grade) on the theory taught during the selected choice topics at the start of week 5 and the resit takes place in week 10. The grade of choice topics is the average score of the three choice topics one follows in weeks 2-4.
- An *oral test* (weight: 40 % of the final grade) on the entire learning process during the case study project. This test will take place in week 10.

In addition, you will need to submit **Personal Development Plan (PDP)** before your oral test. It is not counted towards the final grade but the oral test is largely based on your reflection in this report.

ENTRY REQUIREMENTS

Requirement for M-SE program

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 find and use scientific literature to review and summarize the processes (ecological, social, economic) that influence food and water security in the case study area, adhering to proper referencing

LO 2 translate an identified problem under LO1 into a plan for an interdisciplinary research project, containing research questions that lead to an improved understanding of the problem and that can help to define promising interventions

LO 3 make an inventory of available spatial and non-spatial data sources (either provided or open access), reflect on their suitability for analyzing the problem and defining interventions

LO 4 design in a systematic manner an intervention that improves the food and/or water security for specific stakeholders, and assess the social/economic/technical feasibility of the intervention

LO 5 find, evaluate, and apply relevant methods for data analysis to effectively respond to the research questions

LO 6 use appropriate methods for identifying stakeholders; analyze their perspectives on the problem and involving these in the intervention design

LO 7 effectively communicate and discuss the results of the analysis and intervention

LO 8 define a Personal Development Plan and translate this into a Portfolio with the aim of 1) building up knowledge and skills throughout the case study project, and 2) reflect and improve own role as a team member and professional.

LO 9 reflect on how the stakeholders' cultural background may affect the acceptance of the proposed intervention

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	70
Supervised practical	70
Individual assignment	34
Group assignment	162
Self-study	80
Written/oral test	4

TESTPLAN

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Mid-term proposal**	**Final video**	**Choice topic written test**	**Oral test**	**Personal Development Portfolio**
LO 1	find and use scientific literature to review and summarize the processes (ecological, social, economic) that influence food and water security in the case study area, adhering to proper referencing	●	●	●	●	
LO 2	translate an identified problem under LO1 into a plan for an interdisciplinary research project, containing research questions that lead to an improved understanding of the problem and that can help to define promising interventions	●			●	
LO 3	make an inventory of available spatial and non-spatial data sources (either provided or open access), reflect on their suitability for analyzing the problem and defining interventions	●		●	●	
LO 4	design in a systematic manner an intervention that improves the food and/or water security for specific stakeholders, and assess the social/economic/technical feasibility of the intervention		●		●	
LO 5	find, evaluate, and apply relevant methods for data analysis to effectively respond to the research questions	●	●	●	●	
LO 6	use appropriate methods for identifying stakeholders		●		●	
LO 7	effectively communicate and discuss the results of the analysis and intervention		●		●	

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Mid-term proposal**	**Final video**	**Choice topic written test**	**Oral test**	**Personal Development Portfolio**
LO 8	define a Personal Development Plan and translate this into a Portfolio with the aim of 1) building up knowledge and skills throughout the case study project, and 2) reflect and improve own role as a team member and professional.				●	●
LO 9	reflect on how the stakeholders' cultural background may affect the acceptance of the proposed intervention				●	●
	Test type	Assignment(s)	Presentation(s)	Written examination	Oral examination	Report
	Weight of the test	15	25	20	40	0
	Individual or group test	Group	Group	Individual	Individual	Individual
	Type of marking	1-10	1-10	1-10	1-10	Pass/Fail
	Required minimum mark per test					
	Number of test opportunities per academic year					

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	find and use scientific literature to review and summarize the processes (ecological, social, economic) that influence food and water security in the case study area, adhering to proper referencing	●						
LO 2	translate an identified problem under LO1 into a plan for an interdisciplinary research project, containing research questions that lead to an improved understanding of the problem and that can help to define promising interventions		●					
LO 3	make an inventory of available spatial and non-spatial data sources (either provided or open access), reflect on their suitability for analyzing the problem and defining interventions		●					
LO 4	design in a systematic manner an intervention that improves the food and/or water security for specific stakeholders, and assess the social/economic/technical feasibility of the intervention			●				
LO 5	find, evaluate, and apply relevant methods for data analysis to effectively respond to the research questions				●			

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 6	use appropriate methods for identifying stakeholders				●			
LO 7	effectively communicate and discuss the results of the analysis and intervention					●		
LO 8	define a Personal Development Plan and translate this into a Portfolio with the aim of 1) building up knowledge and skills throughout the case study project, and 2) reflect and improve own role as a team member and professional.						●	
LO 9	reflect on how the stakeholders' cultural background may affect the acceptance of the proposed intervention							●

SKILL LEARNING LINES: ACADEMIC SKILLS

Course	**123**
Period	02 September 2024 - 08 November 2024
Course coordinator	dr. C.L. de Boer

INTRODUCTION

The academic skills learning line has an important place in the curriculum and is an integral part of the final qualifications. Of particular relevance it supports

FQ 2:Does research in a purposeful and methodological way

FQ 4:Has an academic approach to the development, justified use and validation of theories and models

FQ 5:Is competent in reasoning, reflection, and judgment

FQ 6:Is competent in cooperation and communication

In the academic skills learning line we focus on developing the skills that students will need to succeed in this master program as well as their future careers. These include skills related to the structuring, organising, and communication of their academic work and ideas.
For the academic skills learning line an expert teacher is responsible for ensuring a coherent incremental education programme over the course of the Spatial Engineering curriculum. In each case study project students will draw on these skills learning lines.
The study load for the academic skills learning lines is estimated at 14 hours per quartile for the first 3 quartiles.

CONTENT

In this case study project the student will be learning about:

Basic information skills:
Formulating a search strategy to find relevant academic literature;
Using a defined format (e.g. APA 6th) for handling citations and references; Creating a personal information structure for literature;

Structured Technical Writing

Writing Structure

Argumentation

Proper Use of Language

TEACHING AND LEARNING APPROACH

Concepts are first introduced in lecture form, whereafter students are given opportunities for application and formative feedback during a hands-on workshop.

TESTS

Skills learning lines form an integral part of the case study project, and will be assessed throughout the regular case study project assessments. The skills learning line Academic and Research Skills is not directly assessed, however it is indirectly assessed through the various assignments during the case study project. Formative feedback is given related to the topics covered in the sessions for academic skills in the quartile

ENTRY REQUIREMENTS

Personal Plan for Development needs to be completed during the first weeks and the goals for Academic skills need to be included. This will help the student navigate the material delivered in this skill learning line.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Apply basic information skills to find and manage scientific literature relevant for the case study

LO 2 Apply rapid and deep reading skills to select and extract information from literature for the case study.

LO 3 Define research objectives and related questions suitable for the case study topic

LO 4 Create a logical structure for reporting which shows the most important elements of the research.

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
	0
Lecture	6
Self-study	8

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	**1**	**2**	**3**	**4**	**5**	**6**	**7**
LO 1	Apply basic information skills to find and manage scientific literature relevant for the case study		●					
LO 2	Apply rapid and deep reading skills to select and extract information from literature for the case study.		●					
LO 3	Define research objectives and related questions suitable for the case study topic		●		●	●		
LO 4	Create a logical structure for reporting which shows the most important elements of the research.		●		●	●	●	

SKILL LEARNING LINES: INTERNATIONAL AND INTERCULTURAL SKILLS

Course	1234
Period	02 September 2024 - 08 November 2024
Course coordinator	dr. M.N. Lengoiboni

INTRODUCTION

The skills learning lines have an important place in the curriculum and are an integral part of the final qualifications (especially the 1st , 6th and 7th). There are three skills learning lines:

1. **International and Intercultural Competences**
2. **Academic and Research Skills**
3. **Project Management and Teamwork Skills**

For each of the skills learning lines an expert teacher is responsible for ensuring a coherent incremental education programme over the course of the Spatial Engineering curriculum. In each case study project students will need to draw on these skills learning lines.

The study load for the three skills learning lines for this quartile is estimated at a total of 42 hours, 14 hours each.

International and Intercultural Competences are indispensable for spatial engineers tackling wicked problems around the world, in international groups consisting of professionals from various political and social cultures and with various disciplinary backgrounds, rooted in technical and social sciences.

CONTENT

In Q1, the student will learn about how cultures influence communication and collaboration; and how to suggest a solution to a policy problem by making use of cultural theory.

TEACHING AND LEARNING APPROACH

Lectures, supervised practical and self-study.

TESTS

Skills learning lines form an integral part of the case study project, and will be assessed throughout the regular case study project assessments. The most important aspects of this quartile for this learning line are described below.

A 500 words essay, to be submitted together with the PDP, about your own (worst) experience in a foreign country or in an intercultural environment, but now taking into account the aspects: (1) beliefs and values and (2) relation between beliefs, values and behaviour.

How the essay will be marked:

Excellent= reference is made to aspects 1+2+3,

Good= reference is made to aspects 1 and 2 only,

Weak = no reference to any of the three aspects.

ENTRY REQUIREMENTS

NA

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Recognize the influence of own cultural background on communication in an intercultural environment

LO 2 Distinguishing observable from hidden aspects of culture; linking values to behaviour; distinguishing between universal, cultural and personal behaviours

LO 3 Recognize the influence of cultural communication styles on policy problem structuring

LO 4 Recognize dominant cultural biases in policy problem structuring and solution strategies Which were the dominant cultural bias(es).

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	4
Self-study	4
Supervised practical	3
Individual assignment	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	**1**	**2**	**3**	**4**	**5**	**6**	**7**
LO 1	Recognize the influence of own cultural background on communication in an intercultural environment						●	●
LO 2	Distinguishing observable from hidden aspects of culture; linking values to behaviour; distinguishing between universal, cultural and personal behaviours					●		
LO 3	Recognize the influence of cultural communication styles on policy problem structuring			●				●
LO 4	Recognize dominant cultural biases in policy problem structuring and solution strategies Which were the dominant cultural bias(es).			●				●

SKILL LEARNING LINES: PROJECT MANAGEMENT AND TEAM BUILDING

Course	**12345**
Period	02 September 2024 - 08 November 2024
Course coordinator	dr. D. Alkema

INTRODUCTION

The skills learning lines have an important place in the curriculum and are an integral part of the final qualifications (especially the 1st , 6th and 7th). There are three skills learning lines:

1. International and Intercultural Competences
2. Academic and Research Skills
3. Project Management and Teamwork Skills

For each of the skills learning line an expert teacher is responsible for ensuring a coherent incremental education programme over the course of the Spatial Engineering curriculum.

In each case study project students will need to draw on these skills learning lines. The study load for the three skills learning lines is estimated at a total of 42 hours, 14 hours each.

CONTENT

This skill learning line will initially focus on how to work as a team; Through exercises and self-tests the students will reflect on the different roles a member can take when working in a team. The aim is to gain insight into how fellow team members work, that this may be different than you expected, and that this is asset rather than a risk. Later, the students will explore project management tools to structure the problem, to plan activities and to effectively report on the results. These tools include the Problem Tree approach and the Gantt Chart.

TEACHING AND LEARNING APPROACH

Formative feedback during the first week, evaluation meetings and self-study.

TESTS

Skills learning lines form an integral part of the case study project, and will be assessed throughout the regular case study project assessments. The most important aspects of the skills learning line assessments are described below.

Project Management and Teamwork Skills is assessed during periodic team meetings as formative component of the group work, as groups via the reporting (proposal and final video) and individually through the PDP and oral test.

ENTRY REQUIREMENTS

Personal Plan for Development

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Analyzing the problem as stated in the project-outline and to formulate a project plan using the Problem Tree framework

LO 2 Implementing the project plan to achieve the proposed results in time

LO 3 Functioning effectively as a team

LO 4 Identifying personal strengths and points of attention while working in a team

LO 5 Monitoring and evaluating the group’s performance during the project

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Supervised practical	10
Self-study	4

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	**1**	**2**	**3**	**4**	**5**	**6**	**7**
LO 1	Analyzing the problem as stated in the project-outline and to formulate a project plan using the Problem Tree framework	●	●					
LO 2	Implementing the project plan to achieve the proposed results in time						●	
LO 3	Functioning effectively as a team						●	
LO 4	Identifying personal strengths and points of attention while working in a team						●	
LO 5	Monitoring and evaluating the group’s performance during the project					●	●	

CLIMATE TRANSITION IN THE IJSSEL DELTA

Course	**202300033**
Period	03 February 2025 - 18 April 2025
EC	15
Course coordinator	ir. M.J.G. Brussel

INTRODUCTION

The IJsseldelta region, home to some 300000 people, is characterized by a varied landscape with historic cities, towns and villages, centuries-old waterways, and polders. Like other areas in the Netherlands, the IJsseldelta is challenged by the impacts of climate change and the need to transition into a climate-proof region by 2050. This transition can be characterized as a wicked problem. Is it faces many challenges, a major one being the difficulty of embedding climate adaptation goals in existing policy, which is a precondition to realize the interventions needed. Several factors play a role here: A variety of stakeholders are involved that often have conflicting interests; there are multiple demands on scarce space for different functions (agricultural, nature, housing, commercial/industrial); infrastructure and technology are in continuous development; it is unclear who needs to pay for local adaptation measures, and so on.

Against this background, student groups are challenged to work on one or a combination of the following themes: water extremes, heat extremes and energy transition. You are expected to develop policies and spatial interventions under different scenarios and study their impact. Doing so will require complex analyses combining large datasets. The proposed policies and interventions need to be developed in consideration of the views of stakeholders. The societal dimension involves the review of participatory approaches to governance and planning, including new data sources and information channels such as geosocial media, citizen science, and databases made available by government agencies.

CONTENT

The content offered in this project consists of group work, keynote lectures and tutorials. The keynote lectures introduce students to the case study region, the themes of the case study and contemporary scientific debates and state–of–art on these themes. The tutorials, where possible linked to the keynotes, are meant to deepen understanding of methods and will introduce tools that students can use in their project. The tutorials often consist of mini-lectures, demonstrations, self-explanatory exercises, videos, etc. Student groups are responsible for the selection of tutorials and for the application to their case.

The following keynotes are envisaged:

1. The IJsseldelta and the city of Zwolle (local issues, viewpoints, policies)
2. Climate change
3. Climate Economics
4. Dutch governance and the legal system
5. Energy transition
6. Hydrology and water extremes
7. Urban Heat

The following tutorials are envisaged:

1. Co-creation and collaborative decision making
2. Engineering design
3. Hydrological modeling and flood modeling
4. Urban Heat modeling
5. Data collection with a mobile device

TEACHING AND LEARNING APPROACH

The teaching and learning approach will follow the general approach as described for the case study projects in the Spatial Engineering programme. Student groups are expected to choose their theme of interest and develop their project work in an independent manner and put a strong effort themselves to search for literature and spatial data. ITC tutors will assist the student groups with the identification and contacting of resource persons and will provide guidance on both project process and content.

TESTS

The following tests will form the basis for the assessment:

1. Mid-term poster (20%, group, summative)
2. Policy Brief (30%, group, summative) + technical annex (10%, individual, summative)
3. Presentation of Policy Brief (group, formative)
4. Oral test (40%, individual, summative)
5. Personal Development Portfolio (individual, formative)

For more information on the assessment details, review the rubrics in the assignment document.

1 Mid-term poster.

At the end of the project inception phase, the project groups will prepare and present a mid-term poster, which should provide, at a minimum, information on the problem understanding, the stakeholders, their objectives and planned interventions and a time plan

2 Policy brief and technical annex

Students are asked to prepare a policy brief, which serves several purposes: to let students summarize in a short and attractive document what they have achieved, to inform the stakeholders, and to form a basis for the presentation.

To accurately assess LO 1, 2 and 3, students are asked to add a technical annex to the policy brief with more details on background, processes, analysis, methods, etc. The technical annex contains an individual component in which students produce a 1-2 page document summarizing their project experience and reflecting on what they have learned.

3 Final policy brief presentation.

This presentation focuses on the interventions and policy proposals that the students have developed. This presentation will take place at the end of week 9. After receiving feedback from the tutors and available stakeholders, the students can still make improvement in the last week. This feedback can also be used by students to prepare for their oral exams. The final policy brief can be submitted on the last day of the course, after the oral exams

4 Oral test

In the oral test, two examiners will ask a series of questions (up to 35 minutes) that focus on the student’s individual learning during the study unit, taking into account all project components, the student's contribution to the project and the skill learning line of internationalization.

5 Personal Development Portfolio

Students are asked to produce a personal development portfolio throughout the whole M-SE programme. The contribution to the PDP in this study unit will focus on (i) the evaluation of a student's own performance and a reflection on the role in the team and (ii) a summary of new experiences and knowledge gained and how these might influence future professional endeavours.

ENTRY REQUIREMENTS

Requirement for the M-SE program

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Describe and explain relevant physical processes, their spatial dimensions, and the associated socio-technical challenges to realize climate transition in the area

LO 2 Collect, process and analyze spatial-temporal data and information required for planned intervention, considering varied sources

LO 3 Reflect on and justify the choice of methods and data, taking into account reproducibility, uncertainty, error propagation, sensitivity, and model robustness

LO 4 Develop an intervention to help achieve climate transition, involving multiple governance perspectives, and systematically evaluating its impact on achieving long-term goals.

LO 5 Convey information and results effectively using written, visual, and oral tools to peers, professionals, and a broader public, in particular considering the spatial context of the problem.

LO 6 Plan a project, formulating SMART objectives and demonstrating project and time management skills

LO 7 Evaluate and reflect on the professional and team roles of project group members, including his/her own

LO 8 Evaluate your experiences and knowledge gained in Q3 and use this to update your Personal Development Portfolio

LO 9 Evaluate and account for own cultural sensitivity and cultural values in project process and outcomes

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	0
Supervised practical	0
Individual assignment	0
Group assignment	0
Self-study	0
Written/oral test	0

TESTPLAN

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Mid-term poster**	**Final Policy Brief and Presentation**	**Oral test**	**Personal Development Portfolio**	**Technical Annex**
LO 1	Explain relevant physical processes, their spatial dimensions, and the associated socio-technical challenges to realize climate transition in the area			●		●
LO 2	Collect, process and analyze spatial-temporal data and information required for planned intervention, considering varied sources			●		●
LO 3	Reflect on and justify the choice of methods and data, taking into account reproducibility, uncertainty, error propagation, sensitivity, and model robustness			●		●
LO 4	Develop an intervention to help achieve climate transition, involving multiple governance perspectives, and systematically evaluating its impact on achieving long-term goals.		●	●		
LO 5	Convey information and results effectively using written, visual, and oral tools to peers, professionals, and a broader public, in particular considering the spatial context of the problem.	●	●			
LO 6	Plan a project, formulating SMART objectives and demonstrating project and time management skills	●				
LO 7	Evaluate and reflect on the professional and team roles of project group members, including his/her own				●	

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Mid-term poster**	**Final Policy Brief and Presentation**	**Oral test**	**Personal Development Portfolio**	**Technical Annex**
LO 8	Evaluate your experiences and knowledge gained in Q3 and use this to update your Personal Development Portfolio				●	
LO 9	Evaluate and account for own cultural sensitivity and cultural values in project process and outcomes			●		
	Test type	Presentation(s)	Presentation(s)	Oral test	Assignment(s)	
	Weight of the test	10	20	40	0	30
	Individual or group test	Group	Group	Individual	Individual	Group
	Type of marking	1-10	1-10	1-10	Pass/Fail	1-10
	Required minimum mark per test	5.5	5.5	5.5		5.5
	Number of test opportunities per academic year	1	1	2		1

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Explain relevant physical processes, their spatial dimensions, and the associated socio-technical challenges to realize climate transition in the area	●						
LO 2	Collect, process and analyze spatial-temporal data and information required for planned intervention, considering varied sources		●		●			
LO 3	Reflect on and justify the choice of methods and data, taking into account reproducibility, uncertainty, error propagation, sensitivity, and model robustness		●		●	●		
LO 4	Develop an intervention to help achieve climate transition, involving multiple governance perspectives, and systematically evaluating its impact on achieving long-term goals.			●				
LO 5	Convey information and results effectively using written, visual, and oral tools to peers, professionals, and a broader public, in particular considering the spatial context of the problem.						●	
LO 6	Plan a project, formulating SMART objectives and demonstrating project and time management skills						●	

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 7	Evaluate and reflect on the professional and team roles of project group members, including his/her own					●		●
LO 8	Evaluate your experiences and knowledge gained in Q3 and use this to update your Personal Development Portfolio							
LO 9	Evaluate and account for own cultural sensitivity and cultural values in project process and outcomes							●

COMMON

INTERNATIONAL MODULE Y1

Course	**202300152**
Period	21 April 2025 - 30 May 2025
EC	8
Course coordinator	dr.ir. W. Bijker

INTRODUCTION

The international module aims to provide different views on the knowledge fields and provide students with ideas for the types of organisations for their internship or later job. Therefore, the module contains an international excursion to several (European) institutes and companies, and/or videoconferences with organisations in- and outside Europe, relevant to the knowledge fields of Spatial Engineering. Care will be taken to have a good mix of research organisations, governmental organisations and private companies, to provide different views on the knowledge fields and different possible working environments. Before and after the excursion the last workshops of the skills learning line International and Intercultural Competences will be organised, to reflect on the ethical aspects of spatial engineering and on working in international and multicultural teams.

CONTENT

The second and third week of the module contain an excursion and/or a series of videoconferences, during which we will visit several European institutes and companies in the knowledge fields of Spatial Engineering and/or have videoconferences with organisations in- and outside Europe. Staff will organise the logistics and ask the host organizations to show at least one concrete project in the field of Spatial Engineering, while students are in charge of preparing content.

The preparation for the visits will be done in the first week of the module. The organisations which will be visited during the excursion or via videoconference will be distributed over the students. Each student will prepare for the visit to one host organisation. Preparation includes obtaining and going through information on the host organisation and the project or topic, and formulating a number of questions to start the discussion after the presentations. Students should prepare for a discussion with elements of the technical aspects, stakeholder- and governance related questions and ethical dilemmas. The latter can be related to the workshops on ethics which are part of the International and Intercultural Skills learning line. At the end of the first week, each student gives a briefing to prepare the others for the visit to that specific organisation. On the briefing students will receive feedback from peers and teachers. This feedback session is scaffolded by a lecture on feedback giving & receiving building on earlier course elements in preceding quartiles and linking to further elements on feedback as part of academic skills during the second year. Students with inadequate preparation are not allowed to join the excursion and/or videoconferences.

After the excursion and/or videoconferences, each student will summarise the findings and reflect on the content of the visit where he or she prepared for. This should be done in a written report, relating the content of the visit to Spatial Engineering and especially the case study projects. In the last week of the module, students will synthesise their findings in a final group report, in which they compare the organisations visited, and reflect on similarities and differences. Depending on the number of students, there can be multiple groups.

The internationalisation skill learning line finishes in this module with workshops and an essay on geo-ethics.

The International module is also the last module formally requiring a plan and a reflection as part of the PDP.

Attendance of the lectures/workshops and visits to companies is mandatory for the completion of the module.

TEACHING AND LEARNING APPROACH

The module contains a mix of individual and group assignments, with ample incentives for reflection. The student will formulate individual learning goals as part of the PDP. During the individual assignment, each student will prepare for and report on the visit to or videoconference with one host organisation, relating the practise in the projects presented to the field of Spatial Engineering, and especially the case study projects. Reflection is further scaffolded by theory and practise of giving and receiving feedback. In the final report, a group of students will compare and synthesise their findings and reflect together on the similarities and differences between the organisations, to obtain a broader view on the field of Spatial Engineering. In the group reflection, also organisations' approach to ethical aspects and to international, multicultural teams should be included, based on the workshops in the international skills learning line. An individual essay on geo-ethics forms the final assessment in the international skills learning line.Individual reflection on personal lessons learnt is part of the PDP reflection report.

TESTS

- Preparation plan and report of the visit to or videoconference with one host organisation (40%, individual, the preparation part has to be approved (pass/fail) by the teachers to gain access to the actual excursion)
- Personal plan for development as part of PDP (individual, pass/fail access to the actual excursion)
- Final report (30%, group)
- Essay on geo-ethics (30%, individual)
- Reflection on lessons learnt as part of PDP (individual, pass/fail)

ENTRY REQUIREMENTS

Completion of the case study projects in quartiles 1 and 3 of the Master's programme Spatial Engineering.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Identify and describe gaps in own knowledge in a Personal Development Plan and resulting learning objectives for the module.

LO 2 Apply the ‘wicked’ problem framework to the analysis of a problem presented by a host organisation, formulate research questions and find and evaluate scientific knowledge on the project presented by the host organisation, identifying data-, information- and knowledge gaps.

LO 3 Define clear operationalized fact-finding questions on stakes and interests for the host organisation and interact effectively and respectfully with host organisations to obtain information for analyses.

LO 4 Present the results, underlying knowledge, choices and considerations, learnt during the excursion and videoconferences and adhere to giving proper credit and referencing.

LO 5 Reflect on own professional behaviour in the interaction with the host organisation.

LO 6 Participate effectively and share knowledge within the project team, describe role as a team member, reflect on own strengths and weaknesses in working in a team.

LO 7 Reflect on the differences experienced during the excursion, comparing organisations and projects presented during the excursion and videoconferences.

LO 8 Describe own professional skills and awareness of ethical values needed for working in international and multicultural teams and environments and as an empathic engineer who aspires to social justice.

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Study trip	84
Lecture	8
Group assignment	30
Individual assignment	60
Self-study	22

TESTPLAN

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Preparation plan and report of the visit or videoconference**	**Final group report**	**Essay on geo-ethics**	**PDP Plan**	**PDP Reflection**
LO 1	Identify and describe gaps in own knowledge in a Personal Development Plan and resulting learning objectives for the module.				●	●
LO 2	Apply the 'wicked' problem framework to the analysis of a problem presented by a host organisation, formulate research questions and find and evaluate scientific knowledge on the project presented by the host organisation, identifying data-, information- and knowledge gaps.	●	●			
LO 3	Define clear operationalized fact-finding questions on stakes and interests for the host organisation and interact effectively and respectfully with host organisations to obtain information for analyses.	●				
LO 4	Present the results, underlying knowledge, choices and considerations, learnt during the excursion and videoconferences and adhere to giving proper credit and referencing.	●	●			
LO 5	Reflect on own professional behaviour in the interaction with the host organisation.	●				●

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Preparation plan and report of the visit or videoconference**	**Final group report**	**Essay on geo-ethics**	**PDP Plan**	**PDP Reflection**
LO 6	Participate effectively and share knowledge within the project team, describe role as a team member, reflect on own strengths and weaknesses in working in a team.		●			●
LO 7	Reflect on the differences experienced during the excursion, comparing organisations and projects presented during the excursion and videoconferences.		●			
LO 8	Describe own professional skills and awareness of ethical values needed for working in international and multicultural teams and environments and as an empathic engineer who aspires to social justice.			●	●	●
	Test type	Assignment(s)	Assignment(s)	Assignment(s)	Personal Development Portfolio	Personal Development Portfolio
	Weight of the test	40	30	30		
	Individual or group test	Individual	Group	Individual	Individual	Individual
	Type of marking	1-10	1-10	1-10	Pass/Fail	Pass/Fail
	Required minimum mark per test	5.5		5.5		
	Number of test opportunities per academic year	1	1	2	2	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Identify and describe gaps in own knowledge in a Personal Development Plan and resulting learning objectives for the module.	●						
LO 2	Apply the 'wicked' problem framework to the analysis of a problem presented by a host organisation, formulate research questions and find and evaluate scientific knowledge on the project presented by the host organisation, identifying data-, information- and knowledge gaps.		●					
LO 3	Define clear operationalized fact-finding questions on stakes and interests for the host organisation and interact effectively and respectfully with host organisations to obtain information for analyses.			●			●	
LO 4	Present the results, underlying knowledge, choices and considerations, learnt during the excursion and videoconferences and adhere to giving proper credit and referencing.				●	●		
LO 5	Reflect on own professional behaviour in the interaction with the host organisation.						●	

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 6	Participate effectively and share knowledge within the project team, describe role as a team member, reflect on own strengths and weaknesses in working in a team.						●	●
LO 7	Reflect on the differences experienced during the excursion, comparing organisations and projects presented during the excursion and videoconferences.							●
LO 8	Describe own professional skills and awareness of ethical values needed for working in international and multicultural teams and environments and as an empathic engineer who aspires to social justice.							●

ACADEMIC SKILLS

Course	202300164
Period	21 April 2025 - 04 July 2025
EC	2
Course coordinator	dr.ir. T.A. Groen

INTRODUCTION

This course provides students with an opportunity to improve their scientific argumentation and writing skills. It builds upon the knowledge and skills they gained during quartiles 1 through 3. There will be one assignment where you practice your general writing skills by writing a short justification for your intended research proposal. In doing so, you will demonstrate that you are able to find and critically read a number of relevant research publications and use these to help identify a suitable research problem that you may use as a basis for your research proposal development . A critical, scientific attitude and the ability to reflect upon your own work and that of others will be developed through peer review sessions. And we will look at how you are able to absorb feedback of others on your work.

CONTENT

1. Scientific communication:
    - Write a well-structured and logically-argued justification for your research topic according to scientific writing principles
    - Design and produce graphic illustrations (maps, charts, diagrams, etc.) and tables to communicate scientific concepts, data and information
2. Critical reflection
    - Evaluate the work of peers in order to stimulate your learning and skill levels
    - Absorb the feedback you receive
    - Identify your strengths and weaknesses to determine requirements for further academic skill development.

TEACHING AND LEARNING APPROACH

Teaching and learning involves a mix of different types of activities: short lectures, peer-review sessions and self study. Active participation and critical reflection are stimulated.

TESTS

Students will be evaluated on the basis a written assignment (See test plan).

ENTRY REQUIREMENTS

Participation in all mandatory courses in quartile 1 and 3

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Effectively communicate research process and outcomes

LO 2 Critically reflect on their performance in the design and execution of research tasks

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	8
Tutorial	12
Individual assignment	36

TESTPLAN

		Learning Outcomes that are addressed in the test
	Learning outcomes (LO) of the course: The student will be able to...	**Writing Assignment**
LO 1	Effectively communicate research process and outcomes	●
LO 2	Critically reflect on their performance in the design and execution of research tasks	
	Test type	Assignment(s)
	Weight of the test	100
	Individual or group test	Individual
	Type of marking	1-10
	Required minimum mark per test	5.5
	Number of test opportunities per academic year	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Effectively communicate research process and outcomes						●	
LO 2	Critically reflect on their performance in the design and execution of research tasks					●		

Course	20230003211
Period	11 November 2024 - 31 January 2025
EC	10
Course coordinator	dr. F.O. Ostermann

INTRODUCTION

Data handling skills are indispensable for quantitative geospatial analyses in a data-rich environment, where heterogeneous datasets require integration. This course builds on the algorithmic thinking and programming skills acquired in the parallel course on Scientific Geocomputing. It aims to go a step further by presenting participants with a typical challenge encountered by scientists and analysts: To check or expand on a given, prior study wihtout having access to full documentation, data sources, or code.

CONTENT

The course will introduce participants to a range of topics and skills necessary to successfully tackle the challenge:
- reproducibility and replicability in quantitative (geographic information) science
- developing a conceptual analysis workflow
- finding, accessing, retrieving external data sources
- checking and ensuring interoperability of the required data sets
- choosing appropriate form of integrating data sets (e.g., relational database or file system)
- setting up an appropriate data and code sharing mechanism (e.g., public Git repository)
- evaluation and reflection of approach and output

TEACHING AND LEARNING APPROACH

The course will begin with initial lectures on key concepts, while students form groups and choose one of several provided challenges. Such a challenge could take the form of a published paper describing a quantitative geospatial analysis, but for which data and code are not publicly available. The students then choose whether to reproduce the analysis (aiming for the same results to validate the original study) or replicate it (changing input data or methods to support or refute the original study's findings).

During the last weeks of Q2, the student groups will work on their defined challenge mostly independently, with intermittent supervised labs. The output will be the creation of a reproducible package that includes a short report as reflection and documentation, and complete data, code, and outputs. A short presentation at the end of the course completes the student work.

There will be peer-feedback moments, and collaboration between groups is encouraged. Use of internet resources such as Stackoverflow or large language models (LLM) is encouraged but needs to be clearly documented (provenance of code). Use of LLMs for the reflection, evaluation, and documentation is strongly discouraged in the students' own interest, because these tasks train much-needed skills for the MSc research. A more detailed and binding policy will be made available at the start of the course.

TESTS

The assessment consists of two parts: first, a technical report containing the documentation and evaluation of the group project work plus a reproducible data/code package; second, ongoing engagement in class and group work plus a short individual reflection report at the end of the course. In case of an insufficient grade, a repair to reach a pass is possible.

ENTRY REQUIREMENTS

Participation in the Scientific Geocomputing course.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Develop a conceptual analysis workflow and data management and sharing plan

LO 2 Share a reproducible package of the implemented workflow, containing all required data and code and sufficient documentation

LO 3 Reflect on approach and implementation, and evaluate the degree of success of reproduction or replication

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Group assignment	56
Lecture	14
Supervised practical	14

TESTPLAN

		Learning Outcomes that are addressed in the test	
	Learning outcomes (LO) of the course: The student will be able to...	**Final report**	**Individual reflection**
LO 1	Develop a conceptual analysis workflow and data management and sharing plan	●	
LO 2	Share a reproducible package of the implemented workflow, containing all required data and code and sufficient documentation	●	
LO 3	Reflect on approach and implementation, and evaluate the degree of success of reproduction or replication	●	●
	Test type	Report	Assignment(s)
	Weight of the test	90	10
	Individual or group test	Group	Individual
	Type of marking	1-10	1-10
	Required minimum mark per test		
	Number of test opportunities per academic year	2	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Develop a conceptual analysis workflow and data management and sharing plan	●	●	●	●			
LO 2	Share a reproducible package of the implemented workflow, containing all required data and code and sufficient documentation	●	●	●			●	
LO 3	Reflect on approach and implementation, and evaluate the degree of success of reproduction or replication					●	●	●

DATA MASTERY CHALLENGE

Course	**202300032**
Period	11 November 2024 - 31 January 2025
EC	3
Course coordinator	dr. F.O. Ostermann

INTRODUCTION

Data handling skills are indispensable for quantitative geospatial analyses in a data-rich environment, where heterogeneous datasets require integration. This course builds on the algorithmic thinking and programming skills acquired in the parallel course on Scientific Geocomputing. It aims to go a step further by presenting participants with a typical challenge encountered by scientists and analysts: To check or expand on a given, prior study wihtout having access to full documentation, data sources, or code.

CONTENT

The course will introduce participants to a range of topics and skills necessary to successfully tackle the challenge:
- reproducibility and replicability in quantitative (geographic information) science
- developing a conceptual analysis workflow
- finding, accessing, retrieving external data sources
- checking and ensuring interoperability of the required data sets
- choosing appropriate form of integrating data sets (e.g., relational database or file system)
- setting up an appropriate data and code sharing mechanism (e.g., public Git repository)
- evaluation and reflection of approach and output

TEACHING AND LEARNING APPROACH

The course will begin with initial lectures on key concepts, while students form groups and choose one of several provided challenges. Such a challenge could take the form of a published paper describing a quantitative geospatial analysis, but for which data and code are not publicly available. The students then choose whether to reproduce the analysis (aiming for the same results to validate the original study) or replicate it (changing input data or methods to support or refute the original study's findings).

During the last weeks of Q2, the student groups will work on their defined challenge mostly independently, with intermittent supervised labs. The output will be the creation of a reproducible package that includes a short report as reflection and documentation, and complete data, code, and outputs. A short presentation at the end of the course completes the student work.

There will be peer-feedback moments, and collaboration between groups is encouraged. Use of internet resources such as Stackoverflow or large language models (LLM) is encouraged but needs to be clearly documented (provenance of code). Use of LLMs for the reflection, evaluation, and documentation is strongly discouraged in the students' own interest, because these tasks train much-needed skills for the MSc research. A more detailed and binding policy will be made available at the start of the course.

TESTS

The assessment consists of a short report containing the documentation, evaluation, and individual reflection on contributions, and a reproducible data/code package. There will be no second test opportunity, but a repair to reach a pass is possible.

ENTRY REQUIREMENTS

Participation in the Scientific Geocomputing course.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Develop a conceptual analysis workflow and data management and sharing plan

LO 2 Share a reproducible package of the implemented workflow, containing all required data and code and sufficient documentation

LO 3 Reflect on approach and implementation, and evaluate the degree of success of reproduction or replication

TESTPLAN

		Learning Outcomes that are addressed in the test
	Learning outcomes (LO) of the course: The student will be able to...	**Final report**
LO 1	Develop a conceptual analysis workflow and data management and sharing plan	●
LO 2	Share a reproducible package of the implemented workflow, containing all required data and code and sufficient documentation	●
LO 3	Reflect on approach and implementation, and evaluate the degree of success of reproduction or replication	●
	Test type	Report
	Weight of the test	100
	Individual or group test	Group
	Type of marking	1-10
	Required minimum mark per test	
	Number of test opportunities per academic year	1

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Develop a conceptual analysis workflow and data management and sharing plan	●	●	●	●			
LO 2	Share a reproducible package of the implemented workflow, containing all required data and code and sufficient documentation	●	●	●			●	
LO 3	Reflect on approach and implementation, and evaluate the degree of success of reproduction or replication					●	●	●

SCIENTIFIC GEOCOMPUTING

Course	**201800280**
Period	11 November 2024 - 31 January 2025
EC	7
Course coordinator	dr.ir. R.A. de By

INTRODUCTION

Recent advancements in information-gathering technologies have resulted in the production of high volume, diverse and versatile spatial data. Satellite imagery, Unmanned Aerial Vehicles (UAV), Global Positioning Systems (GPS), GPS-enabled handheld devices, and Location-based Social Networks are generating various spatial and spatiotemporal data on a daily basis. Such a diversity of data has opened a new window toward tackling a wide range of significant problems that had been out of reach a decade ago.

Dealing with such voluminous and versatile data sources and extracting information and knowledge from those datasets requires exploiting methods and building custom solutions beyond those already provided by off-the-shelf GIS tools. The ability to construct custom solutions and techniques is an essential capability of the Geoinformatics specialist, who should be competent in addressing geospatial problems through scientific programming. Scientific programming allows us to access different data sources, manipulate the underlying data, and freely apply different sorts of analysis to our data. Scientific Geocomputing is an introductory course in which you will learn basic scientific programming concepts, focusing on spatial data manipulation, analysis, and visualization. The course's programming language is Python, but throughout the Geoinformatics specialization, you will learn to implement your algorithms using also other programming languages.

The course starts with an introduction to Python syntax, its data, and control structures. In parallel, you'll learn about solution strategies and algorithmic thinking so that you can improve your problem-solving skills. You will get familiar with several libraries that are used to manipulate high-dimensional data in the data science community. The course introduces you to the most important programming libraries that can handle and analyze spatial data in raster and vector formats. Also, you will learn about spatial database management systems (SDBMS) and how you can store, retrieve, and manipulate spatial data in such a system. You will learn about data visualization and how you can present the outcomes of your analysis in the form of maps, graphs, and charts using programming libraries. We will discuss the scientific side of programming by introducing literate programming, which emphasizes code documentation, and the FAIR principles of scientific data management, which apply to data and code.

CONTENT

1. Python data types, variables, expressions, functions, and data manipulation
2. Control flow in Python
3. Object-oriented programming in Python
4. Literate programming: interwoven documentation and coding and Jupyter Notebook principles
5. Spatial data types (simple vector features, image types)
6. Spatial database operation
7. Scientific programming libraries
8. Libraries for spatial data handling
9. Principles of scientific data visualization (charts and maps)
10. Principles of web mapping
11. Algorithmics: computational abstractions, problem classes, time and data complexity, algorithm design, and analysis
12. Supervised exercises
13. Learn, Code, Join, Share session

TEACHING AND LEARNING APPROACH

The student should expect a course that aims to bring professional and scientific skills in computational work with geospatial data. Short but intensive lectures bring the theoretical background, which is separately examined. Extensive practicals aim for the student to learn alone but also together and to share with peers in what is learned; students will be asked to explain their problems and solutions in the practical sessions. These practicals prepare for a batch of skills tests that each student executes individually during the course. A final skills test is executed at course end.

TESTS

Written test: one on theory, open book, but not open internet (30%)
Written test: one on coding skills, closed environment (40%)
Group assignments: two formative assessments for two-student groups, on separate topics (20% total)*
Self-reflection report (10%, double as course evaluation)*

*: No resit opportunity offered.

ENTRY REQUIREMENTS

Core modules of ITC Master's program in Geo-Information Science and Earth Observation (M-GEO)

Note: The course design assumes no previous scripting/coding experience.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 List and memorize the basic syntax of the programming language
LO 2 Explain mathematical notions in well-structured algorithms and understand their computational complexities
LO 3 Apply the knowledge of algorithmics and literate programming in code development to solve problems with spatial components
LO 4 Use spatial databases to load, curate and otherwise manipulate spatial data in database management systems
LO 5 Use the notions of scientific data visualization and web mapping to demonstrate the outputs of their programs to increase understandability and interpretability
LO 6 Read and analyze code that other programmers developed
LO 7 Critically evaluate and fix program logic and correctness through reading, back-tracking, testing and debugging cycles
LO 8 Develop programs to analyze spatial data in raster and vector formats using dedicated libraries
LO 9 Learn new programming libraries, from scratch, without direct help from instructors and use those libraries in designing and formulating their solutions

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	42
Supervised practical	32
Written/oral test	10
Individual assignment	24
Self-study	84

TESTPLAN

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Test 1 (theory)**	**Test 2 (skills)**	**Test 3 (portfolio 1)**	**Test 4 (portfolio 2)**	**Self-reflection**
LO 1	List and memorize the basic syntax of the programming language	●				●
LO 2	Explain mathematical notions in well-structured algorithms and understand their computational complexities		●	●		●
LO 3	Apply the knowledge of algorithmics and literate programming in code development to solve problems with spatial components	●	●	●	●	●
LO 4	Use spatial databases to load, curate and otherwise manipulate spatial data in database management systems		●	●	●	●
LO 5	Use the notions of scientific data visualization and web mapping to demonstrate the outputs of their programs to increase understandability and interpretability	●			●	●
LO 6	Read and analyze code that other programmers developed		●	●		●
LO 7	Critically evaluate and fix program logic and correctness through reading, back-tracking, testing and debugging cycles	●				●
LO 8	Develop programs to analyze spatial data in raster and vector formats using dedicated libraries			●	●	●
LO 9	Learn new programming libraries, from scratch, without direct help from instructors and use those libraries in designing and formulating their solutions					●
	Test type	Written examination	Written examination	Assignment(s)	Assignment(s)	Assignment(s)
	Weight of the test	40	30	10	10	10

		Learning Outcomes that are addressed in the test				
	Learning outcomes (LO) of the course: The student will be able to...	**Test 1 (theory)**	**Test 2 (skills)**	**Test 3 (portfolio 1)**	**Test 4 (portfolio 2)**	**Self-reflection**
	Individual or group test	Individual	Individual	Group	Group	Individual
	Type of marking	1-10	1-10	1-10	1-10	1-10
	Required minimum mark per test					
	Number of test opportunities per academic year	2	2	1	1	1

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	List and memorize the basic syntax of the programming language							
LO 2	Explain mathematical notions in well-structured algorithms and understand their computational complexities							
LO 3	Apply the knowledge of algorithmics and literate programming in code development to solve problems with spatial components							
LO 4	Use spatial databases to load, curate and otherwise manipulate spatial data in database management systems							
LO 5	Use the notions of scientific data visualization and web mapping to demonstrate the outputs of their programs to increase understandability and interpretability							
LO 6	Read and analyze code that other programmers developed							
LO 7	Critically evaluate and fix program logic and correctness through reading, back-tracking, testing and debugging cycles							
LO 8	Develop programs to analyze spatial data in raster and vector formats using dedicated libraries							

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 9	Learn new programming libraries, from scratch, without direct help from instructors and use those libraries in designing and formulating their solutions							

ELECTIVES

SIS I: SPATIAL DATA VISUALIZATION

Course	**202300138**
Period	11 November 2024 - 31 January 2025
EC	2
Course coordinator	dr. P. Raposo

INTRODUCTION

Maps come into action as soon as a location is involved. Maps reveal patterns and can show trends, and as such give answers to questions about the student population distributions in the city, or how the ice cover at the North Pole is evolving over time. **Maps offer insight in how phenomena relate to each other**, such as settlement structures and hydrographic patterns. Today, maps of human movement patterns can be created on the fly based on our mobile phone locations. However, we can only explore these patterns efficiently and comprehend the mapped processes effectively if the maps are attractive and well designed. In other words: “maps that matter should raise interest, be engaging, instantly understandable, and relevant to society”. It is the objective of the discipline of Cartography to realize and facilitate this.

To visualize changes and the dynamics in our multi-dimensional society sometimes requires solutions beyond the standalone ’traditional’ 2D map. Not only interaction is required to view multi-dimensional objects from different angles or to move along the timeline to see change in action, but also options to see alternatives and to reason. **Mapping the third dimension** requires knowledge on the when and how to apply depth cues in the visualization and / or which viewing environment to use. **Mapping time** requires one to go beyond the snapshot-based approach to incorporate processes. This can be combined in an interactive geovisualization environment.

CONTENT

The course consist of two main parts:

1. Cartography basics: Introduction to Spatial Data Visualization
    1. Generic (maps, cartography, needs and context)
    2. Design (design constraints, organising qualitative and quantitative data, guidelines, reading the map, design at work, animation, perception of change)
    3. Base maps (topographic and base maps; geographic names, (administrative) boundaries)
    4. Thematic maps (chorochromatic maps, isoline maps, choropleth maps, proportional symbol map, other maps (dot map, cartogram, flowmap))
2. Advanced cartography: Mapping time and the 3rd dimension
    1. 3D (examples, map types, and perception/depth cues);
    2. Time (what is time/change, representation environments, data analysis and design, map types);
    3. Geovisualization (context scientific/info/data visualization, (geo)visual analytics;

TEACHING AND LEARNING APPROACH

Lectures and exercises. Project work supported by mini-lectures.

TESTS

The theory is assessed in a written test.

ENTRY REQUIREMENTS

M-SE entry requirements

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Apply cartographic design principles to different kinds of geodata, taking data characteristics and use issues into account

LO 2 Judge the appropriateness of the application of design principles in their different multidimensional representations and use contexts.

LO 3 Understand the requirements of the 3d viewing environment and in relation to this be able to explain the application of depth cues and their different perceptions properties

LO 4 Select appropriate graphical representations to map changes based on different notions of time.

LO 5 Understand what geovisualization can do in a collaborative working environment

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	12
Individual assignment	13
Self-study	29
Written/oral test	2

TESTPLAN

	Learning Outcomes that are addressed in the test Learning outcomes (LO) of the course: The student will be able to...	Not Applicable
LO 1	Apply cartographic design principles to different kinds of geodata, taking data characteristics and use issues into account	
LO 2	Judge the appropriateness of the application of design principles in their different multidimensional representations and use contexts.	
LO 3	Understand the requirements of the 3d viewing environment and in relation to this be able to explain the application of depth cues and their different perceptions properties	
LO 4	Select appropriate graphical representations to map changes based on different notions of time.	
LO 5	Understand what geovisualization can do in a collaborative working environment	
	Test type	Written examination
	Weight of the test	100
	Individual or group test	Individual
	Type of marking	1-10
	Required minimum mark per test	0
	Number of test opportunities per academic year	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Apply cartographic design principles to different kinds of geodata, taking data characteristics and use issues into account	●					●	
LO 2	Judge the appropriateness of the application of design principles in their different multidimensional representations and use contexts.	●			●	●	●	
LO 3	Understand the requirements of the 3d viewing environment and in relation to this be able to explain the application of depth cues and their different perceptions properties	●					●	
LO 4	Select appropriate graphical representations to map changes based on different notions of time.	●					●	
LO 5	Understand what geovisualization can do in a collaborative working environment	●					●	

SPG I: INSTITUTIONALIZING SPATIAL INFORMATION SYSTEMS IN POLICY AND THE MARKET PLACE

Course	**202300237**
Period	11 November 2024 - 31 January 2025
EC	2
Course coordinator	dr.ir. L.G.J. Boerboom

INTRODUCTION

You have been learning a lot about spatial information and spatial information technologies. Although some solely have a scientific purpose, many at least aspire to make a difference in the policy arena or in the marketplace. Yet, evidence is ignored and product introductions fail. The technologies fail to fit in with the existing practices, they fail to institutionalize and become part of the written and unwritten rules and norms of policy-makers or consumers. Why is that? And can we strategize to increase the use of spatial information and spatial information technologies?

CONTENT

Spatial information and information systems are of value in the policy arena and/or marketplace. How they become part of the written and unwritten rules of the policy or market game, i.e. how they institutionalize, is the question addressed in this elective.

To that end, the course integrates three topics. First, it defines institutionalization and explores what we know and don't know about institutionalization of information and information systems. Second, it will define the policy process and how spatial evidence and information systems are used and institutionalized in the policy arena. And third, it explores how they institutionalize in the marketplace. Of course, spatial information and spatial information system value in the policy arena are likely to be different from their value in the value chains of the marketplace.

The objective is that you learn to strategize for the institutionalization of spatial information and spatial information systems in the policy arena or in the marketplace and avail of the methods to do so, from an understanding of both the policy and market context as well as the nature of the information and information technology. For the policy context, you will be introduced to different views on the policy process, elements of policy analysis, auditing, framing, the use/non-use/abuse of evidence, and fake facts to eventually make an argument. For the market context, you will be introduced to methodology for markets and value chains, and for business development. For both the policy and marketplace context we will finish by developing an institutionalization strategy

TEACHING AND LEARNING APPROACH

Seminars (attendance required!), selected readings, discussion, exercise, case studies, application to personal interest.

TESTS

Formative assessment through discussion in seminars. Summative assessment through individual submission of an institutionalization strategy of personal interest either in the policy arena or marketplace.

ENTRY REQUIREMENTS

None

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Strategize institutionalization of spatial-information and spatial information systems in a policy context or the marketplace.

LO 2 Recognize different models of policy change in policy practice and the role of evidence develop policy arguments

LO 3 Apply the concepts of market and value chain theory in a rudimentary value chain description, addressing dilemma's

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	10
Supervised practical	10
Group assignment	10
Individual assignment	10
Self-study	10
Written/oral test	6
	0

TESTPLAN

	Learning Outcomes that are addressed in the test	
	Learning outcomes (LO) of the course: The student will be able to...	**Not Applicable**
LO 1	Strategize institutionalization of spatial-information and spatial information systems in a policy context or the marketplace.	●
LO 2	Recognize different models of policy change in policy practice and the role of evidence develop policy arguments	●
LO 3	Apply the concepts of market and value chain theory in a rudimentary value chain description, addressing dilemma's	●
	Test type	Personal Development Plan
	Weight of the test	100
	Individual or group test	Individual
	Type of marking	1-10
	Required minimum mark per test	0
	Number of test opportunities per academic year	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	**1**	**2**	**3**	**4**	**5**	**6**	**7**
LO 1	Strategize institutionalization of spatial-information and spatial information systems in a policy context or the marketplace.	●	●	●	●	●	●	●
LO 2	Recognize different models of policy change in policy practice and the role of evidence develop policy arguments		●		●	●		●
LO 3	Apply the concepts of market and value chain theory in a rudimentary value chain description, addressing dilemma's		●		●	●		●

SIS II: DIGITAL ELEVATION MODELS AND THEIR USES

Course	**202300139**
Period	11 November 2024 - 31 January 2025
EC	2
Course coordinator	dr. B. Alsadik

INTRODUCTION

In this course, students will gain the knowledge and skills necessary to represent topography using DEMs. They will learn about some important Earth Observation (EO) sensors for data collection and the optimal procedures to process specific sensor data.

By studying Digital Elevation Models, students in spatial engineering will acquire several competencies like examining terrain features, creating accurate maps, conducting spatial analysis, etc.

Throughout the course, students will work on various exercises, applying photogrammetry, aerial laser scanning, and point cloud processing techniques to generate DEMs. They will also explore the application of DEMs in simulating floods, enabling them to make informed decisions on data acquisition and processing methods for specific problems. They will also learn how to apply quality checks on the derived DEMs.

In summary, students will gain valuable insights and practical skills to analyze terrains, create maps, simulate floods, and make informed decisions in spatial engineering projects.

CONTENT

In this elective topic, the students learn how to represent the topography by creating **Digital Elevation Models (DEMs)**; which EO sensors are available for data collection and what is the optimal procedure to process this sensor data.

Spatial engineering students who study Digital Elevation Models will have the knowledge and abilities to examine terrain features, integrate DEMs into other applications. For example:

- DEMs offer essential data on the elevation and slope of the land surface. DEMs are useful for locating potential development sites, predicting water flow patterns, evaluating flood hazards, and applying different environmental evaluations.
- DEMs are necessary for producing precise and appealing maps especially for the generation of topographic maps, contour maps, and 3D visualizations by combining DEM data with other geospatial data.
- DEMs are used as input data for various spatial analysis and modeling techniques. Students can undertake slope analysis, viewshed analysis, and suitability modeling by combining DEMs with other spatial information. Environmental evaluations, urban planning, and land management decision-making are all aided by these analyses.
- DEMs are vital in predicting water flow, identifying drainage patterns, and assessing water availability, benefiting water resource management and land use studies.

TEACHING AND LEARNING APPROACH

The course will follow a blended learning approach including face-to-face lectures to introduce key concepts, theories, and techniques related to DEMs, with feedback and guidance provided to support learning. Students will also engage in hands-on tasks using real-world data and technologies to improve their practical skills. This includes processing sensor data, creating DEMs, and using spatial analytic methods. Software packages such as QGIS, CloudCompare, LAStools, and Metashape will be utilized for activities related to DEM production, point cloud processing, and quality checks. Students will have access to materials on CANVAS, including software tutorials, data sets, and selected literature. Self-study is encouraged for students to explore additional information sources and stay up to date with the latest developments. The teaching and learning methodology include theoretical lectures, hands-on practice, an individual assignment, and a written exam to ensure a thorough understanding and implementation of DEMs in spatial engineering.

TESTS

The test will consist of an individual assignment and a written exam to assess the students' understanding of Digital Elevation Models with a focus on photogrammetry and laser scanning techniques.

ENTRY REQUIREMENTS

Completion of Q1. No specific requirements or skills are needed. However, a basic understanding of geographic information systems (GIS), remote sensing, and spatial data analysis concepts will be helpful.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 • Describe the standard processes of generating height data, to produce DEMs.

LO 2 • Apply photogrammetric image orientation and point cloud derivation to generate a DEM

LO 3 • Apply Aerial Laser Scanning (ALS) and point cloud processing procedures and generate a DEM

LO 4 • Utilize acquired knowledge to make informed decisions on the best way of data acquisition and processing methods for creating a DEM

LO 5 • Assess and evaluate the learned data acquisition methods and processing techniques for creating DEMs, considering factors such as accuracy, efficiency, and applicability to specific project requirements.

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	12
Supervised practical	15
Self-study	14
Written/oral test	3
Individual assignment	12

TESTPLAN

		Learning Outcomes that are addressed in the test	
	Learning outcomes (LO) of the course: The student will be able to...	**Written Exam**	**Individual assignment**
LO 1	• Describe the standard processes of generating height data, to produce DEMs.	●	
LO 2	• Apply photogrammetric image orientation and point cloud derivation to generate a DEM	●	●
LO 3	• Apply Aerial Laser Scanning (ALS) and point cloud processing procedures and generate a DEM	●	●
LO 4	• Utilize acquired knowledge to make informed decisions on the best way of data acquisition and processing methods for creating a DEM	●	
LO 5	• Assess and evaluate the learned data acquisition methods and processing techniques for creating DEMs, considering factors such as accuracy, efficiency, and applicability to specific project requirements.	●	●
	Test type	Written examination	Assignment(s)
	Weight of the test	60	40
	Individual or group test	Individual	Individual
	Type of marking	1-10	1-10
	Required minimum mark per test		
	Number of test opportunities per academic year	2	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	**1**	**2**	**3**	**4**	**5**	**6**	**7**
LO 1	• Describe the standard processes of generating height data, to produce DEMs.				●			
LO 2	• Apply photogrammetric image orientation and point cloud derivation to generate a DEM	●						
LO 3	• Apply Aerial Laser Scanning (ALS) and point cloud processing procedures and generate a DEM	●						
LO 4	• Utilize acquired knowledge to make informed decisions on the best way of data acquisition and processing methods for creating a DEM				●	●		
LO 5	• Assess and evaluate the learned data acquisition methods and processing techniques for creating DEMs, considering factors such as accuracy, efficiency, and applicability to specific project requirements.		●		●			

TE I: SYSTEMS ANALYSIS & DYNAMIC MODELLING

Course	**202300140 =**
Period	11 November 2024 - 31 January 2025
EC	2
Course coordinator	dr.ir. T.A. Groen

INTRODUCTION

Systems analysis deals with how to visualize **systems** in easy to understand **Conceptual Diagrams**. Such systems can be anything, from a bucket of water filling up to more complex systems like ecosystems of economical systems. Making conceptual diagrams of these systems is a fist step to identify elements in a system that vary over time, and for which the dynamics can be modelled using a **Dynamical Model**. Dynamical modelling is the modelling of changes in systems over time as a function of "rates" and "states". Such systems are often called "Dynamical Systems". Simple systems can be analyzed by mathematical derivations of differential equations. However, once systems become more complex, mathematical solutions become unfeasible and simulations are the only way to analyze these systems.

In this elective you will learn how to make conceptual diagram of a system, build a dynamical model based on that diagram and analyze it with mathematical and simulation approaches to understand the dynamics of the system.

CONTENT

The course is build up from the following elements

1. Because many different visualization techniques exists that are (often confusingly) presented as Conceptual Diagrams we will start by sorting out different types of "illustrations" as in use to provide insights into the functioning of studied systems like: Problem Trees, Mind Maps, Concept Maps, Conceptual Diagrams, System Diagrams (Causal Loop Diagrams) and Flow Charts.
2. Create a functional Conceptual Diagram of an existing system
3. Practice how that diagram can be used to formulate policy- or project-interventions and study-hypotheses.
4. convert that diagram into a system diagram and from that a dynamical model
5. analyze this model by making it mode complex along the way and run simulations of it

TEACHING AND LEARNING APPROACH

The course will be organized in 2 parts. In the first part you will work as a group (we will make groups of between 3-4 persons, depending on the number of participants) on building a conceptual diagram for a system that is provided by the teaching staff, although you are also invited to bring your own case study. In the second part you will be working individually to create a dynamical model of (a part of) the system for which you made a conceptual diagram. The creation of either products will be supported by theoretical lectures on systems analysis and dynamical modelling by staff and plenary discussions on the progress you make, sharing progress and insights in the group.

TESTS

The elective will be analyzed by means of 1) a group assignment and 2) an individual assignment. In the group assignment you create, justify and explain the conceptual diagram. In the individual assignment you create and analyze a dynamical model.

ENTRY REQUIREMENTS

Basic understanding of algebra and statistics.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 identify different types of diagrams that are in use to provide insights into the functioning of studied systems

LO 2 design a conceptual diagram illustrating how a (semi-)natural system works and how humans influence it

LO 3 Recognize and understand a simple Ordinary Differential Equation (ODE)

LO 4 Convert the main processes from a conceptual diagram into a set of ODE's

LO 5 analyze a set of ODE's by means of simulation by discretizing the process

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	11
Self-study	15
Individual assignment	15
Group assignment	15

TESTPLAN

		Learning Outcomes that are addressed in the test	
	Learning outcomes (LO) of the course: The student will be able to...	**Conceptual diagram**	**Dynamical model**
LO 1	identify different types of diagrams that are in use to provide insights into the functioning of studied systems	●	
LO 2	design a conceptual diagram illustrating how a (semi-)natural system works and how humans influence it	●	
LO 3	Recognize and understand a simple Ordinary Differential Equation (ODE)		●
LO 4	Convert the main processes from a conceptual diagram into a set of ODE's		●
LO 5	analyze a set of ODE's by means of simulation by discretizing the process		●
	Test type	Assignment(s)	Assignment(s)
	Weight of the test	40	60
	Individual or group test	Group	Individual
	Type of marking	1-10	1-10
	Required minimum mark per test	5.5	5.5
	Number of test opportunities per academic year	2	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	identify different types of diagrams that are in use to provide insights into the functioning of studied systems	●			●			
LO 2	design a conceptual diagram illustrating how a (semi-)natural system works and how humans influence it			●				
LO 3	Recognize and understand a simple Ordinary Differential Equation (ODE)	●						
LO 4	Convert the main processes from a conceptual diagram into a set of ODE's	●	●					
LO 5	analyze a set of ODE's by means of simulation by discretizing the process	●			●			

SIS III: VOLUNTEERED GEOGRAPHIC INFORMATION

Course	**202300141**
Period	11 November 2024 - 31 January 2025
EC	1
Course coordinator	dr. F.O. Ostermann

INTRODUCTION

The concept of (public) participation in geospatial research has a long tradition. However, the adoption of Web 2.0 technologies facilitates the generation and sharing of and collaboration on digital content with a geospatial component, and has therefore expanded possibilities and practice. This choice topic gives an overview of its history and new developments, focusing on examples of successful and unsuccessful projects to identify criteria for sustainable crowdsourcing or volunteering, including issues of privacy and ethical research. For the case study projects, it is particularly relevant for eliciting and arguing the needs, interests, and positions of any stakeholder that incorporates or directly works with the public.

CONTENT

The elective covers the following topics:

- Types of participatory research and data collection
- Communities, organizations, and research ethics
- Participatory or crowdsourced data sources
- Tools and methods for retrieving and collecting data
- Representativeness and quality of crowdsourced or volunteered data
- Reproducibility and sustainability of crowdsourced research and citizen science

TEACHING AND LEARNING APPROACH

The topic is split into thematically grouped study units. Each study unit usually consists of reading a key paper and discussing its content, a short lecture on key concepts, followed by practical lab work to experiment with software tools and data, an opportunity for self-regulated learning (i.e. students decide individually whether to deepen knowledge through reading or continuing with practical work), and concluded with a brief recap at the beginning of the next study unit.

At the start of the course, the participants decide on a project design that uses participatory geodata. It can be based on the interests of the participant. This project design is then being extended and elaborated with the insights gained during the study units until a full project plan is ready that could serve as the input for a funding call. This project plan forms the basis of the assessment.

TESTS

A project plan detailing a self-defined approach using participatory geodata. There is no second test opportunity, but in case of a fail, a repair to reach a pass is possible.

ENTRY REQUIREMENTS

Participation in case study unit 1.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 distinguish different types of participatory research and data collection, and explain their (dis)advantages

LO 2 discuss important concepts related to building and managing communities including research ethics

LO 3 distinguish different sources for crowdsourced or volunteered data and explain their (dis)advantages

LO 4 find, choose, and customize appropriate participatory data collection tools and techniques

LO 5 examine and argue quality and representativeness of a crowdsourced or volunteered data set

LO 6 discuss and ensure basic reproducibility and sustainability of participatory research

TESTPLAN

	Learning Outcomes that are addressed in the test	
	Learning outcomes (LO) of the course: The student will be able to...	**Project plan**
LO 1	distinguish different types of participatory research and data collection, and explain their (dis)advantages	●
LO 2	discuss important concepts related to building and managing communities including research ethics	●
LO 3	distinguish different sources for crowdsourced or volunteered data and explain their (dis)advantages	●
LO 4	find, choose, and customize appropriate participatory data collection tools and techniques	●
LO 5	examine and argue quality and representativeness of a crowdsourced or volunteered data set	●
LO 6	discuss and ensure basic reproducibility and sustainability of participatory research	●
	Test type	Assignment(s)
	Weight of the test	100
	Individual or group test	Individual
	Type of marking	1-10
	Required minimum mark per test	0
	Number of test opportunities per academic year	1

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	distinguish different types of participatory research and data collection, and explain their (dis)advantages							
LO 2	discuss important concepts related to building and managing communities including research ethics							
LO 3	distinguish different sources for crowdsourced or volunteered data and explain their (dis)advantages							
LO 4	find, choose, and customize appropriate participatory data collection tools and techniques							
LO 5	examine and argue quality and representativeness of a crowdsourced or volunteered data set							
LO 6	discuss and ensure basic reproducibility and sustainability of participatory research							

SPG II: SPATIAL KNOWLEDGE MANAGEMENT

Course	**202300142**
Period	11 November 2024 - 31 January 2025
EC	1
Course coordinator	dr. J.A. Martinez

INTRODUCTION

This 1 EC elective introduces students to the politics of spatial knowledge management in relation to the spatial development and governance of an area. It explores various types of spatial knowledge and the processes involved in their production, use, sharing, or contestation by different actors or networks of actors, with or without the assistance of geo-spatial data, methods, and tools. The course places particular emphasis on the critical interpretation of spatial knowledge processes and products in area development. It integrates critical GIS theoretical perspectives with practical, illustrative case studies from the field.

CONTENT

- Spatial knowledge types
- Spatial knowledge types application & actors
- Spatial knowledge processes & frames
- Spatial knowledge building processes (Mode 1 & 2)
- Application workshop

TEACHING AND LEARNING APPROACH

In our lectures and workshops, we utilise active learning techniques, such as the 'think-pair-share' method, to promote individual thinking, encourage collaboration, and stimulate discussion.

TESTS

Group oral presentation (40%) followed by short individual written test (60%)

ENTRY REQUIREMENTS

Participation in previous case study

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 • Describe and identify different (spatial) knowledge types, ranging from tacit knowledge to scientific knowledge;

LO 2 • Analyse the actors and actor networks who produce, use, share or contest spatial knowledge;

LO 3 • Analyse knowledge building processes and underlying framings;

LO 4 • Analyse spatial knowledge products (e.g. zoning maps) with respect to choices made with regard to data, classifications, generalizations, boundaries, and cartographic representations;

LO 5 • Sketch the spatial knowledge landscape with respect to a case study.

TESTPLAN

		Learning Outcomes that are addressed in the test	
	Learning outcomes (LO) of the course: The student will be able to...	**Group oral presentation**	**Short individual written test**
LO 1	• Describe and identify different (spatial) knowledge types, ranging from tacit knowledge to scientific knowledge	●	●
LO 2	• Analyse the actors and actor networks who produce, use, share or contest spatial knowledge	●	●
LO 3	• Analyse knowledge building processes and underlying framings	●	●
LO 4	• Analyse spatial knowledge products (e.g. zoning maps) with respect to choices made with regard to data, classifications, generalizations, boundaries, and cartographic representations	●	●
LO 5	• Sketch the spatial knowledge landscape with respect to a case study.	●	
	Test type	Presentation(s)	Written examination
	Weight of the test	40	60
	Individual or group test	Group	Individual
	Type of marking	1-10	1-10
	Required minimum mark per test	5.5	5.5
	Number of test opportunities per academic year	1	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	**1**	**2**	**3**	**4**	**5**	**6**	**7**
LO 1	• Describe and identify different (spatial) knowledge types, ranging from tacit knowledge to scientific knowledge		●		●	●		
LO 2	• Analyse the actors and actor networks who produce, use, share or contest spatial knowledge		●		●	●		
LO 3	• Analyse knowledge building processes and underlying framings		●		●	●		
LO 4	• Analyse spatial knowledge products (e.g. zoning maps) with respect to choices made with regard to data, classifications, generalizations, boundaries, and cartographic representations		●		●	●		
LO 5	• Sketch the spatial knowledge landscape with respect to a case study.		●		●	●	●	

TE II: GEOAI

Course	202400640
Period	11 November 2024 - 31 January 2025
EC	1
Course coordinator	ir.ing. A. Dahal

INTRODUCTION

The objective of this course is to introduce the concepts of GeoAI to students in a brief and concise manner without in-depth mathematical framework but with a general understanding of the concepts and their uses. This course will equip students with the knowledge and skills to distinguish between various statistical, machine learning, and deep learning models, understand probability distributions and their common types, select suitable models and loss functions for different tasks, correctly handle and divide datasets, and use basic deep learning models using TensorFlow and Python.

CONTENT

tbd

TEACHING AND LEARNING APPROACH

tbd

TESTS

One individual project to test the knowledge of all the learning outcomes, submitted as a Jupyter notebook consisting of code and explanation of why they use such code.

ENTRY REQUIREMENTS

tbd

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Differentiate between the architectures and types of statistical, machine learning, and deep learning models.

LO 2 Understand the basics of probability distributions and identify common types such as Gaussian and binomial.

LO 3 Select appropriate models and loss functions for classification and regression tasks.

LO 4 Comprehend the differences between training, validation, and test datasets and correctly divide them.

LO 5 Develop and implement basic deep learning models for mapping using TensorFlow and Python.

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Lecture	12
Supervised practical	0
Written/oral test	0
Individual assignment	6
Group assignment	0
Self-study	10

TESTPLAN

		Learning Outcomes that are addressed in the test		
	Learning outcomes (LO) of the course: The student will be able to...	**Written test**	**Individual assignment**	**Group assignment**
LO 1	Differentiate between the architectures and types of statistical, machine learning, and deep learning models.	●	●	
LO 2	Understand the basics of probability distributions and identify common types such as Gaussian and binomial.		●	
LO 3	Select appropriate models and loss functions for classification and regression tasks.		●	●
LO 4	Comprehend the differences between training, validation, and test datasets and correctly divide them.			
LO 5	Develop and implement basic deep learning models for mapping using TensorFlow and Python.			
	Test type	Written test	Individual assignment	Group assignment
	Weight of the test	20	70	10
	Individual or group test	Individual	Individual	Group
	Type of marking	1-10	1-10	1-10
	Required minimum mark per test			
	Number of test opportunities per academic year	2	2	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Differentiate between the architectures and types of statistical, machine learning, and deep learning models.							
LO 2	Understand the basics of probability distributions and identify common types such as Gaussian and binomial.							
LO 3	Select appropriate models and loss functions for classification and regression tasks.							
LO 4	Comprehend the differences between training, validation, and test datasets and correctly divide them.							
LO 5	Develop and implement basic deep learning models for mapping using TensorFlow and Python.							

INTERNSHIP PROJECT

INTERNSHIP PROJECT

Course	**201900001**
Period	21 April 2025 - 04 July 2025
EC	15
Course coordinator	drs. T.R. Luiten MBA

INTRODUCTION

In the internship, the student demonstrates the ability to work at an academic level in a professional project context. As such, doing the internship is indispensable for acquiring the competences of an academic and professional Spatial Engineering graduate. Whether this internship is his/her first introduction to the world of work, or whether he/she has already gained a lot of professional experience, the student will get the chance to further develop his/her knowledge and skills. The student is expected to apply the tools and concepts of the project management skill learning line.

The internship may be carried out within consultant companies, government agencies, research institutes, NGOs or intergovernmental organizations in the Netherlands or abroad. ITC has a working relation and has made agreements on the possible placement of interns with these organizations. The student will be able to apply for an internship topic based on interests and preferences, and will develop this topic into an Internship Project Plan (IPP) prior to the start of the internship. During the internship, he/she will receive guidance from a daily supervisor in the organization concerned. At the end of the internship, the student will make an internship report (IR) and an Internship Reflection Report (IRR) report in which he/she discusses results, experiences and highlights the learning that has been achieved during the internship. The supervisor of the host organization will provide him/her with formative feedback on his/her professional skills using the Host Evaluation Form (HEF). This form will be discussed between host superviser and ITC supervisor during the performance review. Th ITC superviser determines the grade associated with the performace review.

CONTENT

During the internship period, the student will be part of a professional project organization. They will be working on a societal problem in a professional context and will typically contribute to an ongoing project and operate in a project context. The project needs to be closely related to the content of the Spatial Engineering programme such that at least two of the three core knowledge areas are covered. ITC is providing a database in CANVAS with host organizations and project outlines from which the student can choose his/her internship project. The student can also develop his/her own internship project. For support, they can contact the internship coordinator.

After choosing the project outline, the student will make a project proposal for the internship (IPP) and apply for internship placement within the organization. The IPP will be evaluated by the ITC supervisor and the supervisor in the host organization. Only after approval of the IPP by the ITC supervisor, can the actual internship commence. Orientation and planning an internship should preferably start at least six months prior to the desired date for an internship in the Netherlands and preferably nine months in advance for an international internship. This extra time is required for arrangements that need to be made such as applying for accommodation, visa and other formalities. The UT online tool “mobility online” and the internship coordinator help in planning and organizing the internship. During the internship, the student will be supervised by an ITC staff member as well as by a representative of the host organization where the internship takes place.

At the end of the internship the student will hand in an Internship Report (IR) in which the project is described. This IR provides a content description of the process and results of the internship and includes a discussion of the problem and context, objectives of the assignment, the questions addressed, the methods used, analyses performed, results and discussion. He/she also makes an Internship Reflection Report (IRR) that highlights his/her learning on professional skills during the internship project.

The mark of the internship will be based on the discussion of an assessment committee, which consists of both supervisors and an ITC staff member who has not been involved in the internship. The representative of the host organization advises the internship examiner in the assessment of the internship (specifically on professional attitude and skills), whereas the ITC supervisor focuses on the academic level of the internship.

TEACHING AND LEARNING APPROACH

practical application of skills and knowledge under supervision of the internship host supervisor, using project management tools to plan and report on the work.

TESTS

Internship Project Plan (IPP)

The project plan contains the following elements:

1. Introduction (with the title of the project, name of the author, UT and company supervisors, date, planned period of the training)
2. Project definition and aims
3. Project plan
4. Expected results

Internship Report (IR)

A report contains the following elements:

1. Introduction
2. Interpretation of the assignment
3. Delivered results
4. Discussion and conclusion

Host organization Evaluation Form (HEF) to be used for the performance review

1. Initiative and creativity
2. Insight in functioning of the organization
3. Adaptation capacity
4. Commitment and perseverance
5. Independence
6. Handling supervisor's comments and development skills
7. Time management
8. Dealing with uncertainty and risks in project
9. Dealing with limited resources
10. Responsibility
11. Flexibility; compromise in complex situations
12. International multicultural teamwork
13. Contribution to the scientific knowledge of the internship organization
14. Presentation of the results of the internship project

Reflection report

The reflection report describes the non-technical aspects of the internship period.

Its size should be two to four pages.

The reflection report should reflect on:

- The learning **process:** which professional skills did the student gain in the workplace, with focus on application of theoretical knowledge, problem solving, time management and teamwork
- The **realization** process: how were the tasks and deliverables realized and
- The **communication** process; how were the internship results communicated to professionals, ITC and the host?
- Self-assessment **reflection** on student's strengths (best skills), values (what matters most to him/her) and interests (what he/she likes to do) in professional work
- **Recommendation** for improved experience on internship

ENTRY REQUIREMENTS

Academic Research at least a pass for the research proposal defence, advice is not the start working until after having recieved a positive feedback on mid term review.

IMPORTANT:
Whether an internship is possible in a certain country could depend on scholarship conditions. As these are different for each scholarship provider, the internship coordinator should be consulted to provide clarity on this issue.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 translate an open assignment into a coherent and feasible workplan using relevant management tools where needed to address the needs of the organisation.

LO 2 function in an already existing team of professionals in a different environment

LO 3 demonstrate professional skills: Initiative and creativity, Insight in functioning of the organization and the team, Adaptation capacity, Commitment and perseverance, Independence, Handling supervisor's comments and development skills.

LO 4 to contribute to the development of knowledge within the host organization with at least one of the core knowledge areas of Spatial Engineering by means of a self-explanatory report on the internship assignment

LO 5 to reflect on their professional skills, own role in the team, ethical values needed for working in international and multicultural teams and environments.

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Supervised practical	420

TESTPLAN

		Learning Outcomes that are addressed in the test			
	Learning outcomes (LO) of the course: The student will be able to...	**Project Proposal**	**Report**	**Reflection Report**	**Performance Review**
LO 1	translate an open assignment into a coherent and feasible workplan using relevant management tools where needed to address the needs of the organisation.	●			
LO 2	function in an already existing team of professionals in a different environment				●
LO 3	demonstrate professional skills: Initiative and creativity, Insight in functioning of the organization and the team, Adaptation capacity, Commitment and perseverance, Independence, Handling supervisor's comments and development skills.			●	
LO 4	to contribute to the development of knowledge within the host organization with at least one of the core knowledge areas of Spatial Engineering by means of a self-explanatory report on the internship assignment	●			
LO 5	to reflect on their professional skills, own role in the team, ethical values needed for working in international and multicultural teams and environments.		●		
	Test type	Assignment(s)	Assignment(s)	Assignment(s)	Assignment(s)
	Weight of the test	10	40	0	50
	Individual or group test	Individual	Individual	Individual	Individual
	Type of marking	1-10	1-10	Pass/Fail	1-10
	Required minimum mark per test				
	Number of test opportunities per academic year	2	2	2	1

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	translate an open assignment into a coherent and feasible workplan using relevant management tools where needed to address the needs of the organisation.		●				●	
LO 2	function in an already existing team of professionals in a different environment						●	●
LO 3	demonstrate professional skills: Initiative and creativity, Insight in functioning of the organization and the team, Adaptation capacity, Commitment and perseverance, Independence, Handling supervisor's comments and development skills. ●				●	●	●	
LO 4	to contribute to the development of knowledge within the host organization with at least one of the core knowledge areas of Spatial Engineering by means of a self-explanatory report on the internship assignment ●				●			
LO 5	to reflect on their professional skills, own role in the team, ethical values needed for working in international and multicultural teams and environments.				●		●	

ACADEMIC AND RESEARCH PHASE

ACADEMIC AND RESEARCH PHASE

Course	**202400001**
Period	02 September 2024 - 18 April 2025
EC	40
Course coordinator	drs. T.R. Luiten MBA

INTRODUCTION

The MSc research is the main part of the second year. It is an individual effort where the student will learn to use scientific principles to do reasearch. From a societal or scientific overall problem, the student will investigate the state-of-the-art using peer reviewed literature and formulate what needs to be investigated in order to improve our understanding. From this, research objectives are defined, corresponding questions are formulated and a detailed and transparent methodology is created to provide answers. Conclusions and recommendations and a synthesis are formulated in a critical way. Spatial Engineering is a multidisciplinary study. Although this is a specialisation phase where the student can analyse a problem in depth, they are required to use at least 2 out of 3 of the core knowledge areas, and reflect on how the results in potentially related to the third core knowledge area. If the research is for instance more technical in nature, the results should include a reflection on the potential effects on stakeholders. If the emphasis is on planning/governance, a reflection on the feasibility of the technical engineering context should be included. The MSc research is in total 45 EC, split in a proposal writing phase and a research phase that results in a thesis. The proposal itself is a written document that is defended in an oral test before a Proposal Assessment Board (PAB), and must be successful in order to be allowed into the research phase itself.

Details on the assessment of the Academic and Research phase can also be found on the ITC intranesite: https://www.itc.nl/intranet/education/rules-and-procedures/assessment/assessment-instructions/.

CONTENT

Proposal

Developing the MSc research proposal requires a sufficient understanding and integration of research aspects from all different scientific technical and non-technical disciplines involved in the proposed research. So, in addition to the academic and research skills already gained during the first-year students will receive guidance on these skills during this part of the Academic Research phase.

The proposal is developed in steps that follow the logic of a written proposal.

General lectures are provided on

1. Development of research questions

2. Methodological choices

3. Ethical concerns

In addition each research theme provides supervised peer review sessions.

The proposal has to contain a detailed methodology that in principle should be able to answer each of the questions. Analysis methods and models have to be specified in sufficient detail, and based on an expected outcome and potential problems encountered. If you do not master parts of the methodology yet, make sure you understand these sufficiently to estimate their outcome, based on your literature review. Plan sufficient time to learn new methodologies.

The student will have two supervisors with whom the content of the proposal is discussed. The supervisors will ascertain that the proposal is feasible, and will help with identifying counterparts that the student may contact. One of the supervisors should be from ITC faculty representing one of the three core knowledge areas of Spatial Engineering. The other can be from another research institute.

Practical constraints apply: the topic must be possible in terms of availability of data, logistics, and supervision, and be financially possible. If a field investigation is envisaged, supervision in the field is required and the investigation must be possible within the time frame and financial constraints.

Thesis

The research phase has a normal duration of 2 quartiles and usually starts with acquisition of data and information. In case this involves fieldwork, a staff member or a counterpart will be present for a part of the time. Regular meetings are scheduled at the student's initiative. The student comes to the meetings prepared, and gives a concise summary with action points afterwards. It is expected that the student gradually takes control of his/her own research and becomes an expert in the topic. The role of the supervisor is to guide the independent research of a student. Sometimes, depending on the data vailability or application of a focus along the way, research objectives may be adjusted. This is done in discussion with the supervisors. The set of objectives, analysis and conclusions in the thesis should be an integrated work, but it can differ from the original proposal. During this phase new analysis techniques may be learned, but plan sufficient time for this.

TEACHING AND LEARNING APPROACH

Guided proposal writing, performing independently although supervised research and report on the results.

TESTS

There are four assessment moments:

The proposal has to be defended before a committee of staff members and peers. A written feedback is given by both staff and students with points of attention that should be addressed in the course of the research. The proposal presentation is chaired by the research chair or replacement. The presentation should be attended by all staff available and fellow students. Acceptance of the proposal is required to be allowed to continue into the research phase.

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Upon the approval of the completed MSc research by the research theme leader (or delegate) and the first supervisor the student submits the Thesis for the MSc research exam.

The oral defence will be scheduled after submission of the thesis for the MSc research exam. The written thesis, the research process and the oral defense are together judged by a Thesis Assessment Board, consisting of the chair, an independent researcher and the two supervisors.

ENTRY REQUIREMENTS

At least 46 EC's of the first academic year.

LEARNING OUTCOMES

Upon completion of this course, the student is able to:

LO 1 Translate a multidisciplinary (societal) problem to a set of research objectives and questions, based on state-of-the-art peer-reviewed literature, of sufficient scope and depth related to the three core knowledge areas of Spatial Engineering.

LO 2 Define a clear structured methodology with conscious and justifiable choices between different modelling techniques for spatio-temporal processes.

LO 3 Collect and analyse relevant data and information, and use, develop and validate models, working in a transparent and fully reproducible way.

LO 4 Draw viable conclusions and generate a good synthesis, and where possible, give recommendations that recognize the needs and wishes of stakeholder groups involved.

LO 5 Work in a structured and independent way, while making adequate use of the guidance of the supervisor

LO 6 Convey written information effectively using a professionally written and structured research proposal and thesis

LO 7 Convey information effectively using professional visual and oral means in presenting the research

ALLOCATED TIME PER TEACHING AND LEARNING METHOD

Teaching / learning method	Hours
Individual assignment	1036

TESTPLAN

		Learning Outcomes that are addressed in the test		
	Learning outcomes (LO) of the course: The student will be able to...	**Proposal**	**Thesis**	**Process and Defense**
LO 1	Translate a multidisciplinary (societal) problem to a set of research objectives and questions, based on state-of-the-art peer-reviewed literature, of sufficient scope and depth related to the three core knowledge areas of Spatial Engineering.	●	●	
LO 2	Define a clear structured methodology with conscious and justifiable choices between different modelling techniques for spatio-temporal processes.	●	●	
LO 3	Collect and analyse relevant data and information, and use, develop and validate models, working in a transparent and fully reproducible way.		●	●
LO 4	Draw viable conclusions and generate a good synthesis, and where possible, give recommendations that recognize the needs and wishes of stakeholder groups involved.		●	●
LO 5	Work in a structured and independent way, while making adequate use of the guidance of the supervisor			●
LO 6	Convey written information effectively using a professionally written and structured research proposal and thesis	●	●	
LO 7	Convey information effectively using professional visual and oral means in presenting the research		●	●
	Test type	Report	Report	Presentation
	Weight of the test	0	70	30
	Individual or group test	Individual	Individual	Individual
	Type of marking	Pass/Fail	1-10	1-10
	Required minimum mark per test			
	Number of test opportunities per academic year	2	2	2

RELATION OF LEARNING OUTCOMES (LO) OF THE COURSE WITH THE PROGRAMME LEARNING OUTCOMES

	Learning outcomes (LO) of the course: The student will be able to...	1	2	3	4	5	6	7
LO 1	Translate a multidisciplinary (societal) problem to a set of research objectives and questions, based on state-of-the-art peer-reviewed literature, of sufficient scope and depth related to the three core knowledge areas of Spatial Engineering.	●						●
LO 2	Define a clear structured methodology with conscious and justifiable choices between different modelling techniques for spatio-temporal processes.	●	●					
LO 3	Collect and analyse relevant data and information, and use, develop and validate models, working in a transparent and fully reproducible way.		●		●			
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LO 6	Convey written information effectively using a professionally written and structured research proposal and thesis						●	
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ACADEMIC AND RESEARCH PHASE

Course	**20240000**
Period	21 April 2025 - 04 July 2025
EC	5
Course coordinator	drs. T.R. Luiten MBA

INTRODUCTION

The MSc research is the main part of the second year. It is an individual effort where the student will learn to use scientific principles to do reasearch. From a societal or scientific overall problem, the student will investigate the state-of-the-art using peer reviewed literature and formulate what needs to be investigated in order to improve our understanding. From this, research objectives are defined, corresponding questions are formulated and a detailed and transparent methodology is created to provide answers. Conclusions and recommendations and a synthesis are formulated in a critical way. Spatial Engineering is a multidisciplinary study. Although this is a specialisation phase where the student can analyse a problem in depth, they are required to use at least 2 out of 3 of the core knowledge areas, and reflect on how the results in potentially related to the third core knowledge area. If the research is for instance more technical in nature, the results should include a reflection on the potential effects on stakeholders. If the emphasis is on planning/governance, a reflection on the feasibility of the technical engineering context should be included. The MSc research is in total 37.5 EC, split in a proposal writing phase and a research phase that results in a thesis. The proposal itself is a written document that is defended in an oral test before a Proposal Assessment Board (PAB), and must be successful in order to be allowed into the research phase itself.

Details on the assessment of the Academic and Research phase can also be found on the ITC intranesite: https://www.itc.nl/intranet/education/rules-and-procedures/assessment/assessment-instructions/.

CONTENT

Proposal

Developing the MSc research proposal requires a sufficient understanding and integration of research aspects from all different scientific technical and non-technical disciplines involved in the proposed research. So, in addition to the academic and research skills already gained during the first-year students will receive guidance on these skills during this part of the Academic Research phase.

The proposal is developed in steps that follow the logic of a written proposal.

General lectures are provided on

1. Development of research questions

2. Methodological choices

3. Ethical concerns

In addition each research theme provides supervised peer review sessions.

The proposal has to contain a detailed methodology that in principle should be able to answer each of the questions. Analysis methods and models have to be specified in sufficient detail, and based on an expected outcome and potential problems encountered. If you do not master parts of the methodology yet, make sure you understand these sufficiently to estimate their outcome, based on your literature review. Plan sufficient time to learn new methodologies.

The student will have two supervisors with whom the content of the proposal is discussed. The supervisors will ascertain that the proposal is feasible, and will help with identifying counterparts that the student may contact. One of the supervisors should be from ITC faculty representing one of the three core knowledge areas of Spatial Engineering. The other can be from another research institute.

Practical constraints apply: the topic must be possible in terms of availability of data, logistics, and supervision, and be financially possible. If a field investigation is envisaged, supervision in the field is required and the investigation must be possible within the time frame and financial constraints.

Thesis

The research phase has a normal duration of 2 quartiles and usually starts with acquisition of data and information. In case this involves fieldwork, a staff member or a counterpart will be present for a part of the time. Regular meetings are scheduled at the student's initiative. The student comes to the meetings prepared, and gives a concise summary with action points afterwards. It is expected that the student gradually takes control of his/her own research and becomes an expert in the topic. The role of the supervisor is to guide the independent research of a student. Sometimes, depending on the data vailability or application of a focus along the way, research objectives may be adjusted. This is done in discussion with the supervisors. The set of objectives, analysis and conclusions in the thesis should be an integrated work, but it can differ from the original proposal. During this phase new analysis techniques may be learned, but plan sufficient time for this.

TEACHING AND LEARNING APPROACH

Guided proposal writing, performing independently although supervised research and report on the results.

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