

ITC STUDY GUIDE 2010

**Undergraduate Diploma course
in Geo-information Science and
Earth Observation for**

Geoinformatics

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Foreword

Dear course participants,

Welcome to ITC.

Having left your family and country, you have come to ITC to further your education. We hope that the course you have selected will fulfil your expectations.

A major change has taken place, as from the 1st of January 2010 ITC has become a faculty of the University of Twente (UT). ITC education, however, will continue to be offered at the present location of our Institute.

Education at ITC is characterised by:

- a modular set-up,
- a mixture of theory and practice, often including participants' own experiences,
- a core curriculum for Remote Sensing (RS), Geo-information Systems (GIS) and Geo-Visualization,
- choice options according to individual (project) interest and/or the needs of your own organisation.

We are pleased to present you this study guide for the 2010 Diploma course offered full-time at ITC Enschede. This study guide gives you information on the courses, an overview of the modules and the detailed content of the course modules. ITC is continuously modifying its courses to the needs of its students and their organisations.

Description of all elements of education at ITC and the descriptions of the modules of other courses are available on the ITC website (<http://www.itc.nl/Study> or <http://www.itc.nl/Pub/Study/Studyguide>).

But there is more to life at ITC than only education. You have arrived at an Institute with more than 400 students from over 70 countries. Furthermore, also ITC staff is originating from more than 25 countries: a truly international environment where you will be able to meet colleagues from all over the world. ITC is organising all sorts of social, cultural and sports activities. Well-known are the International Sports Tournament, the International Food Festival and the International Cultural Event. We would like to encourage you to participate in many if not all of these events and to make new friends in the process.

We will do our best to provide you with the quality of education that you expect from our Institute.

We wish you the best of success during your studies and a pleasant stay at ITC and in the Netherlands.

1. Undergraduate Diploma course in Geoinformatics

Geographic and Earth sciences rely increasingly on digital spatial data, much of which is acquired from remotely sensed images, analysed through Geographic Information Systems (GIS) and visualised on the computer screen or on paper. The technologies supporting the processes of acquisition, analysis and visualisation of spatial data form the core of geoinformatics. Operational skills alone are not sufficient for organisations involved in the production and management of geoinformation. To optimise the use of technology, additional capabilities must be available in an organisation, such as a thorough understanding of efficient data collection, structuring of spatial databases and data output by visualisation techniques, as well as a sound organisational infrastructure for the management of and access to the data.

To meet these requirements the Geoinformatics Domain at the ITC offers more than training in operating the technologies; it aims to provide a profound understanding so that participants can continue to keep pace with rapid technological developments long after they leave the ITC.

1.1 Curriculum, Objectives and competences

In map and geoinformation production organisations the prime concern of the technologist staff is the execution of daily operational tasks. Such tasks demand specialist practical skills as well as in-depth knowledge of the technical processes involved. The function of the technologist is the co-ordination of production processes, the implementation of work procedures, and the supervision of groups of operators, either in a multi-disciplinary or specialised production environment.

The undergraduate diploma course in Geoinformatics is appropriate for:

- staff responsible for the implementation of production tasks and for the supervision of the various processes in map and geoinformation production at national and regional agencies, local authorities, and private companies;
- staff responsible for technical training at/for the above mentioned organisations.

The duration of the Diploma course is 9 months and is only offered in the Geoinformatics Domain.

The aim of the course is to provide participants with the theoretical education and practical training needed to contribute to the production of maps and geoinformation using appropriate, state-of-the-art technology with in-depth knowledge in one of the specific aspects of the production process. Special attention is given to the implementation of the digital production of geoinformation.

At successful completion of the Diploma course, the student is able to:

1. Effectively and efficiently execute primary map and geoinformation production tasks;
2. Assist in the planning and supervision of specific production tasks;
3. Assess product quality with reference to technical specifications;
4. Interact effectively with professionals from associated production disciplines in coordinating production;
5. Advise on the selection of appropriate production materials and equipment.

These objectives are worked out into objectives at module level. For more information on these, please check the module descriptions.

The Diploma course leads to a diploma with the title:

“Diploma in Geo-Information Science and Earth Observation”.

1.2 Course structure

The course offers an attractive and intensive educational package including theoretical lectures, practical exercises, multidisciplinary project work and hands-on case studies. Practical exercises are normally divided into periods with close staff supervision and periods during which participants are expected to work on their own. Including self study, the study load for the average participant is estimated to be 48 hours per week. Apart from public holidays, there are no vacation periods in the intensive programme. A catch-up week is however included.

The course consists of a number of modules lasting three or more weeks each. Common modules of the course are designed to ensure that the participants not only acquire the necessary basic knowledge and abilities, but also gain an insight into the multi-disciplinary structure of a modern production environment, and an appreciation of where their own particular contribution lies within that structure.

After completion of the common modules, the course provides three options of streams, namely Remote Sensing and Digital Image Processing, GIS Operation, and Cartography and Geo-Visualisation. The stream modules enable the participants to acquire knowledge and skills specific to their production and technical training tasks in their organisation.

An important theme of the course is "integration of discipline knowledge", in which participants of all streams are actively encouraged (by means of integrated activities), to interact and co-operate with partners from associated disciplines in the achievement of "group goals". Such activities are designed to stimulate a broader appreciation of the total production process. The course culminates in a production-oriented Individual Final Assignment (IFA), for which course participants are encouraged to use data from their home organisation. Various stages of geoinformation production are simulated in the IFA. Using the skills and techniques previously learnt, the participants will work individually on a short production orientated project with emphasis on the interfaces between the different stages of the production line, data exchange and data quality.

In order to familiarise the participants with the structure, organisation and working practices employed in both commercial and governmental mapping organisations, a short study excursion will be made to appropriate centres in the Netherlands and possibly one or more neighbouring countries.

1.3 Streams

Once the common technological concepts and processes in geoinformatics are mastered the participants choose one of the three streams offered. These are:

- Remote Sensing and Digital Image Processing
- GIS Operation
- Cartography and Geo-visualisation

Remote Sensing and Digital Image Processing

The quality of decision making on matters of urban growth, environmental protection, exploration of natural resources, sustainable development and communication depends to a large extent on the timely availability of adequate spatial data. Zealous research efforts and rapid technological developments continuously offer extended and new possibilities of efficient data acquisition. Advances in airborne and spaceborne sensor systems, digital photogrammetry, image understanding and computer vision favour integrated acquisition techniques. Using new and conventional techniques is a challenge to a wide variety of geoinformation production units.

The stream addresses the use of systems and techniques for primary data acquisition. It covers concepts, systems and methods of image transformation and information extraction from primary data. Applying processes on both topographic and thematic data are an important aspect of the stream. Participants are prepared for the operational management of spatial data production.

GIS Operation

This stream provides participants with the theoretical education and practical training needed to build and manage spatial databases and perform spatial analysis using database management systems (DBMS) and GIS tools. GIS tools provide specialised functions for spatial data input, processing, analysis and output, while DBMS tools provide more advanced functions for storing and managing large spatial databases. Participants learn the necessary skills to integrate the two sets of tools for purposes of spatial database management and spatial data analysis.

Although DBMS and GIS tools provide powerful functions for spatial database management and spatial data analysis, a GIS specialist still needs to acquire basic programming skills in order to customise the GIS interface and develop functions not yet available. The first module of the stream introduces the principles of programming. The second module introduces methods and techniques to design, create and use spatial databases. The third module will look into advanced analysis including raster datasets, networks and TINs. In the last module, based upon knowledge obtain during the previous modules, the focus will be on the development of web mapping applications and services.

Cartography and Geo-Visualisation

Modern cartography is more than the presentation of geographical information in map form. The increasing use of the Internet and multi-media to disseminate geographical information place their own specific demands on display techniques. These developments are well reflected in the stream in Cartography and Geo-Visualisation, which aims to give an in-depth training in the principles of map design and in the use and management of the techniques required to produce maps on a computer display screen or on paper.

The stream provides participants with the theoretical education and practical training needed to contribute to the cartographic visualisation of geoinformation by means of either screen displays or hard copies. The first module, deals with compilation analysis and preparation of (geo-spatial) data, the cartographic modelling and the dissemination of the information. In addition, this module contains an introduction to Work Flow Management and cost calculation. The second module outlines the production and actualisation of map with a topographic information content and includes the visualisation of three-dimensional surfaces, photo and image mapping. The third module outlines the diversity, design and production of thematic maps, includes statistics and data classification. In addition interactive, animated and dynamic web mapping will be treated.

The final module, Web cartography and mapping projects outlines the fundamentals of web cartography and web site creation and the technical execution and management aspects of a cartographic production process, implemented in a thematic / topographic web mapping project.

1.4 Assessment

Assessment of the knowledge and skills acquired by the course participants in the Diploma course will be done through formative (feedback) and summative (grading) assessment. In both cases, the purpose of the assessment will be to check that the course participants have achieved the learning objectives of the particular subject and module.

Formative assessment will be used with the objective of giving feedback on knowledge and skills acquired by the course participants; formative assessment will not be taken into consideration for the award of a Diploma.

Summative assessment will be used to test the knowledge of concepts, methods and techniques and problem solving capabilities. This will be realised by means of integrated examinations, assignments, project report and interview, supplemented by personal discussions with staff. Marks will be generated from these assessments and will serve as the basis for the award of the Diploma.

The full procedure for written examinations is:

- question hour session a few days before the examination;
- examination;
- feedback session a few days after the examination;
- students will receive the marks within two weeks of the examination;
- possibility to see the marked examination (contact Module co-ordinator);
- in case of failure a resit to be held in principle within three weeks of receiving the result of the first examination.

Marks for the assessments (subject groups) and a course average will be indicated on the course record that accompanies the diploma.

1.5 Roles within the Curriculum

Course Director

The course director is authorised by and accountable to the Head Education regarding development and implementation of all courses within a specific domain and their streams. The course director is responsible for execution of the courses, including logistic aspects, fieldwork, purchase of all materials, the administration of information regarding students and their study results, diplomas and course records, and course content archiving.

Course Coordinator

The course co-ordinator is the first point of contact for students and assists the students in cases where study or personal problems may have a negative impact on study results. The course co-ordinator is aware of the study progress of the individual students and informs the Course Director about negative study results if these may lead to a non-diploma status. The course co-ordinator assists the students in the selection of an Individual Final Assignment (IFA) and is module co-ordinator of the Individual Final Assignment modules.

Course Secretary

The course secretary supports the execution of the course and the course director. She is the first point of contact for students requiring information regarding the course.

Module Coordinator

Each module is coordinated by a staff member. He or she is responsible for the organisation and execution of the entire module. The module coordinator can be contacted for information or questions regarding the module he/ she is responsible for.

Academic Board

The Academic Board, consisting of all professors of ITC, is amongst other tasks, responsible for the curriculum and quality assurance of education.

1.6 Opening Hours of ITC Facilities

ITC building	
Monday-Thursday	07:30 - 22:30
Friday	07:30 - 21:00
Saturday	09:00 - 17:00

Bookshop (room 0-006)	
Monday-Friday	08:30 – 12:15 12:45 – 16:30

Library (room 3-038)	
Monday, Thursday, Friday	08:30 - 17:00
Tuesday, Wednesday	08:30 – 21:00

Audio-Visual centre (room 3-039)	
Monday, Thursday, Friday	08:30 - 17:00
Tuesday, Wednesday	08:30 – 21:00

Students' financial administration desk (room 1-130)	
Monday-Friday	10.30 – 13.30

Computer helpdesk (room 1-004)	
Monday-Friday	08:30 - 12:45 13:30 – 17:00

Restaurant (ground floor)	
Monday-Friday	
Coffee break free coffee/tea	10:15 – 10:45
Lunch	12:00 - 13:30
Tea break free coffee/tea	15:15 – 15:45

1.7 Starting dates of modules and holidays

Module number	2010
<i>Registration Undergraduate Diploma course</i>	<i>Monday, January 11, 2010</i>
Module 1	January 18 through February 5, 2010
Module 2	February 8 through February 26, 2010
Module 3	March 1 through March 19, 2010
Module 4	March 22 through April 9, 2010
<i>Good Friday</i>	<i>2 April</i>
<i>Easter Monday</i>	<i>5 April</i>
<i>Catch-up week</i>	<i>April 12 through April 16, 2010</i>
Module 5	April 19 through May 07, 2010
<i>Queen's day</i>	<i>30 April</i>
<i>Liberation day</i>	<i>5 May</i>
Module 6	May 10 through May 28, 2010
<i>Ascension day</i>	<i>13 May + 14 ITC closed</i>
<i>Whitsun Monday</i>	<i>24 May</i>
Module 7	May 31 through June 18, 2010
Module 8	June 21 through July 9, 2010
Module 9	July 12 through August 6, 2010
Module 10+11	August 9 through September 17, 2010
Final week	September 20 through September 24, 2010
<i>Closing ceremony</i>	<i>Friday 24 September 2010</i>

1.8 Curriculum of the Domain

Module number		Module title	Co-ordinating staff
Core			
Module 0:	11-01-10/15-01-10	Introduction	A.M. Mank
Module 1:	18-01-10/05-02-10	Principles of Geo-data acquisition	J.P.G. Bakx MSc
Module 2:	08-02-10/26-02-10	Principles of Geographic Information Systems	R.A. Knippers MSc
Module 3:	01-03-10/19-03-10	Principles of Geo-Visualisation	W.J. Kock
Module 4:	22-03-10/09-04-10	Basic concepts of Photogrammetry and Remote Sensing	4a. J.P.G. Bakx MSc
		Database Design and database Management	4b. J.F. Kooistra MSc
		Concepts of Cartographic design	4c. A.M. Mank
		Geo-information dissemination via internet	Project A.M. Mank
	12-04-10/16-04-10	Catch-up week	
Streams			
Remote Sensing and Digital Image Processing			
Module 5:	19-04-10/07-05-10	EO sensors and digital image processing	J.P.G. Bakx MSc
Module 6:	10-05-10/28-05-10	Primary 3D data acquisition from images	Ms Ir. M.K. Heenkenda
Module 7:	31-05-10/18-06-10	Topographic information extraction from sensor data	Ir. S.J. Oude Elberink
Module 8:	21-06-10/09-07-10	Advanced image classification and change detection	J.P.G. Bakx MSc
GIS Operation			
Module 5:	19-04-10/07-05-10	Principles of programming	Dr. O. Huisman
Module 6:	10-05-10/28-05-10	Spatial databases	J.F. Kooistra MSc
Module 7:	31-05-10/18-06-10	Spatial analysis	Ms Ir P.W.M. Augustijn
Module 8:	21-06-10/09-07-10	Use and Development of Web Mapping Application	Ms Dr. I. Ivánová
Cartography and Geo-Visualisation			
Module 5:	19-04-10/07-05-10	Map production workflow and quality management	W. Feringa
Module 6:	10-05-10/28-05-10	Topographic information production	R.A. Knippers MSc
Module 7:	31-05-10/18-06-10	Thematic and interactive map design	J.P.R. van den Worm
Module 8:	21-06-10/09-07-10	Web cartography and mapping projects	W. Kock
Final part			
Module 9:	12-07-10/06-08-10	Integrated Group Project including Study excursion	J.P.R. van den Worm
Module 10+11:	09-08-10/17-09-10	Individual Final Assignment	A.M. Mank
Final week	20-09-10/24-09-10	Closing ceremony Friday 24 September 2010	

1.9 Staff

Course Director and Course co-ordinators		
	Room	Phone
G.C. Huurneman MSc; GFM Course Director	2-009	216
Ms Dr.Ir. W. Bijker; Course co-ordinator of the Master of Science Degree course	2-040	203
Dr. Ir. R.L.G. Lemmens; Course co-ordinator of the Master Degree course	1-064	529
A.M. Mank; Course co-ordinator of the Diploma course	1-043	459

Course secretariat GFM/LA/UPM		
	Room	Phone
Ms J.M. Mol; course secretary Land Administration (LA) courses	2-105	480
Ms D.E. Scholten; course secretary GFM MSc, PG and Diploma courses	2-105	334
Ms L.J.C. Windig; course secretary GFM Master course and UPM courses	2-105	464

Module descriptions

2. Module descriptions

Introduction		
Module: 0	Module coordinator: A.M. Mank	
Start:	11-01-2010	
End:	15-01-2010	
Level: Diploma		U10-GFM-149

Introduction

Module 0 (Introduction) introduces the participants to the ITC study environment, get acquainted with educational and supporting staff, computer facilities and ITC's social activities. Participants will also be introduced to MS-Windows software, Internet, E-mail, the Blackboard teaching platform and the ITC intranet environment. And Introduction tour to the Twente Region will be organized.

Objectives

Upon completion of this module students should:

- Have a general overview of the duties and whereabouts of key ITC staff, which the course participants have to deal with during their stay at ITC.
- Get acquainted in the way how ITC operates as an educational environment.
- Have knowledge of basic computer skills as required within the ITC learning environment: (Basic) Skills in the use of MS-Windows, MS Word, Blackboard learning environment, use of e-mail and internet/intranet.

Contents

- Registration.
- Introduction to key ITC staff.
- Introduction to ITC learning environment.
- MicroSoft Windows.
- MircoSoft Word.
- E-mail.
- Internet/Intranet.
- Blackboard, etc.
- Excursion to Twente Region.
- Social excursion.

Prerequisites

Not applicable.

Recommended Knowledge

Basic knowledge and experience in the use of Microsoft Windows (95, 98, XP, NT or 2000).

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
15	6	0	4	0	4	16

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

For this introductory module no examination will take place.

Principles of Geo-data acquisition		
Module: 1	Module coordinator: J.P.G. Bakx MSc	
Start:	18-01-2010	
End:	05-02-2010	
Level: Diploma		M10-GFM-138

Introduction

This module is designed to ensure the overall understanding about the multi-disciplinary structure of a modern geoinformation production environment. Relevant systems are introduced and the main components, tools and techniques for spatial data acquisition are described.

Objectives

Upon completion of this module students should be able to:

- Describe the main components and their role in geoinformation production and mapping.
- Describe the used coordinate systems and reference surfaces.
- Describe the main steps involved in geoinformation production.
- Describe geodata acquisition methods and their relevance for various applications.
- Describe the main characteristics of Aerial photographs, satellite images, and other relevant spatial data and of derived geo information products.
- Use the basic components ERDAS, LPS and GPS equipment.

Contents

- Introduction geo-information production and methods of data collection.
- Coordinate systems, reference surfaces , transformations and map projections.
- Surveying - GPS.
- Characteristics of Aerial photographs and satellite imagery.
- Introduction to Photogrammetry.
- Introduction to digital image processing of RS images.
- Introduction to ERDAS.
- Introduction/demonstration of digital systems.

Prerequisites

Not applicable.

Recommended Knowledge

Basic computer skills.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
36	48	0	0	0	52	8

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on a written examination.

Principles of Geographic Information Systems		
Module: 2	Module coordinator: R.A. Knippers MSc	
Start:	08-02-2010	
End:	26-02-2010	
Level: Diploma		M10-GFM-139

Introduction

A wide range of organizations and business use Geographic Information Systems (GIS) technology to a variety of problems for different applications. The GIS technology has provided the means to store and access large amounts of geo-data, and process, analyze and visualize the data. This module aims to give you a general understanding what GIS technology is capable of doing for many kinds of problem solving.

Objectives

Upon completion of this module students should be able to:

- Define GIS, explain how to use GIS in solving spatial questions, outline developments and applications.
- Explain how geographic data are represented in a GIS, the spatial data types and their suitability in different applications.
- Build simple relational databases and perform databases query tasks.
- Apply basic GIS operations, including data input, editing, topology building, data transfer.
- Perform spatial analysis on vector data, including vector overlay, network analysis.
- Use the basic components of ArcGIS.

Contents

Main subjects are:

- Introduction to Geographic Information Systems.
- Introduction to ArcGIS.
- Spatial data preparation.
- 2D digitizing.
- Databases and database management systems (incl. introduction to MS Access).
- Spatial data analysis.

Prerequisites

Module 1 of the Diploma core programme.

Recommended Knowledge

Basic computer skills.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
32	44	14	0	0	48	6

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on a combined written/practical examination (closed book, 100%).

Subjects to be covered in the examination:

- Introduction to Geographic Information Systems;
- Databases and database management systems;
- Spatial data preparation;
- Spatial data analysis.

Principles of Geo-Visualization		
Module: 3	Module coordinator: W.J. Kock	
Start:	01-03-2010	
End:	19-03-2010	
Level: Diploma		M10-GFM-140

Introduction

This module is designed to give you a basic understanding of cartographic visualization. A small practically oriented project will focus on the main components of a GIS based map design and production process.

Next to this, this module will introduce you to the basics of Internet Web site design and publishing on the Internet.

Objectives

Upon completion of this module students should be able to:

- Understand the role of geo-data visualization in a GIS-environment.
- Understand basic concepts of cartographic visualization, related to map use and map user requirements.
- Understand the difference between conceptual and graphic map generalization.
- Understand the basic concepts and techniques of Internet mapping.
- Describe the main components of GIS-based map production processes and apply this by executing a map production project including data visualization, map layout and output.

Contents

Main subjects are:

- Introduction to data visualization.
- Workflow design basics.
- Introduction to map production and cartographic output.
- Basic aspects of Map generalization.
- Internet technology basics.
- Project: Map design and production.

Prerequisites

Module 1 and 2 of the Diploma core programme.

Recommended Knowledge

Not applicable.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
32	46	12	0	0	46	8

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on a combined written/practical examination (100%).

Subjects to be covered in the examination:

- Workflow design;
- Data visualization;
- Map production;
- Internet technology basics.

Basic concepts of Photogrammetry and Remote Sensing		
Module: 4a	Module coordinator: J.P.G. Bakx MSc	
Start:	22-03-2010	
End:	09-04-2010	
Level: Diploma		M10-GFM-141

Introduction

The preceding Core modules gave an introduction to the integrated nature of geo-information acquisition, production, analysis and visualisation for efficient and effective application in a variety of fields. Analysis of remotely sensed imagery, from airborne or spaceborn platforms, for topographic and thematic information extraction provides an important source for geospatial databases. To fully understand and appreciate the ongoing development of high resolution digital sensors and application of semi-automatic extraction methods, an introduction to some basic concepts of the geo-information production cycle on the basis of analogue photogrammetry and remote sensing is required.

The geo-information production cycle is taken as basis to introduce the contents of this module and to show relevancy. This module treats basics of/at acquisition (EM), basics of preprocessing (image orientation) and basics of image analysis (DIC). The propagation of radiometric/geometric errors is highlighted from a conceptual point of view, with practical application and illustrations in the 3 main topics. Since working with imagery requires its display, color theory mono and stereo are treated as well.

At the end of the module participant execute an individual assignment from which the output will be integrated in a web based environment.

Objectives

Upon completion of this module students should be able to:

- Describe the mechanisms of interaction between Electro Magnetic energy and the atmosphere and objects.
- Explain and apply image orientation with focus on aerial photography.
- Explain and apply basic digital image classification.
- Explain color systems and their relationships and differences.
- Explain and apply methods for colour image and stereo display.
- Design a basic web site for dissemination of geospatial data.

Contents

- Principles of EM; reflection, absorption, transmission, emission properties of Atmosphere and targets, signatures, atmospheric windows, relationship wavelength – resolution – energy, EM spectrum -> sensor -> application.
- Image Orientation; interior, exterior, relative stereo, absolute stereo, independent model, types and application of Control Points, expected accuracies, focus AP but only relevant aspects for sensors, specific QC.
- Principles of vision: image display, color theory, display principles, mono and stereo (how to display and how to generate), monochromatic and color display.
- Basic concepts of digital image classification: Box, Minimum Distance and Maximum Likelihood classification, specific QC, error matrix.
- Web design for dissemination of geospatial data.

Prerequisites

Core Modules of the Diploma course.

Recommended Knowledge

Elementary mathematics and statistics. Characteristics of digital images and image enhancement, Principles of GIS and visualization, Introduction to ERDAS and ArcGIS.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
36	34	4	20	10	34	6

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual written assessment covering all lecturing topics (closed book, 60%) and assessment of IA Digital Image Classification (40%).

Note(s)

This module consists of a two week stream oriented program and will be succeeded by workshops on presentation matters and dissemination of Geo-information via internet.

These workshops include the following:

Reporting skills and presentation techniques: 2 days.

Database connection and Webservice: 2 days.

Database Design and database Management		
Module: 4b		Module coordinator: J.F. Kooistra MSc
Start:	22-03-2010	
End:	09-04-2010	
Level: Diploma		M10-GFM-142

Introduction

Database Design and Database Management for thematic data is an essential part of Geographic Information System application development. This module gives an introduction to the design and manipulation of relational databases.

Objectives

Upon completion of this subject participants should be able to:

- Explain the concepts of database, query language and database application.
- Explain the phases of database development.
- Understand diagrams used for database design.
- Design and create a small relational database.
- Implement and execute basic SQL queries.
- Use MS Access forms and reports.

Contents

- Definition of key database concepts.
- Structured Query Language (SQL).
- Database design approach: conceptual and logical modelling.
- Use interface design for databases using forms and reports.

Prerequisites

Core modules of the Diploma programme.

Recommended Knowledge

Not applicable.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
24	32	14	24	20	12	18

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on a written examination (60%) and group project (40%).

Note(s)

This module consists of a two week stream oriented program and will be succeeded by workshops on presentation matters and dissemination of Geo-information via internet.

These workshops include the following:

Reporting skills and presentation techniques: 2 days.

Database connection and Webservice: 2 days.

Concepts of Cartographic design			
Module: 4c		Module coordinator: A.M. Mank	
Start:	22-03-2010		
End:	09-04-2010		
Level: Diploma		M10-GFM-143	

Introduction

This introduction of Cartography and Geo-Visualisation is designed to provide the participants with fundamental knowledge on how and when to implement the theoretical approach of the cartographic visualisation process of geoinformation into practical applications.

Objectives

Upon completion of this module students should be able to:

- Describe the cartographic communication process.
- Decide a proper representation method to portray geospatial information based on map use and user requirements.
- Apply the cartographic grammar to the design of functional map symbols and typography.
- Understand the role of colour as one of the most important graphic visual variable, as well as its role and characteristics for different output media (soft- and hard copy).
- Understand the basic conceptual and graphic aspects of generalisation for different map types.
- Have the ability to design and implement a functional map layout model, including legends, on a given dataset within the MacroMedia FreeHand environment.
- Make use of exchange software to import and process different file formats into graphic software.

Contents

As a follow-up to the brief introduction to visualisation of geospatial data in the preceding modules, this module focuses on the main principles of visualisation of geospatial data for both soft- and hardcopy output. Key features are:

- Cartographic communication process.
- Selection of visualisation model and map type.
- Data analyses for presentation.
- Symbol and map design.
- Typography and name placement.
- Use of colour in maps.
- Generalisation for different map types.
- Compilation model for generalisation.
- Exchange software for vector/raster file formats.

Prerequisites

Module 1, 2, and 3 of the Diploma course core programme.

Recommended Knowledge

Knowledge obtained in previous modules.

Compulsory textbook(s)

- “Designing better maps, A guide for GIS users”: Cynthia A Brewer (2005); ESRI Press
- “Colour Basics for GIS Users”: Allan Brown and Wim Feringa (2003); Prentice Hall, Pearson Education Limited.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
36	34	0	30	0	40	4

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on a written examination (closed book, 100%).

Subjects to be covered in the written examination:

- Symbol design and name placement/typography;
- Colour;
- Generalization;
- Map layout.

Note(s)

This module consists of a two week stream oriented program and will be succeeded by workshops on presentation matters and dissemination of Geo-information via internet.

These workshops include the following:

Reporting skills and presentation techniques: 2 days.

Database connection and Webservice: 2 days.

Stream: Remote Sensing and Digital Image Processing

EO sensors and digital image processing		
Module: 5	Module coordinator: J.P.G. Bakx MSc	
Start:	19-04-2010	
End:	07-05-2010	
Level: Diploma		M10-GFM-145

Introduction

A comprehensive overview of sensor characteristics is required to be able to select the most appropriate (aerial or space borne) sensor data for an application. Subsequently a number of geometric and radiometric calibration methods are required to support optimal analysis and integration with other data sets in a geo-information production system (e.g. GIS, geospatial databases). Since operation on aerial and space borne photo's and images increasingly is being done at computer systems, basic knowledge about image display and enhancement is recommended.

Objectives

Upon completion of this module students should be able to:

- Translate application requirements in sensor characteristics and assess feasibility.
- Show practical skills handling sophisticated Satellite Navigation Systems.
- Measure and assess quality of positional control.
- Select required radiometric calibration methods.
- Define appropriate required accuracies for various applications.
- Select and apply appropriate image display and enhancement methods.

Contents

- EO Sensors characteristics: spatial, spectral, temporal, radiometric.
- EO Sensors systems: active (Laser Scanning), passive (only digital).
- Positional control: platform (application of Ephemeris, GPS, INS), ground (application of handheld, RTK, post processing).
- Spectral and spatial image enhancement.
- Radiometric calibration of sensor data.

Prerequisites

Core modules, Module 4 with the Digital Photogrammetry and Remote Sensing focus.

Recommended Knowledge

Not applicable.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
30	28	4	0	8	68	6

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual written assessment covering all lecturing topics (closed book, 80%) and assessment of IA on Positional Control (20%).

Primary 3D data acquisition from images		
Module: 6	Module coordinator: Ms Ir. M.K. Heenkenda	
Start:	10-05-2010	
End:	28-05-2010	
Level Diploma		M10-GFM-146

Introduction

3D positioning using image data requires knowledge of orienting digital images in various configurations. Having solved the primary task of relating an airborne or space borne image to a spatial reference frame, we can convert such images to orthoimages which have the same geometric properties as a map. A prerequisite for producing orthoimages is a digital terrain model (DTM), which is also a standard geoinformation product that can be used for many other applications. Therefore, this module aims to describe tools and techniques related to so called 3D data acquisition process.

Objectives

Upon completion of this module students should be able to:

- Explain and apply digital orientation procedures of images for large and medium scale mapping (including triangulation).
- Estimate the attainable geometric accuracy of positioning by images.
- Explain and apply DTM generation.
- Explain and apply generation of orthoimages and related products.
- Assess the accuracy of primary aerospace image products.

Contents

- Alternative image Orientation
 - Frame camera Image w/o camera calibration (DLT, parameter estimation)
 - Double bundle Orientation (All image types)
- Digital (Bundle) Block Adjustment (AT)
 - Principle and Block Structure, index exercise
 - Gross error detection and elimination
 - Treatment of systematic errors, additional parameter option to resolve additional errors
 - Position and Attitude Recording application
 - Automation benefits and pitfalls
- DTM
 - Sources
 - Applications
 - Extraction
 - Quality checking
 - Editing (exercise)
 - Developments (Laser, Radar)
 - Accuracy assessment of DTM
- Orthoimages
 - Geometric quality / DTM requirement
 - Radiometric quality, Mosaicing
 - Resolution
 - True orthophoto
 - Stereo from orthophotos
 - Stereo Orthophotos

Prerequisites

Core modules. Module 4 and 5 of the Remote Sensing and Digital Image Processing stream.

Recommended Knowledge

Analogue/digital image orientation, EO sensors, stereoscopy, 2D geometric image transform.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
30	33	11	0	20	41	9

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

- Written examination covering all topics (closed book, 60%)
- Individual Assignment for DTM generation and accuracy assessment 20%
- Individual Assignment for Orthophoto/image generation 20%

Topographic information extraction from sensor data		
Module: 7	Module coordinator: Ir. S.J. Oude Elberink	
Start:	31-05-2010	
End:	18-06-2010	
Level: Diploma		M10-GFM-147

Introduction

Topographic feature extraction from images and updating of topographic database is a key issue of providing base maps in digital form. Well trained human operators are required to do this job efficiently as automated processes of acquiring topographic information are only partly applicable in operational practice. The module treats in a practical manner feature and object extraction from aerial photographs and high resolution satellite images.

Objectives

Upon completion of this module students should be able to:

- Describe characteristics of topographic databases and related software.
- Translate topographic database/map specifications into data acquisition parameters and workflows.
- Explain and apply manual terrain feature extraction on mono and stereo systems.
- Describe basics of object based classification and techniques in support of automatic terrain feature extraction.
- Explain related quality control procedures.
- Apply databases updating.

Contents

- Topographic databases: characteristics and impact on data acquisition.
- Spatial data standards, map specifications and meta data.
- "Mapping" systems.
- Visual image interpretation and change detection for base mapping.
- 2D and 3D feature extraction by digitizing.
- Object based classification and semi-automatic feature extraction for buildings.
- On-screen editing.
- Field check and completion.
- Quality control.
- Database updating and generating meta data.

Prerequisites

Core modules. Module 5 and 6 of the Remote Sensing and Digital Image Processing stream.

Recommended Knowledge

EO systems, Image enhancement, Image Orientation, Stereoscopy, GIS and visualization, Surveying and GPS.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
24	52	4	20	12	26	6

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Practical (IA): Individual's task and assignment covering the topographic information extraction subject, the strategies, and the analysis of output quality of final product.
 Assessment (IA): (IA-Interview: 50%; IA- Product delivery: 25%; IA-reporting, work flows-procedures, end product of data-documentation & archiving: 25%).

Advanced image classification and change detection		
Module: 8	Module coordinator: J.P.G. Bakx MSc	
Start:	21-06-2010	
End:	09-07-2010	
Level: Diploma		M10-GFM-148

Introduction

More sophisticated classification algorithms become available "of the shelf" to GI technologists working in mapping and monitoring. Developments like sub-pixel classification, fuzzy classification and rule-based expert systems can be applied successfully for mapping different types of objects with more detail and/or higher accuracy.

In this module also the temporal dimension receives attention, as basic change detection and monitoring techniques, based on remote sensing are explained.

Objectives

Upon completion of this module students should be able to:

- Perform pan-sharpening and (other) image fusion and assess its validity.
- Apply sub-pixel classification using linear unmixing.
- Apply Fuzzy concepts in classification.
- Develop a rule-based expert system for classification.
- Apply post-classification improvement.
- Apply change detection and monitoring techniques.
- Perform relevant error-assessment and quality control.

Contents

- Image fusion.
- Advanced image classification (Sub-pixel classification, fuzzy, object-based, expert/rule based).
- Post-classification processing.
- Change detection and monitoring.

Prerequisites

Core modules, modules 4,5,6,7 of the Remote Sensing and Digital Image Processing stream.

Recommended Knowledge

Radar geometry, basic image classification, relative atmospheric calibration.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
36	38	2	0	16	46	6

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual written assessment covering all lecturing topics (closed book, 40%) and assessment of IA on Advanced Image Classification (60%).

Stream: GIS Operation

Principles of Programming		
Module: 5	Module coordinator: Dr. O. Huisman	
Start:	19-04-2010	
End:	07-05-2010	
Level: Diploma		M10-GFM-149

Introduction

Current 'Desktop' GIS come equipped with a range of functions and capabilities aimed at the end user. In the field of GeoInformatics, programming is an important skill in both the development of applications and the generation of solutions to complex problems. This course is aimed at GIS developers as well as industry professionals. It focuses on basic concepts of computing and programming languages, and introduces the Python programming language for automating and customizing GIS analyses.

Objectives

Upon completion of this module students should:

- Understand and be able to explain the basic elements of programming languages.
- Be aware of the possibilities of programming a GIS.
- Be able to design and develop simple programs using python.

Contents

This module consists of the following subjects:

- Principles of Programming (30%). This subject introduces the basic concepts of computing and programming languages.
- Introduction to Python (70%). This will involve learning the syntax of the python programming language for relevant applications.

Prerequisites

Not applicable.

Recommended Knowledge

Practical skills of Windows operating system.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
28	50	0	0	18	38	10

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Assessment for this course is made up of a group project as well as an individual exam.

Spatial databases		
Module: 6		Module coordinator: J.F. Kooistra MSc
Start:	10-05-2010	
End:	28-05-2010	
Level: Diploma		M10-GFM-150

Introduction

In a previous module the concepts of databases were introduced and we learned how to design and create a relational database. In this module we will build onto this knowledge and skills and extend it to spatial databases.

Spatial databases assemble geo-spatial data from various sources into a form in which the data can be stored, searched, retrieved and analyzed. Methods and techniques are introduced to design, create and use spatial databases.

Objectives

Upon completion of this module participants should be able to:

- Explain the difference between spatial and non-spatial data.
- Understand spatial data models (vector, raster).
- Explain the concepts and structure of spatial databases, simple behaviour.
- Design and create Geodatabases.
- Understand diagrams used for spatial data modelling.
- Extend a non spatial database with spatial data.
- Apply the concept of topology.
- Validate and update UML geodatabase schemas.

Contents

This module is the link between the Database Design and Database Management module (4) and the Spatial Analysis module (7)

Topics:

- Geographic phenomena and Spatial data structures.
- Spatial databases versus (attribute) databases.
- Simple behaviour (domains, subtypes, relationship classes).
- Topology.
- Introduction to spatial data modelling.
- Extension of the basic concepts of UML to include spatial datalayers.
- Design and Create a Geodatabase.
- Test and update UML Geodatabase schemas.

Prerequisites

Core modules and module 5 of the GFM Diploma Course, GIS operations.

Recommended Knowledge

General knowledge about databases.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
26	28	16	0	24	40	10

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

A written examination with questions from all given subjects (50%) and an individual practical assignment (50%).

Spatial analysis		
Module: 7		Module coordinator: Ms Ir. P.W.M. Augustijn
Start:	31-05-2010	
End:	18-06-2010	
Level: Diploma		M10-GFM-151

Introduction

During module 2 and 6 we dealt with several data models applied in ArcGIS and basic operations of spatial analysis. It is now clear that data models and analysis cannot be separated because the type of data model implies the possible analysis. This module will look into more advanced analysis including analysis on raster datasets, networks and TINs.

Objectives

Upon completion of this subject participants should be able to:

- Explain the basic elements of network data model.
- Prepare data sets for network analysis.
- Perform network analysis.
- Understand the raster data structure in Arc/GIS.
- Manipulate and query raster data.
- Formulate expressions for spatial analysis using map algebra language.
- Explain TIN data model.
- Perform surface analysis operations.
- Perform analysis using ArcGIS model builder.

Contents

The content of this module is split to represent the three different types of analysis (network, raster and surface).

For network analysis:

- Basic elements of road and utility network data model;
- Basic steps in preparing network data sets;
- Defining connectivity and cost;
- Network analysis.

For raster analysis:

- Raster data model;
- Surface analysis;
- Reclassification;
- Map algebra;
- Distance functions.

For surface analysis:

- TIN data model;
- Surface display and profile generation;
- Visibility analysis;
- Volume calculation;
- Slope and aspect calculation.

For each of these topics students will learn how to perform the analysis via tools and geo-processing models using the ArcGIS model builder. Examples will be given on how to perform the operations via geo-processing scripts (Python).

Model builder:

- Building process;
- Types of models;
- Storing models;
- Model iterations.

Prerequisites

Modules 1 to 6 of the GFM Diploma course, including good practical skills in ArcGIS 9.3 and a good understanding of basic GIS operations and analysis.

Basic skills in using model buider.

Recommended Knowledge

General knowledge about (geo) databases. Understanding of Subtypes, Domains, Topology.

Compulsory textbook(s)

Michael Zeiler (1999) Modelling our World, the ESRI guide to Geo-database design, Environmental Systems Research Institute<INC, USA, 199 pages.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
24	38	32	0	0	34	16

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Practical tests (raster, model builder, network and surface analysis). Total mark will be the average of the individual test scores.

Use and Development of Web Mapping Application			
Module: 8		Module coordinator: Ms Dr. I. Ivánová	
Start:	21-06-2010		
End:	09-07-2010		
Level: Diploma		M10-GFM-152	

Introduction

This module focuses on the development of web mapping applications. The knowledge and skills acquired in the previous modules will be also applied. New knowledge and skills will be introduced – with emphasis on use and development of web mapping application and services. The techniques learnt in this module will be applied in a case study, which will be carried out in small groups of students.

Objectives

Upon completion of this module students should be able:

- To determine User Requirements.
- To make a design for a Web mapping application.
- To use geo-Web services – web map application in a client.
- To develop geo-Web services – web map application on a server.
- To appreciate the need for team co-operation in GIS applications development.

Contents

Main topics are:

- Dynamic maps on the web.
- Using geo-Web services – web mapping application in a client.
- Developing geo-Web services – web mapping application on a server.
- Group work on a case study for Web mapping application development.

Prerequisites

Module 3, 4, 5, 6, 7.

Recommended Knowledge

Basic concepts of programming. Concepts of databases, Principles of GIS.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
20	40	0	40	0	30	14

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

This module will be assessed by a group presentation and a written examination:

- Group presentation of the case study. (40%)
- Individual assessment based on a written examination. (60%)

Stream: Cartography and Geo-Visualisation

Map production workflow and quality management		
Module: 5	Module coordinator: W.F. Feringa	
Start:	19-04-2010	
End:	07-05-2010	
Level: Diploma		M10-GFM-153

Introduction

This module does not focus on the actual map production aspects but deals with the management of the production (from start till end) and quality of the intermediate and final product(s).

In order to simulate a realistic map production process of general purpose maps within a mapping organisation, the production processes to handle geo-spatial data are sequentially treated in a series of lectures and associated exercises.

This includes the compilation analysis and preparation of (geo-spatial) data, the cartographic modeling and the dissemination of the information. To meet the growing demand to plan, describe and manage this map production line, this module contains an introduction to Resource and Work Flow Management, cost calculation and quality aspects.

Objectives

Upon completion of this module the participants should have:

- Knowledge of the basic concepts and technical constrains of the cartographic production line.
- Knowledge of processes at different production stages.
- Knowledge of in- and output requirements for mapping.
- Understanding of the basic principles of the Work Flow Management and Cost Calculation.
- Understanding of the basic principles of Quality control.

Contents

- The basics of Work Flow Management and Cost Calculation.
- An introduction to MicroSoft Visio as a tool for Work Flow Management.
- Setting up map production specifications.
- Map production using different types of data derived from various sources.
- Map production technology with emphasis on input and output.
- Map production according to specifications.
- Quality control according to specifications.

Prerequisites

Modules 1,2,3, and 4 of the Diploma course core programme.

Recommended Knowledge

Not applicable.

Compulsory textbook(s)

"Colour Basics for GIS Users": Allan Brown and Wim Feringa (2003); Prentice Hall, Pearson Education Limited.

"Design better maps, a guide for GIS Users": Cynthia Brewer (2005), ESRI Press.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
26	60	8	0	0	40	10

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on the results of the practicals (50%).
 Individual assessment by means of one written examination (50%).

Subjects treated in the examination:

- Production preparation;
- Cartographic processing;
- Cost calculation;
- Quality control;
- Production management.

Topographic information production		
Module: 6		Module coordinator: R.A. Knippers MSc
Start:	10-05-2010	
End:	28-05-2010	
Level: Diploma		M10-GFM-154

Introduction

Topographic information plays an important role in the planning and development of our environment. The greatest need for topographic data - such as geographic datasets, orthophoto imagery, raster-based digital elevation models (DEMs) - exists in settled areas where man's influence on the landscape is the greatest. Proper management of these areas is only possible with up-to-date data.

The increasing use of the Internet and multi-media to disseminate geo-information place their own specific demands on the dissemination and visualization of topographic information. These developments are well reflected in this module.

Objectives

Upon completion of this module students will be able to:

- Understand the special requirements in use, design and production of topographic maps, large-scale maps, photo and image maps and 3D-models.
- Describe how topographic maps are designed and produced (including the process of generalization), starting from a topographic database.
- Explain and apply the basic principles of Digital Terrain Models and their visualization.

Contents

This module outlines the production and actualization of geo-information for general purpose, with emphasis on topographic information, both for large scale and small scale.

Main subjects are:

- Topographic mapping.
- Photo and Image mapping.
- Large scale mapping.
- DTMs and 3D visualization.

Prerequisites

Modules 1,2,3 and 4 of the Diploma course core programme. Module 5 of the Diploma stream on Cartography and Geo-Visualization.

Recommended Knowledge

Good proficiency in ArcGIS.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
28	56	8	0	0	44	8

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on a written examination (closed book, 70%) on the following subjects:

- Topographic mapping
- DTMs and 3D visualization
- Photo and Image mapping

Performance in the subjects on Topographic mapping, Photo and Image mapping and Large-scale mapping will be assessed by means of the produced outputs (30%).

Thematic and interactive map design			
Module: 7		Module coordinator: J.P.R. van der Worm	
Start:	31-05-2010		
End:	18-06-2010		
Level: Diploma		M10-GFM-155	

Introduction

This module outlines the diversity, design and production of thematic map types, including the principals and application of statistics and data classification for thematic mapping.

Dissemination of spatial information through the web has become common. Therefore attention is also paid to the design and production of interactive and animated web maps using one of the world's leading commercial web design software packages (Adobe Flash).

Finally you will be introduced to a new cartographic visualization option : the creation of (semi-realistic) 3D map objects such as buildings that can be placed in e.g. Google Maps.

Objectives

Upon completion of this module the participants shall be able to:

- Define thematic mapping and give a description on the difference(s) between thematic and topographic mapping.
- Define the role of a base map within the context of thematic mapping.
- Define and describe the main thematic map types and their constraints in relation to cartographic design and content.
- Understand concepts and application of (descriptive) statistics for thematic mapping purposes.
- Understand the need for geographic data classification, in particular the classification of nominal and ordinal geographic data for mapping purposes at different scales.
- Describe concepts of web-based maps (planning, design and production).
- Design and produce a number of static and/or inter-active thematic (web) maps using Adobe Illustrator CS4, Avenza MaPublisher, Adobe Flash CS4 and Google SkecthUp Pro software for analogue and/or digital output.

Contents

- Thematic mapping (Lectures and class exercises).
- Statistics and data classification (Lectures and practicals).
- Thematic map production using Adobe Illustrator CS4 and Avenza MaPublisher software (Demo and practicals).
- Internet mapping: creation interactive, animated and dynamic webmaps using Adobe Flash CS4 professional software.
- Use of Google SketchUp / GoogleMaps to create semi-realistic 3D map objects.

Prerequisites

Modules 1,2 and 3 of the Diploma core programme. Modules 4 and 6 of the Diploma stream on Cartography and Geo-Visualization.

Recommended Knowledge

Not applicable.

Compulsory textbook(s)

- "Design better Maps, a guide for GIS Users": Cynthia Brewer (2005), ESRI Press.
- "Web Cartography": edited by Menno-Jan Kraak and Allan Brown (2001), Taylor and Francis.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
26	50	16	0	0	48	4

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment based on a written test (closed book examination 60%) and practical assessment (40%).

Subjects covered in the written examination:

- Thematic mapping;
- Web mapping;
- Statistics.

Subjects covered in the practical assessment:

- Thematic map production;
- Execution of practicals interactive web map design.

Web cartography and mapping projects		
Module: 8	Module coordinator: W. Kock	
Start:	21-06-2010	
End:	09-07-2010	
Level: Diploma		M10-GFM-156

Introduction

This module outlines the fundamentals of Web Cartography and Web Site creation and the technical execution and management aspects of a cartographic production process, which will be implemented by carrying out a Thematic or Topographic and a Web Mapping project.

Objectives

Upon completion of this module students will be able to:

- Design a cartographic production work flow.
- Apply quality control for different production stages.
- Execute a cartographic production project.
- Execute a Web mapping project.

Contents

Main subjects are:

- Web Cartography.
- Production technology.
- Topographic or Thematic mapping project.
- Web Mapping project.

Prerequisites

Modules 1, 2, and 3 of the Diploma Core programme. Module 4, 5, 6, and 7 of the Diploma stream on Cartography and Geo-Visualization.

Recommended Knowledge

Software experience: ArcGIS, Adobe Dreamweaver, Adobe Illustrator/MaPublisher and Microsoft Visio.

Compulsory textbook(s)

"Designing better maps, A guide for GIS users": Cynthia A Brewer (2005); ESRI Press.

"Colour Basics for GIS users": Allan Brown and Wim Feringa (2003); Prentice Hall, Pearson Education Limited.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
18	60	12	0	0	50	4

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

Individual assessment of the execution and the result of the Cartographic project (50%) and the Web Mapping Project (50%).

Integrated Group Project including study excursion		
Module: 9	Module coordinator: J.P.R. van der Worm	
Start:	12-07-2010	
End:	06-08-2010	
Level: Diploma		U10-GFM-150

Introduction

The aim of the integrated project is to allow participating students to apply their expertise, accumulated during the stream modules, in a small multidisciplinary geoinformation production case, based upon a realistic database and clearly defined individual tasks.

Objectives

Upon completion of this module students should be able to:

- Organise production issues like:
 - Production overview / planning / collaboration / etc.
 - Choice of hardware / software.
 - Quality / quality control.
- Apply their expertise in /give technical support to a multidisciplinary geoinformation production team.
- Explain and justify the chosen production line.
- Implement the acquired knowledge of production integration of the fields in geoinformation.
- Present and defend their final product(s).

Contents

- Within this module, the module specific knowledge acquired within the three fields of specialisation will be fused together and exploited in multi-disciplinary production team on a realistic data set of an urban area of the municipality of Enschede (Roombeek). Geographic information in digital format as well as aerial photographs and satellite images of the area are available.
- The results may be in the form of hard/soft copy maps, a multimedia presentation or an interactive internet application.

Prerequisites

Successfully completed all Diploma core and stream modules taught previously.

Recommended Knowledge

Not applicable.

Compulsory textbook(s)

None.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
2	0	0	106	0	26	10

Time (in # of hours) allocated per major method:

- L lecture,
SP supervised practical,
UP unsupervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study,
O overhead (e.g. QH, exam, opening)

Assessment

During the Integrated Project, each team will demonstrate the progress of their project verbally to the project supervisors at fixed times during three presentations.

The following topics will be assessed:

- Team presentations;
- The final result.

Study excursion

For a period of approximately one week, the student group will take part in a guided study excursion to selected European organisations involved in geographic information production. These organizations may include National Mapping Organisations, commercial companies, and training or research/development institutions.

Objectives

Upon completion of this module students should be able to:

- Be aware of various modern technologies applied to geoinformation production.
- Describe the structure, organisation and working practices employed in both commercial and governmental mapping organisations.
- Be able to report on the excursion.

Allocated time per teaching / learning method

L	SP	UP	GA	IA	S	O
0	36	0	4	0	0	0

Time (in # of hours) allocated per major method:

- L lecture,
SP supervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study (including unsupervised practicals),
O overhead (e.g. QH, exam, opening)

Assessment

No assessment.

Individual Final Assignment			
Module: 10-11		Module coordinator: A.M. Mank	
Start:	09-08-2010		
End:	17-09-2010		
Level: Diploma		U10-GFM-151	

Introduction

Within the field of their specialization, the Individual Final Assignment allows the course participants to work individually on a short GeoInformation production oriented project of a topic of their own (or organizations') interest. At an early stage in the course, the participants should consider what topic he/she might work on, and whether any material is required from his/her home country. The Individual Final Assignment aims to prepare the participant to prospective production tasks within their organization.

Objectives

Upon completion of this module students should be able to:

- Describe and apply the skills and techniques previously learnt in a piece of production work of their own choice.
- Individually plan large tasks, prepare work schedules and finish a task within a fixed and limited amount of time.

Contents

- New topics will not be taught in this concluding module. The participant should be confident to apply the accumulated expertise throughout the entire course in a project, which includes planning, work procedures, design, implementation and presentation.
- The data required for the enforcement of the project will be collected from the participant's organisation, if not feasible, comparable data will be supplied by ITC.

Prerequisites

Successfully completed all Diploma core and stream modules taught previously.

Recommended Knowledge

Stream depended Diploma course content.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
2	0	0	0	234	48	4

Time (in # of hours) allocated per major method:

- L lecture,
- SP supervised practical,
- UP unsupervised practical,
- GA group assignment (e.g. workshop, project),
- IA individual assignment (including Thesis, IFA),
- S self study,
- O overhead (e.g. QH, exam, opening)

Assessment

The assessment will be done by the allocated supervisor from the chosen stream in two phases.

- 1) Mid-term Assessment: intermediate assessment on the progress and status of the project.
- 2) Final Assessment: by means of drawn up written criteria and should result in a mark with a minimum weight of 60.

Assessment Regulations

ITC REGULATIONS FOR COURSES LEADING TO AN ITC DIPLOMA

- September 2009 -

- 1. Range of application**
- 2. Management, structure and organization of the course**
- 3. Admission to the course and individual changes in the course**
- 4. Assessment of modules (excluding Final Assignment)**
 - 4.1 Organization of module assessment**
 - 4.2 Feedback to participants and re-sits**
- 5. Final Assignment**
 - 5.1 The Final Assignment and result**
 - 5.2 Admission to the Final Assignment period**
 - 5.3 Supervision of the Final Assignment**
 - 5.4 Submission of the Final Assignment result**
 - 5.5 Assessment of the Final Assignment**
- 6. End-of-course assessment**
- 7. Awards and certification**
- 8. Early termination of the course**
- 9. Student appeal procedures**

Appendix:

Bodies and persons involved in management and quality assurance of the course.

These ITC Regulations for courses leading to an ITC Diploma were approved by the Rector and the Academic Board on 17 September 2008. These regulations apply to all Diploma courses commencing September 2009 onwards and replace all former ITC Regulations for courses leading to an ITC Diploma.

1. Range of application

- 1.1. These assessment regulations apply to all courses leading to an ITC Diploma starting from September 2009 onwards and replace all previous ITC Regulations for courses leading to an ITC Diploma.
- 1.2. The course can be an ITC course only (fully taught by ITC) or a joint course (fully taught by one or more of ITC's partners or partly by the partner and partly by ITC). The course can be taught face-to-face, at a distance or be a combination of both formats. In all cases, ITC monitors and assures the quality of the whole course.
- 1.3. In most cases where the course is taught in conjunction with a partner, the two institutes will agree upon new procedures which may take precedence over these 'ITC regulations for courses leading to an ITC Diploma'. The Course Director of the course concerned will inform the participants which assessment regulations and procedures apply.
- 1.4. Per 1 January 2010 ITC will be integrated in and will become a Faculty with special status of the University of Twente. This integration might have consequences for the assessment regulations and might lead to changes in these assessment regulations during the course.
- 1.5. In all cases that are not dealt with in these rules, the Course Director of the course concerned will decide upon an appropriate course of action. Disputes about the interpretation of these regulations shall be referred to the Rector, who will determine the interpretation and action that should be taken.
- 1.6. In exceptional circumstances, the Academic Board, Head Education and/or Course Director may deviate from these regulations, but only with the approval of the Rector.

2. Management, structure and organization of the course

- 2.1. Diploma courses are organized into modules¹ and may contain a Final Assignment at the end.
- 2.2. Participants may spread the course over a maximum of three and a half years.
- 2.3. The formal curriculum of a Diploma course has been approved by the Academic Board. Responsibility for detailed development and implementation of the approved course rests with Head Education, who delegates this responsibility to the Course Director. Responsibility for quality assurance of the Diploma course rests with the Academic Board.
The Academic Board decides on the eligibility of the participant to receive the Diploma.
(See also the appendix 'Bodies and persons involved in management and quality assurance of the course').

¹ A module consists of related subjects and has duration of 3 weeks. Courses may contain project-oriented elements of two or more combined modules.

- 2.4. During and at the end of the course, a participant's competence in the field of study will be assessed through tests, examinations and/or assignments in written, oral and/or practical form and/or based on participation. Assessments will be used to:
- Provide feedback to participants so that they may improve their performance (formative assessment), or,
 - Grade participants with a mark or quality description on a scale, which indicates their competence in the field of study (summative assessment).
- Before any assessment, participants shall be told which of the above two functions applies.
These regulations describe the conditions and procedures concerning summative assessments.
- 2.5. At the beginning of the course, each participant shall receive a study guide or written statement describing:
- Descriptions of the content of the course and modules
 - A copy of these regulations
 - The certification to be received on successful completion of the course
 - The course-specific conditions relating to such certification
 - Which module assessment will result in a mark and which modules in 'completed/fail'.
- 2.6. The relationship between mark ranges, 'completed/fail' and grades is as follows:

Mark:	Grade:
90 - 100	Excellent
80 - 89	Very good
70 - 79	Good
60 - 69	Pass
00 - 59	Fail
'completed'	Pass or higher
'fail'	Fail

3. Admission to the course and individual changes in the course

- 3.1. Applicants who meet the entry requirements, as stipulated in the current course brochure, may be registered for the course at the discretion of the Course Director.
- 3.2. Participants may be given exemption for a module of the course when they have shown they have already mastered the content of the module. An exemption for a module may lead to direct admission to the next module or to exchange of the module for a module in another course. All changes in the course are subject to the approval of the Academic Board (and in case of exchange for a module in another course, approval of the Course Director of that course).
A participant can also request to take modules/subjects in addition to the formal curriculum.
- 3.3. Exemption for a module will be given when this module was successfully completed by the participant:
- (1) As part of another course in the same ITC domain as the Diploma course and
 - (2) No longer ago than three and a half years before the participant is expected to complete the Diploma course.

At least 50% of the course has to be taken to be eligible for the Diploma. If less than 50% is taken the participant will be considered to be in an individual study programme and will get a Certificate mentioning the modules taken.

Requests for exemption that do not meet these conditions will be considered on an individual basis, at the discretion of the Academic Board. In such cases, exemption can be given for a maximum of 25% of the modules.

Exemption can never be given for (part of) the Final Assignment.

- 3.4. In exceptional cases, a participant may also exchange a module of which the content has not been mastered for a module given in other courses, provided that the Course Director of that course approved. This is up to a maximum of two modules and subject to the approval of the Academic Board.
- 3.5. Rules 3.2, 3.3 and 3.4 concerning changes in individual curriculum do not apply to joint courses and other cases where ITC has an agreement with a partner institute that students who have successfully completed a specific curriculum in the partner institute can be given direct admission to a later part of the Diploma course.

4. Assessment of modules (excluding Final Assignment)

4.1. Organization of module assessment

- 4.1.1. Each module will be assessed by means of a test, examination, assignment and/or based on participation. More than one assessment per module is allowed but must result in one single module mark (0 - 100) or 'completed/fail'.
- 4.1.2. For combined modules (e.g. core modules, Final Assignment) one overall assessment is allowed. However, for admission to the Final Assignment (see rule 5.2.1) and for the calculation of the average of all modules (see rules 6.2 and 6.3) the result obtained for combined modules will be given to each separate module.

The assessment of a maximum of 25% of the modules in a course may result in 'completed/fail'. All other module assessments must result in a mark.

- 4.1.3. Participants shall be informed of the date, subject, objectives and form of the assessment (practical, written, oral or computer-based, open or closed book), at least one week before an assessment.
- 4.1.4. The maximum duration of each assessment shall be as follows:

Written theoretical exam	3 hours
Computer-based theoretical exam	2 hours
Practical assignment	determined by the Course Director
Oral theoretical or practical exam	45 minutes

Participants shall be informed at the start of each assessment of:

- the duration of the assessment;
- if there is a choice, the number of questions to be answered;
- the weight of each question;
- whether books and/or notes may be used.

Two staff members must be present at an oral assessment.

4.2. Feedback to participants and re-sits

4.2.1. Participants shall be informed, individually, of the results of an assessment by the staff responsible for the assessment or by the Course Secretary, normally within two weeks of an assessment. The marks awarded for each question or assignment will be made known to each participant.

4.2.2. Marked scripts shall be shown to participants so that they may know the strengths and weaknesses of their answers. Answers to questions and results of assignments shall be reviewed in a class session, through the distribution of answer sheets or through comments on scripts. Staff responsible for the assessment are required to give an explanation of the marks awarded.

Scripts will be retained until at least one year after the results are officially recorded.

4.2.3. The following rules apply to re-sits:

- (1) Only those participants who fail an assessment at the first attempt (i.e. who achieve a mark less than 60 or 'fail') may re-sit that assessment. Only one re-sit per assessment is allowed.
- (2) Participants who re-sit an assessment may obtain only a maximum mark of 69 (or PASS grade) or 'completed'.
- (3) The previous mark or 'fail' will only be superseded when participants achieve a higher mark or 'completed' in the re-sit.
- (4) Only the final grade will be shown on the Course Record or Module Certificate, without any indication whether the final grade was obtained through a re-sit or not.
- (5) Participants who have failed due to serious circumstances (at the discretion of the Course Director) can apply for a new assessment, provided they have reported their circumstances in writing to the module coordinator or staff member responsible for the assessment before the scheduled assessment time.

4.2.4. In the case of practical assignments of long duration (practical exercises, a case study with fieldwork, project work) the possibility of repetition can be considered only in exceptional circumstances and subject to approval by the Course Director.

4.2.5. A participant not attending a scheduled assessment, not completing an assignment or not presenting the required work within the specified time, will be considered as having failed. The participant will be given a 'fail' or a mark of 40 (or the lowest mark, if lower than 40, scored by the other participants on this assessment). If an acceptable reason (to the discretion of the Course Director) can be offered, the participant can apply in writing for a new assessment or extension of the deadline for submission of the assignment.

- 4.2.6. In case of fraud, the participant(s) concerned will be considered to have failed and a mark 0 (zero) will be given (see also rule 8.5).
- 4.2.7. The grade sheets managed by the Course Secretary are the official record of the results of assessments. In case of discrepancies between this official record and marks and grades presented to participants in other ways, the marks and grades in the official record apply.

5. Final Assignment

5.1. The Final Assignment and result

- 5.1.1. The Final Assignment period focuses on the application of knowledge, methods and techniques in the subject of the course to the task performed or to the topic investigated. Depending on the course, the Final Assignment will be done individually or in small groups. The Final Assignment work requires that the participant/group:
 - (1) Presents a draft Final Assignment proposal to the Course Director as required by the course, before the deadline set by the Course Director.
 - (2) Makes the Final Assignment plan, in consultation with the supervisor(s)
 - (3) Carries out the Final Assignment plan and reports on progress (which might include a mid-term assessment) and final result to the supervisor(s) according to an agreed schedule for the Final Assignment.
- 5.1.2. The Final Assignment work will be assessed on two occasions:
 - (1) The Final Assignment plan, leading to approval of the plan or to disapproval and an warning in writing (see rule 8.1).
 - (2) The assessment of the Final Assignment result.In addition to these two formal assessments the participant or group will receive feedback on performance from the supervisor(s).
- 5.1.3. A participant or group not completing the Final Assignment plan and /or not finishing the Final Assignment within the specified time, will be considered to have failed. Only in exceptional cases, and for reasons beyond the control of the participant/group (at the discretion of the Course Director), the participant/group may apply in writing for a new opportunity to meet the above requirements.
- 5.1.4. A participant or group may not incorporate material that has been submitted for achieving certification from any other educational institution, in the Final Assignment result.
- 5.1.5. The source of any photograph, map, or other illustration shall be indicated, as shall the source, published or unpublished, of any material not resulting from the participant/group's own work. If material from other work is incorporated verbatim, without proper acknowledgement of the source (plagiarism), the Course Director may decide that the Final Assignment will not be assessed. This means that the Diploma cannot be awarded. (See also rule 8.3 and 8.5.)

5.2. Admission to the Final Assignment period

- 5.2.1. For admission to the Final Assignment, the assessment results obtained in the course must still allow meeting the criteria for the award of a diploma (see rule 6.2), to be decided by the Course Director.
- 5.2.2. A participant who is not eligible for admission to the Final Assignment, may however be allowed to continue with an individual special project (assessment will result in 'completed' or 'fail'). At the end of the course, the participant cannot be awarded the Diploma of the course but will get certification according to the rules in section 7.
- 5.2.3. When the participant is eligible to the Final Assignment but the Course Director is of the opinion that the Final Assignment proposal does not have the required level, the participant/group gets one week to develop and write a better proposal. If still not satisfactory the participant(s) will receive an official warning of the Course Director (see rules 8.1 and 8.2) but may still continue the Final Assignment work and has still access to the Final Assignment assessment.

5.3. Supervision of the Final Assignment

- 5.3.1. Based on the draft Final Assignment proposal and in consultation with members of staff and the participant/group, the Course Director shall recommend a primary (and sometimes a secondary) supervisor to their department. Supervisors are appointed by the management team of their department.
- 5.3.2. Supervisor(s) shall:
 - (1) Guide the participant/group in deciding on the final Final Assignment plan.
 - (2) Establish a schedule of supervisory meetings with the participant/group.
 - (3) Provide general advice and guidance on the execution of the Final Assignment.
 - (4) Provide feedback on work, normally within five days of submission.
 - (5) Forward, where appropriate, any comments on the performance of the participant(s) to the Course Director.
 - (6) Inform the Course Director when the progress of a participant gives cause for concern so that action can be taken in accordance with these regulations (see rules 8.1 and 8.2).
- 5.3.3. If a participant/group considers that he/she is not receiving the quality of supervision required in the regulations, the participant/group should seek action from the Course Director.
- 5.3.4. Replacement of a supervisor may be considered if the subject of the Final Assignment is found to be outside a supervisor's area of expertise or at the request of the supervisor and/or of the participant/group.

5.4. Submission of the Final Assignment result

- 5.4.1. The participant/group must submit a well-organized copy of all digital files associated with the Final Assignment work on DVD, and copies of hard-copy graphic output, to the supervisor(s) on the date of the Final Assignment assessment or as specified by the Course Director.
- 5.4.2. Where the Final Assignment has been executed in groups or where individual Final Assignment work submitted has been executed in cooperation with others, the supervisor(s) must provide a written statement to be stored with the Final Assignment result indicating the extent of the share of the work that each participant has done.

5.5. Assessment of the Final Assignment

- 5.5.1. The Final Assignment assessment consists of a demonstration/simulation/description of the result by the participant/group and a discussion with the supervisor(s) about the completeness and quality of the result. The oral examination has a maximum duration of one hour. The Final Assignment result will be assessed by the supervisor(s).
- 5.5.2. The Course Director assigns a date for the Final Assignment assessment and informs the participant/group of this date at least two weeks in advance.
- 5.5.3. The Final Assignment assessment is closed and observers other than ITC staff are not allowed to be present.
- 5.5.4. On the basis of the assessment of the participant(s) the supervisor(s) shall take one of the following decisions:
 - (1) That the Final Assignment is satisfactory. One single mark is given.
 - (2) Subject to minor corrections (that can be implemented within three working days and implemented before the official end of the course) in the Final Assignment result, the Final Assignment is satisfactory. One single mark is given subject to the corrections in the Final Assignment result being made.
 - (3) The Final Assignment is not satisfactory and is given the FAIL grade.
- 5.5.5. In exceptional cases extension to the Final Assignment work may be given, but only before the Final Assignment assessment and only when:
 - (1) Funding for the extension is available and
 - (2) The main cause of the unsatisfactory level of the Final Assignment has been beyond the control of the participant/group, at the discretion of the Course Director (see 5.1.3).
 - (3) The participant will take the initiative and apply in writing for extension. If the Course Director is of the opinion that condition 2 is met he/she will forward the request for decision to Head Education.
- 5.5.6. Extensions have a maximum duration of 50% (or one month if that is shorter) of the standard duration of the Final Assignment. Extensions are allowed only when the participant/group stays at ITC or in the case of a joint course at the institute of the partner.

This rule does not apply to participants who study part-time. They may work on the Final Assignment in the home organization until the end of the period of three and a half years counting from the official starting date of the course (see rule 2.2). In such cases, no extensions are possible.

6. End-of-course assessment

- 6.1. On the basis of the assessment results of the participant, the Academic Board decides whether the participant will be awarded the Diploma.
In case the Academic Board decides that the Diploma will not be awarded, the Course Director will decide whether the participant will be awarded a Certificate or Certificate of Attendance.

- 6.2. The criteria for the award of a Diploma are:

- (1) The average of all final module marks must be at least 60.
When a module is assessed with 'completed' or 'fail': a 'completed' will not be included in the average, a 'fail' will be counted as a mark of 50.
In case of one overall assessment for combined modules, the overall mark will be given to each separate module, before calculation of the average.
- (2) No more than 20% of the modules may have a mark below 60. No final module mark below 50 is allowed.
- (3) The final assignment must have a mark of at least 60.

Only results of modules that are part of the formal curriculum of the Diploma course are included in the calculation of the average and counted for the number of marks below 60 and below 50. Therefore results of a module that is taken in addition to the formal curriculum or in exchange for a module of the formal curriculum for which exemption was given will not be included. However, a module that was taken in exchange because of a reason other than exemption (see rule 3.4), is (only for the application of this rule 6.2) considered as part of the formal curriculum.

When a module is assessed with 'completed', this will not be included in the average. When a module is assessed with 'fail', this will be counted as a mark of 50.

- 6.3. To be entitled to receive a Diploma 'with distinction' the average of all module assessments must be 80 or above. The Final Assignment must have a mark of 80 or above. No marks below 70 or 'fail's are allowed.

Participants who have made changes in the formal curriculum of their Diploma course (exemption or exchanged modules) that affect more than two modules, are not entitled to receive a Diploma 'with distinction'.

- 6.4. If results of modules were obtained more than three and a half years before the end of the course, then the validity of these modules must be confirmed by the Academic Board (see rule 3.3.).

- 6.5. The Academic Board shall take one of the following decisions:

- (1) That the Final Assignment (if applicable) and overall course performance of the participant are satisfactory. The Diploma shall be awarded.
- (2) That the Final Assignment (if applicable) and overall course performance of the participant are such that the Diploma shall be awarded 'with distinction'.
- (3) Only in case the course contains a Final Assignment: That subject to minor corrections in the Final Assignment result, the Final Assignment and overall course performance are satisfactory. The Diploma shall be awarded subject to the corrections in the Final Assignment result being made before the official end of the course.
- (4) That the Final Assignment (if applicable) and/or overall course performance are not satisfactory. The Diploma shall not be awarded.

7. Awards and certification

- 7.1. A **“Diploma”** mentioning the title of the course will be awarded to a participant who has been officially admitted to a Diploma course and has fulfilled the assessment requirements of that course.

A **“Certificate”** will be awarded to a participant who (1) has been officially admitted to a Diploma course but has not fulfilled all assessment requirements for that course, and (2) who has fulfilled the assessment requirements of at least one summatively assessed module of that Diploma course.

The Certificate will mention that the participant ‘has followed a course in Geo-information Science and Earth Observation’ and the study load. Only the modules that have been completed and the modules in which the participant has participated for at least 80%, will be included in the study load.

A **“Certificate of Attendance”** will be given to participants who have been officially admitted to a Diploma course, but have not fulfilled the assessment requirements of any summatively assessed module.

The Certificate of Attendance will mention that the participant ‘has attended a course in Geo-information Science and Earth Observation’ and the study load. Only the modules in which the participant has participated for at least 80% will be included in the study load.

No qualification other than “with distinction” will be indicated on any Diploma.

- 7.2. Diplomas are issued under the responsibility of the Rector. Certificates and Certificates of Attendance are issued under the responsibility of the Course Director.

- 7.3. Signatures:

- (1) Diplomas are signed by the Rector of the ITC and Head Education.
- (2) Certificates and Certificates of Attendance are signed by the Course Director.

- 7.4. Diplomas and Certificates are accompanied by a Course Record, signed by the Course Director. The Course Record will show the period of study, the study load, the titles of and marks or grades obtained for the modules that have been finished successfully or that the participant has participated in for at least 80% but not finished successfully.

The assessments ‘completed’ or ‘fail’ will appear as such in the Course Record.

- 7.5. Only the names and the results obtained of the modules that are taken are mentioned on the Course Record.

In case of exemption the number and not the name of the module will be mentioned (e.g. “Modules 1-3: exemption”). In case a new module was taken in exchange for a module for which exemption was given, the name of the new module will be mentioned also (e.g. “Module 3: exemption. Extra module: Database design”). In case of exchange of a module for another reason than exemption only the name of the new module will be mentioned (e.g. “Module 3: Database design”).

The names and the results obtained of modules that are taken in addition to the formal curriculum of the Diploma course are also listed on the Course Record (e.g. “Extra module: Database design”).

8. Early termination of the course

- 8.1. Where a Course Director and/or Head Education believe(s) that a participant's progress in a Diploma course gives cause for concern the participant shall be informed of the situation by the Course Director. Where a participant's performance is such that she/he is unlikely to obtain a Diploma without a significant improvement in performance, the participant shall be advised in writing by the Course Director of the situation and the implications. (Oral and/or written advice by the Course Director may not be given when the concern arises after the approval of the final Final Assignment plan.)
- 8.2. In cases of obvious non-performance, a Course Director and/or Head Education may decide at any time that a participant must discontinue his/her course. Such a decision will not be taken without the participant having received one written warning and being given time to improve performance.
- 8.3. In case of fraud during an exam or in assignments, the participant(s) concerned will be considered to have failed and a mark 0 (zero) will be given.

In case of plagiarism in the submitted final assignment, the Course Director may decide that the final assignment will not be assessed. This will mean that the Diploma cannot be awarded, the participant will get a Certificate.

- 8.4. In case of other types of misbehaviour, the Course Director will consider expulsion from the course.
- 8.5. In case of severe or repeated fraud, plagiarism or other types of misbehaviour, the Course Director, in consultation with Head Education, will decide that the participant is expelled from the course.
Expulsion from the course means that the participant will not receive any certification.
- 8.6. ITC may use plagiarism detection software or other tools to detect fraud.

In submitting a text, the participant implicitly consents to the text being entered in the database of the detection software concerned.

9. Student appeal procedures

- 9.1. In case of problems of a general or structural nature in the course, the Student Association Board (SAB) may be consulted.
- 9.2. In the event that a participant disagrees with decisions taken by a staff member, he/she may present this decision for reconsideration to the Course Director.
Where a participant finds that he/she is not receiving the quality of Final Assignment supervision required in the regulations, the participant should also seek action from the Course Director.
- 9.3. If not satisfied with the decision of the Course Director, the participant can seek action from Head Education. If Head Education rejects the complaint of the participant he/she will respond in writing describing the reasons.

- 9.4. If still not satisfied, participants have a last right of appeal with the Student Appeals Board. An appeal will only be accepted if:
- The formal methods of dealing with complaints (see rules 9.2 and 9.3) have not led to agreement,
 - The appeal concerns the implementation of these 'ITC Regulations for Courses leading to an ITC Diploma' or the assessment of the Final Assignment and
 - The appeal has been made before the official end of the course.
- Appeals should be addressed in writing to the Chairman of the Student Appeals Board, through the Rector, and be accompanied by the argued written response to the appeal by Head Education.
- 9.5. Where unequal treatment of participants is claimed, copies of all relevant scripts shall be made available for review by those investigating the appeal.
- 9.6. The Student Appeals Board consists of three staff members to be appointed by the Rector. These staff members should not have been involved in the situation leading to the appeal. For appeals concerning the assessment of the Final Assignment, staff members representing fields related to the subject of the Final Assignment will be invited to sit on the Student Appeals Board.
- 9.7. After having heard all parties involved (including the Course Director) for relevant information, the Student Appeals Board will take a final decision on the appeal. The decision on an appeal will be passed on to the Rector only if the Appeals Board cannot reach consensus. No further appeal will be possible.
- 9.8. The Student Appeals Board can reject the appeal or support it. In the latter case, the Appeals Board shall suggest remedial actions, which may include extension of the fellowship.
- 9.9. The Student Appeals Board should deal with the case within two weeks of receipt of the appeal. If necessary the fellowship will be extended for the duration of the appeal procedure.

Bodies and persons involved in management and quality assurance of the course

The mentioned tasks and responsibilities must be carried out in accordance with these 'ITC Regulations for Courses leading to an ITC Diploma'

Rector

The Rector has the overall responsibility for all tasks of ITC.

The Rector has delegated the academic, quality and policy aspects of the educational programmes and courses to the Academic Board and the implementation of the programmes and courses to Head Education.

The Rector appoints the Head Education, Course Director and Student Appeals Board.

Scientific Council

The Scientific Council advises the Rector and Academic Board on the quality of education and research of the ITC. This responsibility includes:

- Advice on course curricula, including admission criteria
- Advice on ITC's quality assurance system
- Advice on degree and assessment regulations, including these 'ITC Regulations for Courses leading to an ITC Diploma'

The Scientific Council is a mainly external body; two third of the members are professors of Dutch universities.

Academic Board (AB)

The AB is responsible for the quality of ITC's courses and for development of policy on education. This responsibility includes:

- Approval of the curriculum of the Diploma course
- Approval of ITC's quality assurance system and monitoring of the implementation
- Advice on course-specific elements of the quality assurance system
- Approval of policy on education
- Approval of degree and assessment regulations, including these 'ITC Regulations for Courses leading to an ITC Diploma'
- Decision on deviation of the formal curriculum by individual participants
- Decision on award of the Diploma to individual participants

The Academic Board consists of the Rector and all full and visiting professors of ITC.

Head Education

Head Education is responsible for:

- Monitoring of the implementation of the course, ITC's quality assurance system and ITC's educational policy as approved by the Academic Board and the Rector. Head Education delegates the factual implementation to the Course Director
- Coordination and implementation of supra-course aspects.

Course Director (CD)

The Course Director is responsible for:

- Implementation of the course, ITC's quality assurance system and ITC's educational policy, as delegated by Head Education
- Implementation of decisions taken by Head Education
- Day-to-day co-ordination and execution of the course
- Counselling of participants in matters concerning their studies

Student Appeals Board

The Student Appeals Board is a semi-permanent committee, which will be appointed by the Rector when an appeal from a participant is received.

EA/4334

**Additional rules for
short courses and individual study programmes leading to an
ITC CERTIFICATE ²
- September 2009 -**

Short courses and individual study programmes consist of modules of an ITC (Postgraduate) Diploma, Master and/or Master of Science (MSc.) course. The regulations that apply to the latter courses apply to the parts as well. Only the rules described below take precedence over the Diploma, Master and MSc. regulations.

1. These additional rules apply to all courses and individual study programmes leading to an ITC Certificate starting from September 2009 onwards³. These courses consist of one or more modules of a Diploma, Master and/or Master of Science course.

Short courses have specific course objectives. These courses may start and/or finish with a few days for introductory respectively rounding-off activities. The individual study programmes consist of one or more separate modules chosen by the participant.

2. **Management of the course**

The curriculum of short courses has been approved by the Academic Board. Individually chosen combinations of separate modules need the approval of the Course Director. In case the individual study programme consists of modules of block 3 of the MSc. course only or of a combination of modules from more than one domain, approval of Head Education is needed. Individual changes made in the course curriculum of the short course lead to the course being seen as an individual study programme.

Responsibility for implementation of the approved short course or individual study programme rests with Head Education, who delegates this responsibility to the Course Director(s) or, in the case of elective modules, to Module Coordinators.

Responsibility for quality assurance rests with the Academic Board.

3. **Assessment**

Courses leading to a Certificate are summatively assessed. The right to re-sit for an examination exists only when the date of the re-sit falls within the official study period of the participant.

² These rules were approved by the Rector and by the Academic Board on 17 September 2008; they apply to all courses commencing September 2009 onwards.

³ Per 1 January 2010 ITC will be integrated in and will become a Faculty with special status of the University of Twente. This integration might have consequences for the assessment regulations and might lead to changes in these assessment regulations during the course.

4. **Certification**

A "Certificate", mentioning that the participant has followed the course, will be awarded to a participant in a short course who has fulfilled all assessment requirements for that course. For short courses of 4 or more modules one module mark between 50 and 60 is allowed.

A "Certificate", mentioning that the participant 'has followed an individual study programme in Geo-information Science and Earth Observation', will be awarded to

- A participant in a short course who has fulfilled the assessment requirements of one module but has not fulfilled all assessment requirements of that short course and to
- A participant in an individual study programme who has fulfilled the assessment requirements of at least one module.

A "Certificate of Attendance", mentioning that the participant 'has attended an individual study programme in Geo-information Science and Earth Observation', will be awarded to all other participants who have participated for at least 80% in one or more modules. The titles of these modules will be mentioned on the Certificate of Attendance.

Certificates and Certificates of Attendance mention the study load. Only the study load of the modules that have been completed and the study load of the modules that the participant has participated in for at least 80%, are included in the study load.

Certificates are accompanied by a Course Record mentioning the period of study, the study load and the titles of the modules that the participant has completed or participated in for at least 80%.

Certificates, Certificates of Attendance and accompanying Course Records are signed by the Course Director or, in case the short course or individual study programme consists of modules 14 and 15 of the MSc. course only or of a combination of modules from more than one domain, by Head Education. Certificates and Certificates of Attendance of distance courses are signed by the Course Coordinator and by the Course Director or, in case of new distance courses, by Head Education.

5. **Building blocks for Diploma or Degree**

Successfully completed modules of short courses and individual study programmes can be used as building blocks for obtaining an ITC (Postgraduate) Diploma, Master degree or MSc. degree, provided the participant has been formally admitted to the (Postgraduate) Diploma, Master or Master of Science course.

Participants have three and a half years to meet all requirements of the (Postgraduate) Diploma, Master or MSc. course. If results of modules were obtained more than three and a half years before the end of the course, then the validity of these modules must be confirmed by the Degree Assessment Board (MSc. and Master courses) or Academic Board (Diploma courses).

Appendix:

- ITC Regulations for courses leading to an ITC Diploma (September 2009).