1A

B	6,0 ECTS	B	6,0 ECTS	B	6,0 ECTS	B	6,0 ECTS	B	6,0 ECTS
Numerical Analysis		**Probability and Stochastic Processes**		**Signal & Image Processing**		**Basics of software – GIS, Software and MetaData**		**Electromagnetism, Physical Principles & Interaction with Matter – General Remote Sensing**	
This subject aims at an establishment of a common level for all students, smoothing out differences in their individual entry levels. The module will provide secure skills numerical analysis for later use in the other subjects of the master. The different objectives that are pursued are: to deal with mathematical problems such as the solution of partial differential equations (PDEs), to understand how physical/mathematical problems can be solved by numerical methods, to solve physical/mathematical problems by applying MATLAB routines, to get a feeling for the accuracy of the solution and the error budget, to handle measurements appropriately.		Revisit the fundamental concepts and introduction to advanced concepts on the theory of stochastic processes and parameters estimation, for one, and multidimensional signals, with a general application framework and with emphasis on those aspects most related to Geomatics and Navigation disciplines.		Students shall get a sound theoretical and practical understanding of continuous and discrete signal and image analysis in time/space and frequency domain. Topics relevant for photogrammetry and remote sensing as: image Properties, sampling, quantization, storage of digital Images, histogram, correlation, point processing, local image operators, digital filter, edge detection, morphological operators, global Image operators, correlated and uncorrelated noise, geometric transformation, bilinear interpolation or segmentation will be presented		The course aims at explaining the ins and outs of a GIS and the different ways to store and manage multilayer and multisource data		The objective of this subject is to present a global overview of electromagnetism as it is an important subject to both, Geomatics and navigation disciplines. Basics of electromagnetic waves, their definition, its different parameters (frequency, wavelength, polarization, etc…) its propagation and its interaction with the matter will be presented and analyzed in detail. Special emphasis will be paid to the interaction with matter, as it will provide the necessary analysis tools to determine the information that can be retrieved with remote sensing sensors in the optical, infrared and microwave ranges of the electromagnetic spectrum. This subject will also cover the basics of antennas.	
GEOTECHNICAL PROFILE		**GEOTECHNICAL PROFILE**		**GEOTECHNICAL PROFILE**		**GEOTECHNICAL PROFILE**		**COMMON TO BOTH PROFILES**	
MATHEMATICS		**MATHEMATICS**		**SIGNAL THEORY AND COMMUNICATIONS**		**GEOMATICS**		**REMOTE SENSING**	

1A

B	6,0 ECTS	B	6,0 ECTS	B	6,0 ECTS	B	6,0 ECTS	B	6,0 ECTS
Geodesy		**GNSS Technologies**		**Reference Frames and Coordinate Systems**		**Photogrammetry**		**Electromagnetism, Physical Principles & Interaction with Matter – General Remote**	
This subject considers the study of the Earth form and the observation and calculation of geodesic networks.		This course is designed to assist students in mastering the working principles of GNSS receivers. The principles of positioning and navigation will be firstly (and briefly) reviewed being the “inside” of the equipment (receivers and sensors) used for these purposes the main topic of the course. A basic introductory knowledge of electromagnetic theory, radio wave propagation and electronics is assumed. The students will have the opportunity to use very simple GNSS receivers to understand its working principles.		The goal of this course is to study the various possibilities how to 'project' an idealized Earth - Earth models are the Sphere or the Ellipsoid-of-Revolution - onto a planar map. A major part of the course is devoted to the unavoidable deformations which occur during the mapping process. Special attention is paid to optimal as well as legal and widely-used map projections, i.e. Gauß-Krüger/UTM with their specific geodetic coordinates and coordinate systems. Datum transformation models are presented in order to transform sets of coordinates from one reference system to the other.		The objective of this subject is to present to the students the basics about photogrammetry, stereoscopic vision, the orientation process for photograms and the knowledge of the specific vocabulary.		The objective of this subject is to present a global overview of electromagnetism as it is an important subject to both, Geomatics and navigation disciplines. Basics of electromagnetic waves, their definition, its different parameters (frequency, wavelength, polarization, etc…) its propagation and its interaction with the matter will be presented and analyzed in detail. Special emphasis will be paid to the interaction with matter, as it will provide the necessary analysis tools to determine the information that can be retrieved with remote sensing sensors in the optical, infrared and microwave ranges of the electromagnetic spectrum. This subject will also cover the basics of antennas.	
ICT PROFILE		**ICT PROFILE**		**ICT PROFILE**		**ICT PROFILE**		**COMMON TO BOTH PROFILES**	
GEOTECHNICAL ENGINEERING		**GLOBAL NAVIGATION SYSTEMS**		**GEOTECHNICAL ENGINEERING**		**GEOMATICS**		**REMOTE SENSING**	

1B

RS 6,0 ECTS	RS 6,0 ECTS	N 6,0 ECTS	N 6,0 ECTS	VR 6,0 ECTS
Microwave Remote Sensing	**Optical Remote Sensing**	**Advanced GNSS Data Processing**	**Navigation Sensors Systems & Integration**	**Geospatial Modeling & Visual Representation**
The main objective of this course is the physical and engineering principles to obtain images and additional information of distant objects, including penetrable ones, at microwaves frequencies, focused on Earth Observation or Remote Sensing. The course is centered on the basic disciplines and techniques which are necessary for the development and use of airborne and satellite Earth observation sensors at microwaves. Both passive and active sensors are studied. The main applications are described in the context of airborne and satellite missions.	It is the intention of this course to provide an introduction to the technology used in active and passive optical remote sensing, and to generate an understanding of the methods used to extract usable information from the recorded data. In this course we look at the various types of active optical sensors available and at their most important properties. We learn about the electromagnetic spectrum (light) and about radiance-object interactions. We discuss the pros and cons of various active optical remote sensing techniques (e.g., Raman, coherent, Dial, multispectral) with respect to specific applications (e.g., atmospheric processes, weather and climate research, terrain mapping, forestry and hydrology understanding, ecosystem structures). We consider the characteristics of ground-based, air-borne and space-borne platforms. Besides, we will look at different aspects of data analysis, starting with descriptive statistics and continuing with inductive statistics.	The objective of this subject is to provide advanced concepts of GNSS specially, those concerning the analysis of the data for different applications in precise navigation and other disciplines as Earth observation. The synergies between GNSS systems and remote sensing systems will be analyzed in-depth.	The objective of this subject is to provide a global overview of the different navigation sensors and the integration of them, together with other sensors, to provide high precision navigation.	The objective of this subject is to provide a global overview of the state-of-the-art technology for the use and visualization of geospatial information with special emphasis to the presentation and diffusion of these data to final users.
REMOTE SENSING	REMOTE SENSING	NAVIGATION	NAVIGATION	VISUAL REPRESENTATION
REMOTE SENSING	REMOTE SENSING	GLOBAL NAVIGATION SYSTEMS	GLOBAL NAVIGATION SYSTEMS	GEOMATICS

2A

C 5,0 ECTS	C 5,0 ECTS	MT 20,0 ECTS
Mission Analysis and Integration	**Communications**	**Master Thesis**
The purpose of this subject is to explain the essential elements that enter into the design and analysis of a mission, both from a technical point of view, as well as operational and budgetary. The subject we will revise the main architectures, drivers and elements to consider when designing a mission, both in terms of the segment or system that captures operational data and the segment that generates value in the form of knowledge products and services. In a second part of this subject, students will be asked, in the form of groups, considering a problem in the territory to design a mission considering the type of platform, sensors, ideal operation mode, sizing the ground segment, to estimated and analyze potential users and to identify direct and indirect benefits. An evaluation of the solutions, considering pros and cons will discuss.	When confronted with the design of remote sensing or navigation system and services, one of the most important aspects concerns the distribution of the measured data, from the sensor to the processing facilities and from these facilities to the final users. The subject aims at giving an overview of the most important communication systems and channels: space communications, mobile communications, internet, communications networks, etc…	
COMMON	COMMON	COMMON
GEOMATICS	SIGNAL THEORY AND COMMUNICATIONS	