UNIVERSITY OF ZAGREB – FACULTY OF GEODESY

GRADUATE PROGRAMME OF STUDIES OF GEODESY AND GEOINFORMATICS

Zagreb, March 15, 2005

At the 87th special meeting of the Teaching Staff at the Faculty of Geodesy University of Zagreb, held on 10th March 2005, the following proposal for graduate programme of studies of Geodesy and Geoinformatics was passed.

Dean of the Faculty of Geodesy

Prof. Dr. Zdravko Kapović

Contents

1. INTRODUCTION

Croatia has a rather long tradition of higher education. The textbook written by Martin Sabolović *Exercitationes Gaeodeticae*, printed in 1775, brings evidence in this respect. The first diplomas that young graduates were presented certifying that they passed all necessary exams to acquire academic degree and authorizations to act as surveyors were handed in 1811. The students who have graduated from the today's Faculty of Geodesy, University of Zagreb are highly acknowledged experts in Croatia and abroad.

Graduate engineers of geodesy have never had any difficulties in getting employed, and the present situation in the work market indicates that each of 40 annually graduating engineers finds adequate job immediately. Private firms and the public sector grant scholarships and stimulate students in other ways in order to provide high-quality experts for themselves. Scientific work and its connection with the teaching process have influenced the introduction of new cognitions into the teaching activity. In the periods shorter than 10 years, the Faculty of Geodesy has made more significant changes of this curriculum. In this context, this change makes a logical continuation being supplemented with the adaptation of the studies to the Bologna Declaration processes.

The previous curriculum changes at the Faculty of Geodesy have mostly been influenced by the university curricula from Central and Western Europe where the role of surveyors in the society is similar (Austria, Germany, Switzerland…). Thus, this curriculum can also be compared with the curricula at TU Graz, ETH Zurich and TU Delft.

The curriculum change that introduced significant alteration in teaching processes was carried out in 1978. The next new curriculum was adopted in 1985, and the last more important change of the curriculum happened in 1994 with smaller changes carried out in 2001.

Public institutions and the private sector are interested in the initiation of such a curriculum (State Geodetic Administration, Croatian Geodetic Institute, Hydrographic Institute of the Republic of Croatia, Croatian Chamber of Architects and Civil Engineers). The cooperation will be realized through the participation of skilled professionals in the teaching process, but also in the practical training of students in these institutions.

2. GENERAL PART

2.1 The name of the studies

We suggest that undergraduate, graduate and postgraduate studies get the name:

GEODESY AND GEOINFORMATICS

2.2 Holder and performer of the studies

Holder and performer of the studies is:

UNIVERSITY OF ZAGREB, FACULTY OF GEODESY

2.3 Duration of studies

The undergraduate studies last 3 years (6 semesters), the graduate studies 2 years (4 semesters) and postgraduate studies 3 years (6 semesters).

2.4 Admission terms

The terms of admission to the undergraduate studies are ruled by Laws, along with the credits gathered at the entrance exam.

To be admitted at the graduate studies of GEODESY AND GEOINFORMATICS it is necessary to have the diploma of undergraduate studies of GEODESY AND GEOINFORMATICS. There is a possibility to enrol at these studies with the diploma of some other adequate undergraduate studies, which is to be decided by the Faculty Council of the Faculty of Geodesy.

To enrol at the postgraduate studies of GEODESY AND GEOINFORMATICS, one needs a diploma of the graduate studies of GEODESY AND GEOINFORMATICS or any other studies from the same scientific area.

2.5 Undergraduate studies

After graduating from the undergraduate studies, one becomes competent in solving professional jobs in the following activities:

1. Determination of the Earth′s size and shape and measurement of all data necessary for defining the size, position, shape and contours of an part of the Earth, and their changes.
2. Placement and positioning of objects in space and time, and other engineering works on, above or under the Earth′s surface.
3. Production and updating of plans, maps and other documents.
4. Gathering and application of spatial data using close range methods, and aerial and satellite survey.
5. Determining the position of public and private land boundaries, including national and international borders, and recording the land in adequate registers.
6. Maintenance of geoinformation systems (GIS), and gathering and storing data in these systems.
7. Visualisation and communication by means of maps and mobile digital devices.
8. Assessment of values and real estate management, either urban or rural area, land or buildings.

9. Familiarity with geospatial services for various user groups.

While performing the above-mentioned activities, surveyors/geoinformation collaborators take relevant legal, economic and social viewpoints into consideration that affect every single geodetic project.

Training programs for job performance:

- Geodetic surveyor
- GIS-collaborator
- Cadastral surveyor
- Collaborator in photogrammetry
- Collaborator in cartography
- Collaborator in hydrography

Students could attend the graduate curriculum of GEODESY AND GEOINFORMATICS at the Faculty of Geodesy and the following programmes at other faculties of the University of Zagreb, or in the Republic of Croatia or abroad:

- civil engineering, architecture, law, economy, agriculture, forestry.

2.6 Graduate studies

After graduating from the GEODESY AND GEOINFORMATICS graduate studies, the following competencies in solving professional and scientific problems are acquired:

1. Determination of the size and shape of the Earth and measuring all the data necessary to define the size, position, shape and contours of any part of the Earth and their more significant changes.
2. Placement and position determination of objects in space, monitoring the position of natural and man-made objects in space and time, and other engineering works on, above or under the Earth′s surface.
3. Development, testing and calibrating of geodetic instruments and sensors.
4. Designing, production and updating of plans, maps and other documents.
5. Gathering and application of spatial data using close-range, aerial and satellite survey methods, and automation of these processes.
6. Determination of public and private land boundaries, including national and international borders, and recording the land in adequate registers.
7. Designing, establishing and updating geoinformation systems (GIS), and gathering, storing, analysing, managing and distributing data.
8. Analysing, interpreting, and integrating spatial objects and phenomena, and their visualisation and communication by means of maps and mobile digital devices.
9. Studying natural and social environments, survey of land and sea resources, application of data in planning the development of urban, rural and regional areas.
10. Planning, development and renewal of real estates, and value assessment and real estate management, either urban or rural areas, land or buildings.
11. Planning, measurement and management of buildings, including cost assessment.
12. Development of geospatial services adapted to various user groups.

In performing the above-mentioned activities, geodesists/geoinformation engineers take relevant legal, economic, ecological and social viewpoints affecting each single geodetic project.

Training program for performing the jobs:

- Licensed engineer of geodesy
- Geoinformation operator
- GIS-analyst
- Head of geodetic/geoinformation project
- Supervisor of geodetic/geoinformation project
- Spatial information manager
- Cartographer
- Photogrammetrist
- Real estate assessor
- Cadastre planner
- Hydrographer
- Geodetic supervisor
- Court appointed expert for geodetic jobs
- Geodetic entrepreneur

A graduate engineer of geodesy and geoinformatics is an expert with university qualification and technical experience to:

- determine, present and measure the position of portions of land, three-dimensional objects, fields and trajectory on a scientific basis;
- gather and evaluate land information and geoinformation, and to apply this information for the purpose of planning and managing the land, sea and structures, as well as the objects on them;
- encourage the improvement and development of the above stated activities.

The undergraduate studies of GEODESY AND GEOINFORMATICS are sufficient in order to attend the programme.

2.7 Professional or academic title or degree acquired after graduating from the studies

After graduating from the studies one acquires the academic degree according to the Law with the supplement:

IN GEODESY AND GEOINFORMATICS

3. PROGRAMME DESCRIPTION

3.1 The list of obligatory and optional subjects with the number of active teaching hours needed for their execution, and with the number of ECTS credits

UNDERGRADUATE STUDIES OF GEODESY AND GEOINFORMATICS

Ist Semester

			L	E	Ex	ECTS
1.	Beban-Brkić, J.	Analytical Geometry and Linear Algebra	2	2	1	5
2.	Zadelj-Martić, V.	Mathematical Analysis	4	3	1	8
3.	Brkić, M.	Physics	2	2	1	5
4.	Barković, Đ., Vučetić, N.	Basics of Geoinformatics	2	2	1	5
5.	Lasić, Z.	Geodetic Instruments	2	2	1	5
Optional	Špoljarić, D.	Basics of Informatics	1	1	0	2
	Kapović, Z., Džapo, M.	Introduction into Geodesy	2	0	0	2
	Mraović, B.	Business Communication	1	1	0	2
		From the other faculty				2 max
		Total	13(14)	12(11)	5	30
			25			

L = Lectures, E = Exercices, Ex = Examination
Note: 2 ECTS credits are chosen in optional courses

Vranić, Z.: Sports 0+2

IInd Semester

			L	E	Ex	ECTS
1.	Radović, N.	Computer Geometry	2	2	1	5
2.	Vučetić, N.	Programming	2	2	1	5
3.	Džapo, M.	Land Surveying	3	4	1	7
4.	Barković, Đ.	Field Measurements	1	2	1	3
5.	Feil, L.	Analysis and Processing of Geodetic Measurements	3	3	1	7
Optional	Fučkan-Držić, B.	Basics of English for Special Purposes	1	1	1	3
	Fučkan-Držić, B.	Basics of German for Special Purposes	1	1	1	3
	Radović, N.	Spherical Trigonometry	1	1	1	3
	Josipović, T.	Principles of Land Rigister Law	2	0	1	3
		From the other faculty				3 max
		Total	12(13)	14(13)	6	30
			26			

Note: Altogether 3 ECTS are chosen in optional courses

Vranić, Z.: Sports 0+2

IIIrd Semester

			L	E	Ex	ECTS
1.	Medak, D.	Databases	2	2	1	5
2.	Beban-Brkić, J.	Differential Geometry	2	2	1	5
3.	Roić, M.	Cadastre	3	3	1	7
4.	Ivković, M.	Geodetic Plans	2	2	1	5
5.	Mraović, B.	Introduction into Information Society	1	1	1	3
Optional	Fučkan-Držić, B.	English in Geodesy	1	1	1	3
	Fučkan-Držić, B.	German in geodesy	1	1	1	3
	Cigrovski-Detelić, B.	Topography	2	0	1	3
		From the other faculty				5 max
		Total	13	11	7	30
			24			

Note: altogether 5 ECTS are chosen in optional courses

Vranić, Z.: Sports 0+2

IVth Semester

			L	E	Ex	ECTS
1.	Frangeš, S.	Cartography	2	2	1	5
2.	Bašić, T.	Geodetic Reference Frames	2	2	1	5
3.	Fiedler, T.	Photogrammetry	2	2	1	5
4.	Rožić, N.	Geoinformation Quality	2	2	1	5
5.	Medak, D., Roić, M.	Geoinformation Modelling	2	2	1	5
6.	Lapaine, M.	Geoinformation Manipulation	2	2	1	5
			12	12	6	30
			24			

Note: In this semester there are no optional sourses

Vranić, Z.: Sports 0+2

Vth Semester

			L	E	Ex	ECTS
1.	Bačić, Ž.	Satellite Positioning	2	2	1	5
2.	Novaković, G.	Engineering Geodetic Basis	2	2	1	5
3.	Bajić, M.	Remote Sensing	2	2	1	5
4.	Mastelić-Ivić, S.	Land Development	2	2	1	5
5.	Cigrovski-Detelić, B., Barković, Đ.	Professional Practice	0	3	0	3
Optional	Lasić, Z.	Practical Work with Geodetic Instruments	1	1	1	3
	Mastelić-Ivić, S.	Land Information Systems	2	2	1	5
	Frangeš, S.	Topographic Cartography	2	1	1	4
		From the other faculty				7 max
			11	13	6	30
			24			

Note: Altogether 7 ECTS credits are chosen in optional courses

VIth Semester

			L	E	Ex	ECTS
1.	Kapović, Z.	Engineering Geodesy	2	2	1	5
2.	Bašić, T.	State Survey	2	2	1	5
3.	Lapaine, M.	Map Projections	2	2	1	5
4.	Pribičević, B.	Hydrographic Survey	2	2	1	5
Optional	Mraović, B.	Introduction into Management	1	1	0	2
	Roić, M.	Geoinformation Infrastructure	2	2	1	5
	Frangeš, S.	Web Cartography	1	1	1	3
	Špoljarić, D.	Basics of Geodetic Astronomy	2	2	1	5
	Zadelj-Martić, V.	Discrete Mathematics	2	2	1	5
		From the other faculty				10 max
			12	12		30
			24			

Note: Altogether 10 ECTS credits are chosen in optional courses

There are totally 180 ECTS at the undergraduate studies with at least 27 ECTS or 15% in optional courses.

GRADUATE STUDIES OF GEODESY AND GEOINFORMATICS
SUBJECT-OREINTED FIELD GEODESY

VIIth Semester

			L	E	Ex	ECTS
1.	Džapo, M.	Cadastral Survey	2	2	1	6
2.	Feil, L.	Special Algorithms of Geodetic Measurement Processing	2	2	1	6
3.	Kapović, Z.	Engineering Geodesy in Civil Engineering	2	2	1	6
4.		Optional 1	2	2	1	6
5.		Optional 2	2	2	1	6
		From the other faculty				12 max
		Total	10	10	5	30
			20			

Note: Altogether 12 ECTS credits are selected among optional courses

Optional courses in the VIIth semester

		L	E	Ex	ECTS
Fučkan-Držić, B.	English for Academic Purposes	2	2	1	6
Hećimović, Ž.	Global Geodesy	2	2	1	6
Ivković, M.	Digital Plans	2	2	1	6
Izetbegović, J.	Basics of Civil Engineering	2	2	1	6
Kapović, Z.	Movements and Deformations	2	2	1	6
Kapović, Z.	Geodesy in Environmental Protection	2	2	1	6
Lapaine, M.	System of Scientific Information	2	2	1	6
Marušić, J.	Hydrotechnical Improvements	2	2	1	6
Mastelić Ivić, S.	Geodetic Works in Hydrotechnics	2	2	1	6
Mraović, B.	Organisational Theory	2	2	1	6
Pribičević, B.	Presentation Techniques	2	2	1	6
Rožić, N.	Geokinematics	2	2	1	6
Špoljarić, D.	Space Geodesy	2	2	1	6
Vučetić, N.	Cartography and GIS	2	2	1	6
Zadelj-Martić, V.	Complex Analysis	2	2	1	6

VIIIth Semester

			L	E	Ex	ECTS
1.	Bačić, Ž.	Navigation	2	2	1	6
2.	Bašić, T.	Physical Geodesy	2	2	1	6
3.	Novaković, G.	Geodetic Networks for Special Purposes	2	2	1	6
4.		Optional 1	2	2	1	6
5.		Optional 2	2	2	1	6
		From the other faculty				12 max
		Total	10	10	5	30
			20			

Note: altogether 12 ECTS are selected among optional subjects

Optional courses in the VIIIth semester

		L	E	Ex	ECTS
Barković, Đ.	Precise Geodetic Measurements	2	2	1	6
Beban-Brkić, J.	Methods of Linear Algebra	2	2	1	6
Brkić, M.	Geomagnetic Survey	2	2	1	6
Cigrovski-Detelić, B.	Geodesy in Geosciences	2	2	1	6
Džapo, M.	Industrial Survey	2	2	1	6
Fučkan-Držić, B.	German for Academic Purposes	2	2	1	6
Kapović, Z.	Organisation of Geodetic Works	2	2	1	6
Lapaine, M.	Geodetic Heritage	2	2	1	6
Lasić, Z.	Application of Laser Devices	2	2	1	6
Pribičević, B.	Geodetic Business Activity	2	2	1	6
Radović, N.	Geomathematics	2	2	1	6
Rožić, N.	Optimizing Geodetic Networks	2	2	1	6
Zadelj-Martić, V.	Numerical Analysis	2	2	1	6

IXth Semester

			L	E	Ex	ECTS
1.	Bašić, T.	Geophysical Geodesy	2	2	1	6
2.	Mastelić Ivić, S.	Land Consolidation	2	2	1	6
3.	Pribičević, B.	Marine Geodesy	2	2	1	6
Optional		Project 1	0	4	1	6
		Project 2	0	4	1	6
		Total	6	14	5	30
			20			

Note: altogether 12 ECTS are selected among optional subjects

Xth Semester

			L	E	Ex	ECTS
1.		Diploma thesis	10	10	1	30
		Total	10	10		30
			20			

There is a total of 120 ECTS credits at the graduate studies, with at least 24 ECTS credits or 20% among them in optional courses.

GRADUATE STUDIES OF GEODESY AND GEOINFORMATICS
SUBJECT-ORIENTED FIELD GEOINFORMATICS

VIIth Semester

			L	E	Ex	ECTS
1.	Medak, D.	Spatial Databases	2	2	1	6
2.	Roić, M.	Spatial Management Support	2	2	1	6
3.	Vučetić, N.	Computer Cartography	2	2	1	6
4.		Optional 1	2	2	1	6
5.		Optional 2	2	2	1	6
		From the other faculty				12 max
		Total	10	10	5	30
			20			

Note: Altogether 12 ECTS credits are selected among optional courses

Optional courses in the VIIth semester

		L	E	Ex	ECTS
Bajić, M.	Application of Remote Sensing	2	2	1	6
Fiedler, T.	Topographic Systems	2	2	1	6
Fučkan-Držić, B.	English for Academic Purposes	2	2	1	6
Lapaine, M.	System of Scientific Information	2	2	1	6
Mastelić Ivić, S.	Real Estate Estimation	2	2	1	6
Mraović, B.	Organisational Theory	2	2	1	6
Pribičević, B.	Presentation Techniques	2	2	1	6
Vučetić, N.	Map Generalization	2	2	1	6
Zadelj-Martić, V.	Complex Analysis	2	2	1	6

VIIIth Semester

			L	E	Ex	ECTS
1.	Bajić, M.	Advanced Methods of Remote Sensing	2	2	1	6
2.	Fiedler, T.	Geoinformation Systems	2	2	1	6
3.	Medak, D.	Spatial Data Analysis	2	2	1	6
4.		Optional 1	2	2	1	6
5.		Optional 2	2	2	1	6
		From the other faculty				12 max
		Total	10	10	5	30
			20			

Note: Altogether 12 ECTS credits are selected among optional courses

Optional courses in the IIIrd semester

		L	E	Ex	ECTS
Beban-Brkić, J.	Methods of Linear Algebra	2	2	1	6
Fiedler, T.	Photogrammetry Outside Geodesy	2	2	1	6
Fiedler, T.	GIS in Application	2	2	1	6
Frangeš, S.	Thematic Cartography	2	2	1	6
Fučkan-Držić, B.	German for Academic Purposes	2	2	1	6
Lapaine, M.	Multimedia Cartography	2	2	1	6
Mastelić Ivić, S.	Risk Management	2	2	1	6
Medak, D:	Programme Engineering in Geomatics	2	2	1	6
Radović, N.	Geomathematics	2	2	1	6
Zadelj-Martić, V.	Numerical Analysis	2	2	1	6

IXth Semester

			L	E	Ex	ECTS
1.	Bačić, Ž.	Integrated Systems in Geomatics	2	2	1	6
2.	Fiedler, T.	Image Survey	2	2	1	6
3.	Frangeš, S.	Geovisualisation	2	2	1	6
Optional		Project 1	0	4	1	6
		Project 2	0	4	1	6
		Total	6	14	5	30
			20			

Note: Altogether 12 ECTS credits are selected among optional courses

Xth Semester

			L	E	Ex	ECTS
1.		Diploma thesis	10	10	1	30
		Total	10	10		30
			20			

There is a total of 120 ECTS credits at the graduate studies, with at least 24 ECTS credits or 20% among them in optional courses.

Optional project list in the IXth semester for both subject-oriented fields

A student selects 2 out of offered projects

Optional		Project name	L	E	Ex	ECTS
1.	Bačić, Ž.	Satellite Positioning	0	4	1	6
2.	Bajić, M.	Remote Sensing	0	4	1	6
3.	Barković, Đ.	Testing and Calibration of Geodetic Instruments and Accessories According to ISO Standards	0	4	1	6
4.	Bašić, T.	Determination of the Earth's Shape	0	4	1	6
5.	Brkić, M.	Geomagnetic Networks	0	4	1	6
6.	Cigrovski-Detelić, B.	4D-Geodesy	0	4	1	6
7.	Džapo, M.	Land Surveying	0	4	1	6
8.	Feil, L.	Determination of Water Power Plant Object Movement	0	4	1	6
9.	Fiedler, T.	Selected Chapters of Photogrammetry and GIS	0	4	1	6
10.	Frangeš, S.	Practical Cartography	0	4	1	6
11.	Hećimović, Ž.	Global Geodesy	0	4	1	6
12.	Ivković, M.	Digital Plans	0	4	1	6
13.	Kapović, Z.	Engineering Geodesy in Construction	0	4	1	6
14.	Lapaine, M.	Cartography and New Technologies	0	4	1	6
15.	Lasić, Z.	Influence of Atmospheric Condition on Optical Function of Theodolite Telescope	0	4	1	6
16.	Mastelić-Ivić, S.	Spatial Development	0	4	1	6
17.	Medak, D.	Programming in Geoinformation Systems	0	4	1	6
18.	Mraović, B.	How Marketing Operates – Its Tools and Techniques	0	4	1	6
19.	Novaković, G.	Geodetic Networks for Special Purposes	0	4	1	6
20.	Pribičević, B.	Geodynamics of the Adriatic Microplate	0	4	1	6
21.	Roić, M.	Land Information Management	0	4	1	6
22.	Rožić, N.	Optimizing of Geodetic Networks	0	4	1	6
23.	Špoljarić, D.	Geodetic Astronomy	0	4	1	6
24.	Vučetić, N.	Generalization of Geoinformation	0	4	1	6

3.2 Description of each course

GRADUATE STUDIES OF GEODESY AND GEOINFORMATICS

CONTENTS OF COURSES

NAME OF THE COURSE: NAVIGATION

Teacher's name: Assoc. Prof. Željko Bačić, PhD
Assistant name: Danko Markovinović, MSc, Danijel Šugar

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling: attended course "Satellite Positioning"**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Short overview of the principles of navigation. Navigation by means of applying the satellite positioning systems. Absolute methods of observation by means of GPS (absolute and DGPS). Guaranteed and achievable accuracy of positioning by means of absolute observation methods (absolute, DGPS). Accuracy levels of DGPS. Combination of code and phase for the purpose of increasing the accuracy of DGPS. Errors sources in absolute methods and their influence on measuring results. Properties, usage manner and possibilities of GPS devices for navigational purposes. Properties, usage manner and possibilities of GPS software in navigation application. Application of navigation devices in geodesy and geoinformatics. Application of navigation devices for non-geodetic usage (transport, environmental protection, agriculture and forestry, sport, recreation, etc.).
In the practical part (exercises) the students are acquainted with navigation GPS devices and software for data processing, they get practical field task and work on technical report.

Developed competence (knowledge and skills)

The students are expected to adopt knowledge about navigation and application of satellite positioning for that purpose. The advantages and disadvantages of GPS in navigation application. The are acquainted with GPS equipment (hardware and software) for navigational application and adopt skills in using this equipment. Application of satellite navigational technique for geodetic and non-geodetic purposes.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖

Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

b) Additional

Bačić, Ž. i Bašić, T: Satelitska geodezija (interna skripta), Geodetski fakultet, Zagreb, 1999.

Hofmann-Wellenhof, B., Lichtenegger, H., Colins J.: GPS Theory and Practice, 2001.

Bilajbegović, A., Hofmann-Wellenhof, B., Lichtenegger, H.: GPS u teoriji i praksi, 2000.

Kayton, M.: Navigation Land, Sea, Air & Space. The Institute of electrical and Electronics Eng., New York, 1989.

NAME OF THE COURSE: INTEGRATED SYSTEMS IN GEOMATICS

Teacher's name: Assoc. Prof. Željko Bačić, PhD
Assistant name: Danko Markovinović, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling: completion of "Satellite Positioning"**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

New cognitions about the advanced measuring methods with GPS, differential (DGPS) and kinematical in real time (RTK). The methods of determining and techniques of searching for ambiguities are dealt with more extensive (least squares method, variance-covariance, FASF, Lambda method and others) as phase as well as for combination of code and phase. Advanced application of GPS in geodesy and geodynamics and non-geodetic economy. Plans of GPS development and the advantages that new properties will contribute to the intergration of sensors in geomatics. In the second part of the course the basic principals and prereguisites of sensor integration are dealt with, as well as the advantages that result from the integration. There are the characteristics of the sensors given that are applied in the integration for geodetic and geoinformation purpsoses (GPS, inertial systems, remote sensing sensors, odometers, gyroscopes). Algorithms of sensor intgegration. Integration of GPS and GIS as passive and active factors of integrated systems. Sensor integration for non-geodetic tasks. Geomatic approacha to sensor integration, defining the space of integrated sensors, problems of collecting and the quality of data.

Developed competence (knowledge and skills)

The students are expected to adopt extended knowledge about the systems of satellite positioning with an accent on GPS and other sensors convenient for integration. They will understand the concept of sensor integration, advantages and problems. They will develop the skills of solving the problems and applying the knowledge in advanced application of geodetic and geoinformation concepts.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✖	Practicum ✖
Individual research ✖	Field work ✖	Tutorial ✖	Consultations ✖
Workshops ✖	Discussion ✖	Internet ✖	

Student obligations

Oral exam ✓	Written exam ✖	Seminar ✖	Essay ✖	Active participation in education process – production and handing –in the programs ✓

Supervision and grading students

Written exam ✖	Oral exam ✓	Essay ✖	Practicum ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✖	Seminar ✖

References

a) obligatory

Bačić, Ž.: Satelitska geodezija III (interna skripta), Geodetski fakultet, Zagreb 2001.

b) additional

Hofmann-Wellenhof, B., Lichtenegger, H., Colins J.: GPS Theory and Practice, 2001.

NAME OF THE COURSE: SATELLITE POSITIONING – A PROJECT

Teacher's name: Assoc. Prof. Željko Bačić, PhD
Assistant name: Milan Rezo, MSc and Dinko Markovinović, MSc

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: attended course "Satellite positioning" and "Navigation" or "Integrated systems in Geomatics"**
- **Number of weeks in a semester/number of classes in a week: 15/0 + 4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

The Project "Satellite Positioning" encompasses the practical works in which the students will be given a task to prepare the observation, to observe, to process observation data and interpret the obtained results. The project tasks are practically oriented and connected with concrete works in geodetic practice and are partly connected with geodetic firms – contractors for the purpose of making the tasks maximally realistic.

Developed competence (knowledge and skills)

The project is aimed to develop organisational and executive abilities in individual task implementation applying previously adopted knowledge and skills. The independence in working on the project is also motivated by problem-oriented approach to the task and it is required from the student to make decision in the process of project realization.

Ways of teaching

Lectures	Exercises	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial	Consultations
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam	Written exam	Seminar ✓	Essay	Active participation in education process

Supervision and grading students

Written exam	Oral exam	Essay	Practical work
Project ✓	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

a) Obligatory

Bačić, Ž. i Bašić, T: Satelitska geodezija (interna skripta), Geodetski fakultet, Zagreb, 1999.

NAME OF THE COURSE: ADVANCED METHODS OF REMOTE SENSING

Teacher's name: Assoc. Prof. Milan Bajić, PhD
Assistant name: Andrija Krtalić

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling: Remote Sensing**
- **Number of weeks in a semester/number of classes in a week: 15/2 + 2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

This course is planned as a continuation to the knowledge acquired in the course *Remote sensing* (RS). It contains advanced methods of RS that encompass complex methods of interpretation, including interactive and supervised classification, quality control, data fusion, quantitative evaluation of results by means of confusion matrix. The purpose of the subject is making students skilled for between usage of all available information and data, sensor and contextual, about the shot area or the objects on it. Apart from multispectral, radar data and images, there are also hyper spectral data and images considered.

- Spatial differentiation, modulation transfer function, minimal recognisable contract, minimal recognisable temperature difference.
- Improvement of the relationship – signal-noise and bleariness of images with deconvolution (inverse, Wienerov filter).
- Radar with synthetic antenna (SAR). Polarimetric and interfeormetric regimes.
- Specific characteristic and interpretation of radar images and data.
- Multispectral and hyperspectral line and image scanners.
- Specific details about shooting and interpretation of multispectral and hyper spectral images.
- Image processing on the level of pixel and group.
- Method of the main components.
- Interactive interpretation. Classification under surveillance. Quality measures: scattering ellipsis, dendogram, matrix of simultaneous appearance.
- Fusion of the pixel level, features, decision. Basic methods of associating the data. Criteria for association quality control.
- Analysis of the interpolation results by means of matrix confusion.
- Use of programme tools for RS.

Developed competence (knowledge and skills)

Students are acquainted and skilled in the methods of shooting and complex methods of interpreting multisensor, multispectral and hyper spectral images. They learn about applicable characteristics of sensors and shooting systems. They are skilled in applying quantitative method of evaluation and supervision of RS process and result quality.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar ✓

References

a) Obligatory

1. M. Bajić, Remote sensing, course material
2. J.A. Richards, Remote Sensing Digital Image Analysis
3. R.G. Congalton, K. Green, 1999. Assessing the Accuracy of Remotely Sensed Data

NAME OF THE COURSE: APPLICATION OF REMOTE SENSING

Teacher's name: Assoc. Prof. Milan Bajić, PhD
Assistant name: Andrija Krtalić

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/X**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

The course is intended for. a) the students at the Faculty of Geodesy who have not attended the course *Remote Sensing* (RS) at the undergraduate studies or the students of other faculties; b) the students of other faculties who wanton apply the methods of RS in their profession. The course therefore contains the basic principles of RS, it deals with the methods of applied interpretation of aerial and satellite images. Students work on seminar papers in thematic interpretation in the selected specialized field.

- Basic terms, definitions of RS. Usable physical properties of electromagnetic waves that are used in RS.
- Usable properties of aerial and satellite images obtained by means of passive and active sensors.
- The most important methods of thematic interpretation in RS.
- Gecoding and correction of images. Emphasizing, ranking and reduction of properties.
- Automatic and controlled classification.
- Specific characteristics of thematic interpretation for selected specialized areas.
- Preparation of seminars with thematic interpretation in the selected area chosen by students.
- Using of program tools for remote sensing.

Developed competence (knowledge and skills)

This course makes the students acquire skills for using the results of RS methods and the implementation in practical problems of the profession..

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam ✓	Essay ✖	Practical work ✖

✓			
Project ✖	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar ✓

References

a) Obligatory

1. M. Bajić, Daljinska istraživanja(Remote sensing), course manuscript
2. M. Oluić, Snimanje i istraživanje Zemlje iz svemira, sateliti, senzori, primjena. HAZU i GEOSAT, Zagreb, 2001.
3. J. A. Richards, Remote Sensing Digital Image Analysis

NAME OF THE COURSE: REMOTE SENSING – A PROJECT

Teacher's name: Assoc. Prof. Milan Bajić, PhD
Assistant name: Andrija Krtalić

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: Advanced Methods of Remote Sensing**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes): 5**
- **ECTS points: 6**

Description/contents of the course

Creation and derivation of the proposal of a remote sensing project in one or in several combined topics: Thematic interpretation for the needs of the geosciences. Airborne acquisition, airborne surveillance and airborne reconnaissance. Interpretation and evaluation of the satellite scenes. Identification of the system for the airborne multisensor or multispectral acquisition. Evaluation of the results of the remote sensing. Deployment of new sensor in operations. Research and development of the interpretation's methods; of data fusion; of decision support system based on results of the remote sensing, knowledge management and contextual information. Application of the methods for complex projects management PERT, GANNT, SWOT and demanding methodologies for submission of the scientific and technology projects (e.g. of European Commission etc.).

Developed competence (knowledge and skills)

Students will be trained to create and derive proposal of a hypothetic (or real) project in selected thematic topics of the remote sensing by use of the methodologies for preparation and management of projects.

Ways of teaching

Lectures	Exercises	Seminar ✓	Practicum
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory
[1] M. Bajić, “Daljinska istraživanja”, manuscript.
[2] Olujić, M., 2001, “*Snimanje i istraživanje Zemlje iz svemira*, *sateliti, senzori, primjena.* HAZU i GEOSAT, Zagreb.

b) Additional
[1] R.G. Congalton, K. Green, “Assessing the accuracy of remote sensed data: principles and practics”, Lewis Publishers, Boca Raton, 1998.
[2] L. Wald, “ Data fusion definitions and architectures, fusion of images of different spatial resolutions”, Ecole des Mines de Paris, Paris, 2002.
[3] G.D. Boreman, “ Modulation transfer function in optical and electro-optical systems”, The International Society for Optical Engineering, Bellingham, 2001.
[4] J.C. Leachtenauer, R.G. Driggers, “ Surveillance and reconnaissance Imaging System”, Artech House, Boston, 2001.
[5] G. Waldman, J. Wootton, “ Electro-optical performace modeling”, Artech House, Boston, 2001.
[6] G.C. Holst, “ CCD arrays, cameras, and displays”, The International Society for Optical Engineering, Bellingham, 1996.
[7] G. Asrar, “ Theory and applications of optical remote sensing”, John Wiley and sons, New York, 1989.
[8] J. A. Richards, J. Xiuping, “Remote Sensing Digital Image Analysis”, An Introduction, Berlin, 1999.

c) Internet sources
In accordance to the contents of a project.

NAME OF THE COURSE: PRECISE GEODETIC MEASUREMENTS

Teacher's name: Assist. Prof. Đuro Barković, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes): 5**
- **ECTS points: 6**

Description/contents of the course

Lectures:
Introduction inot precise measurements. Global limits of measuring uncertainty of linear and angle quantities. Methods of precize geodetic measurements. methods of precise measurements of linear quantities (distances and elevation differences). Methods of precise measurement of angle quantities. Discrepancy sources with the methods of precise geodetic linear and angle quantities with the estimation of measuring uncertainty, repeatebility, and reliability. Description and theoretical basis of instruments and accessories for precise geodetic measurements of linear and angle quantities. Testing, rectification and comapration of instruments and accessories for precize geodetic measurements of lienear and angle quantities according to international ISO standards. Analysis of measured data obtained by means of comaparison. Establishment of the Laboratory for measurements and measuring techniques of teh Geodetic Institute at the Faculty of Geodesy according to the International standard ISO 17025, and the inititation of the procedure for enlisting the Laboratory into the national (European) network of authorized measurement laboratories.
Exercises
Precize measurement of distances between two given points with the measuring uncertainty of 0,3 mm + 1ppm. The given distance is to be set on the straightline between two points with measuring uncertainty of 0,3 mm + 1 ppm. Three parallel straight lines are to be set up, and the parallel characteristic is to be with measuring uncertainty 0,5". Precize measurement of elevation difference with measuring uncertainty of 0,7 mm/km. Invar measuring rod is to compared on the comaprator of the Faculty of Geodesy, and the measured data are to be analysed. The measuring tape to be compared on the comparator, and analysed the measured data obtained by comparison. Testing and comparison of theodolite and electronic distance meter according to ISO standards. Testing of distance meter frequency in the Laboratory and on the base of the Geodetic Faculty.

Developed competence (knowledge and skills)

Knowledge:
Students acquire the knowledge of the methods of precize geodetic measurements and the instruments and accessories used in these measurements. They have knowledge about field and laboratory preocedures for testing and calibration of geodetic instruments and accessories according to ISO standards. They know how to process and analyse teh data and give reports about testing and calibrating geodetic instruments and accessories.
Skills:

The make precize measurements of distances and angles and of elevation differences using thereby precize geodetic instruments and accessories. They perform field and laboratory testing and calibrating of geodetic instruments and accessories according to ISO standards. They process and analyse, and make reports on testing and calibrating geodetic instruments and accessories.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✓
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✓
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

Benčić, D. (2005): Mjerni instrumenti i sustavi u geodeziji i geoinformatici. Školska knjiga, Zagreb.

Benčić, D. (1990): Geodetski instrumenti. Školska knjiga, Zagreb.

Činklović, N. (1983): Metode preciznih geodetskih mjerenja. Naučna knjiga, Beograd.

Deumlich, F., Staiger, R. (2002): Instrumentenkunde der Vermessungstechnik. Herbert Wichmann Verlag - Heidelberg. Rastatt.

International Standard (1999): ISO-12857. Optics and optical instruments – Geodetic instruments – Field procedures for determining accuracy – Part 1, 2, 3.

International Standard (1999): ISO-12858. Optics and optical instruments – Ancillary devices for geodetic instruments – Part 1, 2.

Interna skripta za studente, u pripremi.

b) Additional

Opći zahtjevi za osposobljenost ispitnih i umjernih laboratorija (ISO/IEC 17025:1999; EN ISO/IEC 17025:2000)

General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:1999; EN ISO/IEC 17025:2000)

NAME OF THE COURSE: TESTING AND CALIBRATION OF GEODETIC INSTRUMENTS AND ACCESSORIES ACCORDING TO ISO STANDARDS – A PROJECT

Teacher's name: Assist. Prof. Đuro Barković, PhD
Assistant name: –

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes): 5**
- **ECTS points: 6**

Description/contents of the course

Testing, rectification and comparison of instruments and accessories for precise geodetic measurements and of linear and angle quantities according to the international ISO standards. Testing and comparison of theodolite and electronic distance meter according to ISO standards, field and laboratory procedures. Testing and calibration of invar levelling tapes and steel measuring tapes on the comparator at the Faculty of Geodesy. Testing of distance meter frequency in the Laboratory and on the base of the Faculty of Geodesy. Processing and analysis of measured data obtained by means of calibration. Making a report on testing and calibration.

Developed competence (knowledge and skills)

Knowledge:
Students acquire the knowledge on theoretical and laboratory procedures for testing and calibrating geodetic instruments and accessories according to ISO standards. They know how to process and analyse the data, and how to make a report on testing and calibration of geodetic instruments and accessories.
Skills:
The students make field and laboratory testing and calibration of geodetic instruments and accessories according to ISO standards. They process and analyse, and make report on testing and calibration of geodetic instruments and accessories.

Ways of teaching

Lectures	Exercises ✓	Seminar ✓	Practicum ✓
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam	Written exam	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam	Essay	Practical work ✓
Project ✓	Continuous evaluation of knowledge	Research ✓	Seminar ✓

	or grading of activity ✖		

References

a) Obligatory

International Standard (1999): ISO-12857. Optics and optical instruments – Geodetic instruments – Field procedures for determining accuracy – Part 1, 2, 3.

International Standard (1999): ISO-12858. Optics and optical instruments – Ancillary devices for geodetic instruments – Part 1, 2.

Course material for student being prepared.

b) Additional

Opći zahtjevi za osposobljenost ispitnih i umjernih laboratorija (ISO/IEC 17025:1999; EN ISO/IEC 17025:2000)

General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:1999; EN ISO/IEC 17025:2000)

NAME OF THE COURSE: PHYSICAL GEODESY

Teacher's name: Prof. Tomislav Bašić, PhD
Assistant name: Danko Markovinović, MSc

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Introduction into the physical geodesy. The principle of determining the shape and the external gravity filed of the Earth. Physical parameters as a connection between the physical surface and the rotational ellipsoid. Coordinate systems in physical geodesy. The elements of the Earth's body physics, basic geological composition of the Earth, geotectonic forces and isostatic compensation. The Earth's tide waves, geomagnetism, seismics (the basic terms). Gravitational acceleration and gravitational potential, centrifugal acceleration and centrifugal potential, gravity and gravity potential. The first, the second and the third differential quotient of gravity potential and their physical significance. Normal gravity field and normal gravity. Gravity anomalies. Absolute and relative determination of the gravity acceleration with the pendulum and gravimeter. The sources of errors in precise gravimetry, calibration function. Gravimetric reference systems and gravimetry networks. Gravity measurement on movable platforms (ship, plane) and necessary corrections. The development of the potential of attraction into the degree according to spherical functions. Introduction of disturbance potential, its properties and significance. Gravimeric method of physical geodesy: the third "geodetic" boundary task of the potential theory and fundamental equation of physical geodesy. Solution for a geoid, Stokes and Bruns theorem. Presentation of Molodenski solution. Astrogeodetic determination of geoid surface, i.e. quasi-geoid. Combined astrogravimetric levelling. Application of the collocation method by means of the least squares and "remove-restore" technique for precise determination of geoid surface using heterogeneous data of the Earth's gravity field, global geopotential models and digital terrain models.

Program of exercises:

Computation of gravity reductions and gravity anomalies. Computation of the effects of Earth's tide waves in precise gravimetry. Computation of normal geomagnetic element values. Application of various method of interpolating anomalies of free air. Calculation of geoid surface using the method of least squares collocation.

Developed competence (knowledge and skills)

Knowledge about determination of the external gravity filed of the Earth as one of the main tasks in geodesy, based on the measured physical parameters on and above the Earth's surface, knowledge and skill during tha practical measurement of those parameters, especially of gravimetric measurement and practical calculation of geoid surface, the basic surface in

geodesy from which the heights have been counted, especially for the necessity of the completation of the new 3D positional datum of the Republic of Croatia.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✖	Seminar ✓

References

a) Obligatory

1. Bašić, T.: Physical Geodesy (Lecture Notes in Croatian), Geodetski fakultet, Zagreb 2004.
2. Heiskanen, H., Moritz, H.: Physical Geodesy, Reprint Technical University Graz 1985.
3. Torge, W.: Geodesy, 3rd Edition, Walter de Gruyter, Berlin – New York 2001.
4. Torge, W.: Gravimetry, Walter de Gruyter, Berlin – New York 1989.

b) Additional

1. Moriz, H.: Advanced Physical Geodesy, Wichman Verlag, Karlsruhe 1989.
2. Klak, S.: Geophysic (Lecture Notes in Croatian), University of Zagreb, 1984.
3. Klak, S.: Gravimetry (Lecture Notes in Croatian), University of Zagreb, 1984.

c) Internet sources

URL1: fttp://www.iag-aig.org/
URL2: fttp://www.galagis.com/iProjekt/karta/geoid.htm

NAME OF THE COURSE: GEOPHYSICAL GEODESY

Teacher's name: Prof. Tomislav Bašić, PhD
Assistant name: Danko Markovinović, MSc

- **(Subject oriented field): Geodesy**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Definition and significance of a new geodetic discipline for better understanding of slow deformation of the Earth's crust. It includes the research of slow movements of the Earth's crust, time and space variations of the Earth's gravity field, as well as the rotation and deformations caused by tide waves of the Earth. The geodetic concept encompasses special processing of the gravity, precession and nutations, and the rotational movement of the deformable body, and the geophysical concept includes the radial structure of the Earth, lateral variations and hypotheses on the plate tectonics, hydrosphere and atmosphere in the sense of the sea level, sea tide waves, atmosphere in motion and underground water. Short overview of terrestrial and satellite measuring methods, and the measurements to the Moon, and radio intereferometric-measuring techniques. The movements of the Earth's crust, tide waves and the rotation of the Earth. Basic presentation of the theory of relativity and its geodetic application.
Description of exercises:
Detailed seminar work in one part of the subject material using available litarature and especially internet, with the obligatory final presentation haveing the benefit of modern presentation technique and defending of the theme.

Developed competence (knowledge and skills)

Knowledge about geodetic and geophysical aspects in the slow deformation of the Earth's crust with the respect to the space-time and frequency-time dimension of those phenomenons, and skill of autonomous research in solving of concrete task using most recent geodetic terrestrial and space techniques and internet.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

1. Bašić, T.: Geophysical geodesy (Lecture Notes in Croatian), Geodetski fakultet, Zagreb 2004.
2. Lambeck, K.: Geophysical Geodesy – The Slow Deformations of the Earth, Oxford Science Publications, Oxford 1988.
3. Torge, W.: Geodesy, 3rd Edition, Walter de Gruyter, Berlin – New York 2001.

b) Additional

1. Moritz, H., Müller, I: Earth rotation, Ungar, New York 1987.
2. Moritz, H., Hoffman-Wellenhof, B.: Geometry, Relativity, Geodesy, Wichmann, Karlsruhe 1993.

c) Internet sources

URL1: fttp://www.iugg.org/
URL2: fttp://www.geology.yale.edu/RETREAT/

NAME OF THE COURSE: EARTH SHAPE DETERMINATION – A PROJECT

Teacher's name: Prof. Tomislav Bašić, PhD
Assistant name: Danko Markovinović, MSc, Milan Rezo, MSc

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): Optional**
- **Conditions of course enrolling: State survey, Physical Geodesy**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes): No**
- **ECTS points: 6**

Description/contents of the course

Project of the practical Earth shape determination in local area using all available positional and physical parameters, global geopotential models, digital terrain models, ev. digital density models, etc. For the purpose of either classical or koncept of integral geodesy (if possible from the hardware point of view), the proper computer software should be developed for the calculation of necesary geometry or/and physical parameters in the investgated area.

Developed competence (knowledge and skills)

Knowledge and skills of autonomous project design towards practical realization of complex tasks of Earth shape determination in the area of interest using all necessary theoretical knowledge and computer programming .

Ways of teaching

Lectures ✖	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✖	Internet ✖	

Student obligations

Oral exam ✓	Written exam ✖	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✖	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity ✖	Research ✓	Seminar ✓

References

a) Obligatory

1. Bašić, T.: State Survey (Lecture Notes in Croatian), Geodetski fakultet, Zagreb 2004.
2. Bašić, T.: Physical Geodesy (Lecture Notes in Croatian), Geodetski fakultet, Zagreb 2004.
3. Heiskanen, H., Moritz, H.: Physical Geodesy, Reprint Technical University Graz 1985.
4. Torge, W.: Geodesy, 3rd Edition, Walter de Gruyter, 2001.
5. Torge, W.: Gravimetry, Walter de Gruyter, Berlin – New York 1989.

b) Additional
1. Vaniček, P., Krakiwski, E. : Geodesy – The Concept, North-Holland, 1986.
2. Kontaktstudium : Geodätische Netze in Landes- und Ingenieurvermessung II, 1985.
3. Moriz, H.: Advanced Physical Geodesy, Wichman Verlag, Karlsruhe 1989.

c) Internet sources
URL1: fttp://www.iag-aig.org/
URL2: fttp://www.euref-iag.net/
URL3: fttp://www.galagis.com/iProjekt/karta/geoid.htm

NAME OF THE COURSE: METHODS OF LINEAR ALGEBRA

Teacher's name: Jelka Beban-Brkić, PhD
Assistant name:

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/ 2 + 2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Real vector space: Subspaces. Linear independence. Basis and dimension. Rank and nullity. Basic ideas of linear algebra (basic algorithms on matrices, vector and matrix norms). Inner product space. Orthogonality. Orthonormal bases. Gram-Schmidt process. QR-decomposition. Least squares. Orthogonal matrices. Change of basis.
Eigenvalues and eigenvectors: Diagonalization and orthogonal diagonalization.
Linear transformations: General linear transformations. Inverse linear transformations. Matrices of general linear transformations.
Additional topics: Quadratic forms. Diagonalizing quadratic forms. Comparison of procedures for solving linear systems. LU-decompositions. The Cholesky algorithm. Some applications of linear algebra in geodesy. Fractals. Chaos.

Developed competence (knowledge and skills)

The students are acquainted with the theory and use of linear algebra methods in solving problems emphasizing its application in geodesy. The problems will be solved by use of the program - *Mathematica* and *WebMathematica*

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✖	Practicum ✖
Individual research ✖	Field classes ✖	Tutorial ✖	Consultations ✓
Workshops ✖	Discussion ✖	Internet ✓	

Student obligations

Oral exam ✖	Written exam ✓	Seminar ✖	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✖	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✖	Seminar ✖

References

a) Obligatory
Anton, H., Rorres, C.: Elementary Linear Algebra, John Wiley & Sons, Inc., N. Y. 2000.

b) Additional
Elezović, N.: Linearna algebra, Element, Zagreb1996.
Elezović, N., Aglić, A.: Linearna algebra, Zbirka zadataka, Element, Zagreb1996.

c) Internet sources
http://archives.math.utk.edu/topics/linearAlgebra.html
http://lavica.fesb.hr/~slap/la.html

NAME OF THE COURSE: GEOMAGNETIC SURVEY

Teacher's name: Assist. Prof. Mario Brkić, PhD
Assistant name: Danijel Šugar

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: -**
- **Number of weeks in a semester/number of classes in a week: 15 /2+2**
- **(Total number of field classes): 3**
- **ECTS points: 6**

Description/contents of the course

Geomagnetism and Geodesy, History of Geomagnetism, Earth's Magnetic Field, Geomagnetic Elements, Appearance of Geomagnetic Field, Sources of Geomagnetic Field, Time Variations of Geomagnetic Field, Secular Variation, Diurnal Variation, Magnetic Storms, K index of Geomagnetic Disturbances, Time Reduction of Measurements, Geomagnetic Charts, Model of Earth's Magnetic Dipole, Global Geomagnetic Models, Litospheric Geomagnetic Models, GEM Systems GSM-G Overhauser Magnetometer /Gradiometer, Bartington's MAG-H D/I System: Magnetometer, Probe and Zeiss Theo B Theodolite, Geomagnetic Surveys, Geomagnetic Points, Repeat Station, Auxiliary Station, Azimuth Reference, Methods for determination of Gradients: Vertical Gradient above Geomagnetic Point, Geomagnetic Point Surroundings Gradients, Gradients of Inner Grid, Gradients of Outer Grid, Survey of Declination, Inclination, and Total Intensity, Setup of PPM Magnetometer, Setup of D/I System, 'Null' Method for Measurements of Declination and Inclination, Measurements of Total Intensity. Exercises consist of Familiarizing with: GEM Systems GSM-G Overhauser Magnetometer /Gradiometer, and Bartington MAG-H D/I System, Total Intensity Gradients Measurements Methods and Software, 'Null' Method for Measurements of Declination and Inclination and Processing Tables, Total Intensity Gradients Field Survey with Processing and Interpretation of Measurements, and Field Survey of Declination, Inclination, and Total Intensity with Processing, Visualisation and Interpretation of Measurements.

Developed competence (knowledge and skills)

Fundamentals of the geomagnetism; application of contemporary measurement methods of the geomagnetic declination, inclination, total intensity and total intensity gradients.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops	Discussion	Internet	

Student obligations

Oral exam ✓	Written exam	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam ✓	Essay	Practical work ✖
Project	Continuous evaluation of knowledge	Research	Seminar ✓

	or grading of activity		

References

a) Obligatory

Brkić, M.: Predavanja iz Geomagnetizma, (interna skripta), Geodetski fakultet, Zagreb 2005.
Šugar, D.: Vježbe iz Geomagnetizma, (interna skripta), Geodetski fakultet, Zagreb 2005.

b) Additional

Newitt, L. R., Barton, C. E., i J. Bitterly (1996): Guide For Magnetic Repeat Station Surveys, IAGA, Boulder, USA.

NAME OF THE COURSE: GEOMAGNETIC NETWORKS – A PROJECT

Teacher's name: Assist. Prof. Mario Brkić, PhD
Assistant name: Danijel Šugar

- **(Subject oriented field):**
- **Year/semester: 5 /IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: Geomagnetic Survey**
- **Number of weeks in a semester/number of classes in a week: 15 /2+2**
- **(Total number of field classes): 7**
- **ECTS points: 6**

Description/contents of the course

Maintenance of Geomagnetic Network, and Geomagnetic Survey: (1) Field Evaluation of Geomagnetic Points Criteria – Sources of Geological and Civilization Noises, Total Intensity Gradients Field Survey, and the others; (2) Field Survey of Declination, Inclination, and Total Intensity with Processing; (3) Composing of Technical Report.

Developed competence (knowledge and skills)

Independence in assessment of the geomagnetic point status; proficiency in surveying of the geomagnetic declination, inclination, total intensity and total intensity gradients; and related reporting and organizational skills.

Ways of teaching

Lectures	Exercises	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops ✓	Discussion	Internet	

Student obligations

Oral exam	Written exam	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam	Essay	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity	Research	Seminar ✓

References

a) Obligatory
Newitt, L. R., Barton, C. E., J. Bitterly (1996): Guide For Magnetic Repeat Station Surveys, IAGA, Boulder, USA.

NAME OF THE COURSE: GEODESY IN GEOSCIENCES

Teacher's name: Assist. Prof. Brankica Cigrovski-Detelić, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Geodetic works in interdisciplinarz geodynamic projects. Geodynamic networks base on GPS measurements. Designing, reconaissence and stabilization of points in geodynamic networks. Absolute and relative adjustment models and the application in geosciences. Geodetic measurements as the basis for establishing geodynamic models. Geodetic models of tectonic movements. Models of seismic activities based upon geodetic measurements. Determination of movements and deformation of external Earth surface by means of geodetic methods. Application of surface deformation analysis in modelling the external Earth surface. Practical application of the correlation of geodetic models of external Earth surface deformation with the models obtained by applying the methods from other areas of geosciences (geophysics, geology, seismisc, tectonics…) for detecting the positions of mineral resources, oil resources, water, movemevent of geological structures, faults, earthquake epicentres etc.

Developed competence (knowledge and skills)

Application of the methods of classical and satellite geodesy in interdisciplinary (geodynamic) projects.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar

References

a) Obligatory
Cigrovski-Detelić, B. (1998): Primjena GPS-mjerenja i getektonskih informacija u obradi geodinamičke mreže CRODYN (Application of GPS measurements and geotectonic information in the processing of geodynamic network CRODYN)

b) Additional
Skoko, D.: (1998): Andrija Mohorovičić
Altiner, Y.: (1996): Geometrische Modelirung innerer und äusserer Deformationen der Erboderflähe

c) Internet sources
key words: GPS-measurements, geodynamic models, tectonics

NAME OF THE COURSE: FOUR-DIMENSIONAL GEODESY – A PROJECT

Teacher's name: Assist. Prof. Brankica Cigrovski-Detelić, PhD
Assistant name:

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Introduction. Geological structure set and recent tectonig activity at the territory of Croatia. Croatian geodynamic project CRODYN. Data analysis of GPS measurements and adjustment in geodynamic networks. Basics of tensor calculation and its application in geodesy. Applicatin of geometric modelling in determination of the deformation of the external Earth's surface. Measures of internal surface deformations determined on the basis of GPS measurements; surface dilatation, surface elongation. External surface dofromations. Calculation of surface deformations on the basis of GPS measurements. Calculation by means of: Gauss surface presentation from external normal surfac coordinates, and computation of deformation in ellipsoid coordinates. Application of final elements method in geodesy. The significance of geodetic contribution in the defomration analysis.

Developed competence (knowledge and skills)

Application of GPS measurements in determining the internal and external deformations of the external Earth's surface. Computing and graphic presentation of movement vector speed and surface deformation measures.

Ways of teaching

Lectures	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar

References

a) Obligatory:

Cigrovski-Detelić, B. (1998): Primjena GPS-mjerenja i geotektonskih informacija u obradi geodinamičke mreže CRODYN (Application of GPS measurements and geotectonic information in the processing of geodynamic network CRODYN)

Brunner F. K., Rizos C. (1990): Developments in Four-Dimensional Geodesy, Springer, Berlin, New York

b) Additional:
Altiner, Y. (1999): Analytical surface Deformation Theory for Detection of the Earts Crust Movements, Springer, Berlin, Heidelberg, New York.

Skoko, D (1998): Andrija Mohorovičić

Hofman-Wellenhof B., Lichtenegger H., Collins J.(1997): Global Positioning System, Springer-Verlag, Wien, New York.

c) Internet sources:
Key words: GPS-mjerenja, tenzori, deformacijska analiza

NAME OF THE COURSE: CADASTRAL SURVEY

Teacher's name: Assoc. Prof. Marko Džapo, PhD
Assistant name: Marko Šljivarić, MSc, Loris Redovniković

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week:15/2+2**
- **(Total number of field classes): 8**
- **ECTS points: 6**

Description/contents of the course

Lectures: Cadastral survey – analysis of the existing geodetic control and designing a new one. Analysis of cadastral register data discrepancies supported by remote sensing. Selection of optionan surveying method. Dvision of land according the manner and purpose of use. Boundary project of land surveying. Detailed survey object, demarcation of survey area boundaries, defining the boundaries and making a plan of marking monuments. Technical regulations of cadastral survey, quality estimation and accuracy classes. Allowed discrepancies (degrees of tolerance). Methods of cadastral survey (pohotogrammetric, polar and RTK). Coded detailed survey and production of plans in analogous and digital form. Integration of coded tacheometry and RTK. Making survey drafts and plan s. Precision and reliability of survey – checking. Procedures of presenting new cadastral survey data. Construction land development. Survey and registering the objects in land register and land registry book. Survey of inner premises.
Exercises: Coded tacheometry. Survey of inner premises – working on floor division.

Developed competence (knowledge and skills)

Students are skilled in independent conducting new cadastral survey, and in making floor division project.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge	Research ✓	Seminar ✓

	or grading of activity ✓		

References

a) Obligatory

1. Džapo, M.: Predavanja – rukopis (Course material – manuscript).
2. Medić, V., Fanton, I., Roić, M. (1996): Katastar zemljišta i zemljišna knjiga (Land register and land registry book). Course material
3. Official Gazette: Laws and ordinances

NAME OF THE COURSE: INDUSTRIAL SURVEY

Teacher's name: Assoc. Prof. Marko Džapo, PhD
Assistant name: Vlado Cetl, MSc

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes): 6**
- **ECTS points: 6**

Description/contents of the course

Industry as the activity field of engineering geodesy. Measuring procedures and instruments in assembling and controlling machines. 3D touchless measurements in real time. Measurement of declination and curvature. Hydrographical levelling. Continuous observation using the hydrostatic levelling. Special devices. Measuring clocks. Tripods. Target marks. Additional reading devices. Special rods and scales. Precise devices for coordinate measurement. Computer aided 3D survey. Measuring robots in geodesy. The role of optical systems with CCD cameras. Measuring systems with theodolites. Geometry problem. Problems of configuration and the influence on accuracy. Signalling the points and selection of marks. Analysis and optimizing of accuracy in industrial survey. Obtaining the results in real time. Presentation of the system in the market. Selected examples of application. Survey and accuracy estimation of industrial object.

Developed competence (knowledge and skills)

Students adopt the knowledge in theory and practice of survey and control of industrial objects.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

a) Obligatory
Hennecke F., Mueller G., Werner H.: Handbuch Ingenieurvermessung, Band 6, Maschinen- und Anlagenbau, Wichmann Verlag, Karlsruhe 1996.
Roić, M.: Industrijska izmjera, interna skripta (Industrial survey), course material, Faculty of Geodesy, Zagreb 2000

NAME OF THE COURSE: LAND SURVEYING – A PROJECT

Teacher's name: Assoc. Prof. Marko Džapo, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes): 5**
- **ECTS points: 6**

Description/contents of the course

Detailed survey as the basis for designing. Measuring data processing and presentation of the free mode. Processing and adjustment of geodetic networks needed in tunnel cutting. Layout and survey of transverse and longitudinal tunnel profiles, volume calculation of excavations and over profiles and under profile. Positional and vertical underground control for monitoring the tunnel cutting and its specific features.

Developed competence (knowledge and skills)

Students are skilled in independent conducting geodetic works.

Ways of teaching

Lectures	Exercises ✓	Seminar ✓	Practicum ✓
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam	Seminar ✓	Essay	Active participation in education process

Supervision and grading students

Written exam	Oral exam ✓	Essay	Practical work ✓
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory
Džapo, M.: Predavanja – rukopis.
Benčić, D., Solarić, N. (2005): Mjerni instrumenti i sustavi u geodeziji i geoinformatici. Školska knjiga, Zagreb.
Kahmen, H. (1997): Vermessungskunde. Berlin.
b) Additional
Macarol, S. (1985): Praktična geodezija. Tehnička knjiga, Zagreb.

NAME OF THE COURSE: SPECIAL ALGORITHMS FOR GEODETIC MEASUREMENT PROCESSING

Teacher's name: Prof. Ladislav Feil, PhD
Assistant name: Martina Gucek

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Analysis and special processing of geodetic measurements. Measurement processing according to $\mathbf{L}_1, \mathbf{L}_2$ and $\mathbf{L}_\infty$ standards. Adjustment of measurement in time sets and deformation analysis. Regression and collocation. Congruency test
Exercises: Practical and computer aided special processing of geodetic measurements. Measurement processing according to $\mathbf{L}_1$ and $\mathbf{L}_\infty$ standards. Adjustment of measurement in time sets and deformation analysis. Regression. Congruency test.

Developed competence (knowledge and skills)

Analysis and special processing of geodetic measurements.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar ✓

References

Feil, L. Teorija pogrešaka i račun izjednačenja I, Textbook of the Faculty of Geodes, University of Zagreb, Zagreb 1990.
Feil, L. Teorija pogrešaka i račun izjednačenja II, Textbook of the Faculty of Goedesy, University of Zagreb, Zagreb 1990.

b) Additional

Klak, S. Teorija pogrešaka i račun izjednačenja, Textbook of the Faculty of Geodesy, University of Zagreb, Zagreb 1982.

NAME OF THE COURSE: DETERMINATION OF WATER POWER PLANT OBJECTS MOVEMENT – A PROJECT

Teacher's name: Prof. Ladislav Feil, PhD
Assistant name: Martina Gucek

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Preparing the study on determination of water power plant objects movement and deformation analysis.

Developed competence (knowledge and skills)

Developing the knowledge and skills for determining the movements of water power plant object and the analysis of movements.

Ways of teaching

Lectures	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam	Written exam	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam	Essay	Practical work
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory

Feil, L.: Elaborati određivanja pomaka objekata hidrocentrala (30 elaborata u posljednjih 25 godina)

NAME OF THE COURSE: IMAGE SURVEY

Teacher's name: Prof. Teodor Fiedler, PhD
Assistant name: Dubravko Gajski, PhD

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Mathematical and physical models of space mapping, and the methods of georeferencing, specific for individual types of sensors. It is vital for understanding and correct application of modern technologies in digital photogrammetry and remote sensing. The following units are encompassed:
Central projection
Coordinate systems in photogrammetry, Homogeneous coordinates
Calibration of classical and digital cameras, distortion
Numerical procedures of inner, relative and absolute orientation
Georeferencing of data with active and passive sensors
Integrated systems (sensors+GPS+IMU)
Aerial triangulation in sets and blocks
Adjustment of triangulation with the methods of independent models and air parcel
Quality estimation of photogrammetric works

Developed competence (knowledge and skills)

The students are motivated and skilled to solve standard tasks in photogrammetry independently and correctly focusing on georeferencing the data collected with classical and digital photogrammetric cameras, and other sensors common in photogrammetry and remote sensing.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge	Research ✓	Seminar ✓

	or grading of activity		

References

a) Obligatory

Kraus, K., Photogrammetry, Vol. 1. Fundamentals and standard processes, Dümmler, 2000.
Kraus, K., Photogrammetry, Vol. 2. Advanced methods and applications, Dümmler, 2000.
Kraus, K., Photogrammetrie Band 3, Topographische Informationsysteme, Dümmler 2001.

NAME OF THE COURSE: TOPOGRAPHIC INFORMATION SYSTEMS

Teacher's name: Prof. Teodor Fiedler, PhD
Assistant name: Dubravko Gajski, PhD

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: no**
- **Number of weeks in a semester/number of classes in a week: 15/2 +2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

The course brings necessary knowledge, important for projecting, building and maintaining of TIS, and it contains the following topics:

- Visualisation of astronomic data for Internet (production of digital map of the star sky intended for Internet).
- Collecting topographic data
- Structures for TIS
- TIS design
- Modelling in TIS
- Interpolations and approximations in TIS
- Digital terrain models
- Quality assessment
- Use of TIS
- Spatial analysis, visualisation and animation of TIS

Developed competences (knowledge and skills)
The students are skilled in competent participation in all phases of designing, building and maintaining of TIS, and in efficient data usage contained in TIS.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge	Research ✓	Seminar ✓

	or grading of activity		

References

a) Obligatory

Kraus, K., Photogrammetrie Band 3, Topographische Informationsysteme, Dümmler 2001.

NAME OF THE COURSE: GEOINFORMATION SYSTEMS

Teacher's name: Prof. Teodor Fiedler, PhD
Assistant name: Tomislav Ciceli, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week:15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Overview and definition of GIS. Basic and spatial concept. Conceptual models and procedure approach. Objects, topology of spatial objects and spatial relations. Spatial attributes, Raster and vector models. Conversion. Databases, structures, Data sources, data collection, hardware and software equipment, program system and algorithms for data collections, analogous-digital conversion. Remote sensing. GPS technology. Data quality, definition of positional accuracy and attributes, logical consistency. Expert systems and GIS.
Exercises: Usage of CAD tools and their modules for preparation of vector and raster data for the project. Topological data processing according to the data model CROTIS. Getting acquainted with program package GEoMedia PRO.

Developed competence (knowledge and skills)

Deeper understanding of GIS and acquiring the knowledge for independent work in the area of collecting processing and analysing the spatial information as infrastructure base of geographic information systems.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

a) Obligatory

Langley, P. A. dr.: GIS, Volume l i Volume 2, NV 1999

Aronof, S. Geographic Information Svstem, A Management Perspective

b) Additional:
Schuurman: GIS a Short Introduction, Blackwell Publishing, 2003.

NAME OF THE COURSE: PHOTOGRAMMETRY OUTSIDE GEODESY

Teacher's name: Prof. Teodor Fiedler, PhD
Assistant name: Tomislav Ciceli, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Practice-oriented tasks in terrestrial photogrammetry. Overview of methods and possibilities. Instruments for shooting, measuring and amateur images. Special problems of calibration and rectifying the used photogrammetric systems for shooting and surveying in terrestrial photogrammetry. Geodetic measurements in field works. Application of terrestrial photogrammetry and solving the tasks in:
Archaeology
Ship building
Construction heritage
Medicine
Underwater photogrammetry
Traffic accidents
Stomatology
Machine engineering

Developed competence (knowledge and skills)

Ability of solving photogrammetric tasks in the scientific areas outside of geodesy

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes ✓	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar ✓

References

a) Obligatory

Karara, H.M. (1989): NON-TOPOGRAFIC PHOTOGRAMMETRY, Second Edition, American Society For Photogrametry And Remote Sensing, Virgina, SAD

Atkinson, K. B. (1996.): CLOSE RANGE PHOTOGRAMMETRY AND MACHINE VISION, Whittles Publishing, Caithness, Scotland, UK.

Kraus, K (1997): PHOTOGRAMMETRY, VOLUME 2, ADVANCED METHODS AND APPLICATIONS, Dümmlers Verlage, Bonn, Germany

b) Additional

Kraus, K (1993): PHOTOGRAMMETRY, VOLUME 1, FUNDAMENTALS AND STANDARD PROCESSES, Dümmlers Verlage, Bonn, Germany

NAME OF THE COURSE: GIS IN APPLICATIONS

Teacher's name: Prof. Teodor Fiedler, PhD
Assistant name: Tomislav Ciceli, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Presenting various examples of GIS project applications. Application areas:
GIS applied in infrastructure (gas, water, drainage, power supply…)
Spatial development and GIS,
GIS in telecommunications,
GIS in transport systems
GIS in environmental protection, Local, national and global application of GIS in agriculture

Developed competence (knowledge and skills)

Ability of deciding where and when to apply Geoinformation systems, to understand and apply GIS in given circumstances.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar ✓

References

a) Obligatory

Longley, P. A., Goodchild, M. F., Maguir, D. J., Rhind, D.W.: Geogaphic information Systems Volume 2, Second Edition, John Wiley & Sons, New York 1999.

b) Additional:

Molenaar, M.: an Introduction to the Theory of Spatial Object Modelling, Taylor & Francis, 1998.

NAME OF THE COURSE: SELECTED CHAPTERS OF PHOTOGRAMMETRY AND GIS – A PROJECT

Teacher's name: Prof. Teodor Fiedler, PhD
Assistant name: Tomislav Ciceli, MSc, Andrija Krtalić, Sanja Šamanović

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: GIS**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes): up to 7**
- **ECTS points: 6**

Description/contents of the course

Practical implementation of a project which will be a mutual project of Photogrammetry and Geoinformatics. Project starts with planning (time, resources, finances), and ends up with finalization. Special issues of interdisciplinary and implemented procedures and methods. It will serve as the introduction in master thesis.

Developed competence (knowledge and skills)

Skills and competences in planning, execution and quality control of the practical tasks in particular project.

Ways of teaching

Lectures	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory
Depending on the chosen subject
b) Additional
Depending on the chosen subject
c) Internet sources
Depending on the chosen subject

NAME OF THE COURSE: THEMATIC CARTOGRAPHY

Teacher's name: Assoc. Prof. Stanislav Frangeš, PhD
Assistant name: Vesna Poslončec-Petrić, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Description of lectures: Historical outline. Goals and tasks of thematic cartography. Thematic maps; experts information systems. Thematic mapping; characteristics of base map for thematic mapping. Differences and similarities of thematic and topographic maps. Classification of thematic maps according to object properties, on the basis of presentation forms and applied map graphics, and according to thematic fields. Design of thematic maps. Basic characteristics of natural territory thematic maps. Basic characteristics of maps belonging to the field of human activity. Nacional atlases. Possibilities of computer programs in the production of thematic maps. Structures of experts information systems. Experts information systems of Croatia.
Description of exercises: Production of various thematic maps using various program packages.
Seminar: Research of production, updating and use of experts informations systems and thematic maps.

Developed competence (knowledge and skills)

The students learn about thematic cartography, classifications and creation of experts information systems and thematic maps and the possibilities of program packages in their production.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✖	Research ✓	Seminar ✓

References

a) Obligatory

Frangeš, S.: Tematska kartografija (Thematic cartography). Manuscript of preparation, www.geof.hr/kartogra/tematska.pdf

b) Additional

Hake, G., Grünreich, D., Meng, L.: Kartographie – Visualisirung raum-zeitlicher Informationen. Walter de Gruyter, Berlin, New York 2002.

Dent, B.D.: Cartography – thematic map design. 5th edition, WCB, Boston 1999.

Slocum, T.A.: Thematic Cartography and Visualization. Englewood, Prentice Hall, New York 1998.

Hake, G., Grünreich, D., Meng, L.: Kartographie – Visualisirung raum-zeitlicher Informationen. Walter de Gruyter, Berlin, New York 2002.

c) Internet sources

http://129.187.175.5/materials/Them_Karto_I/t4_5.pdf

http://129.187.175.5/materials/Them_Karto_II/Themat_Karto_Rep_2003.pdf

NAME OF THE COURSE: GEOVISUALISATION

Teacher's name: Assoc. Prof. Stanislav Frangeš, PhD
Assistant name: Robert Župan, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling: completed a course Geoinformation Systems and Digital Cartography**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Description of lectures: Concept of visualisation, cartographic visualisation, and geovisualisation. Demands on visualisation. Possibilities of an eye and optical illusion. Purpose and need for geovisualisation. Procedures of visualisation of geoinformation; 2D, 3D. Cognitive and usability issues in geovisualisation. Geospatial virtual environments. Dynamic representations. Metaphors, schemata and interface design. Individual and group differences. Evaluating the effectiveness of geovisualisation methods. Collaborative geovisualisation. Geovisualisation tools.
Description of exercises: Comparison and production of various visualisation of geoinformation. Application of various geovisualisation tools.
Seminar: Research of possibilities of various application and tools in geovisualisation.

Developed competence (knowledge and skills)

Interpretation of geoinformation and their visualisation and comunication by means of various cartographic presentations.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✖	Research ✓	Seminar ✓

References

a) Obligatory

Kraak, M.-J., Ormeling, F.J.: cartography, the Visualisation of Geospatial data, London, Addison wesley Longman 2001.

Frangeš, S.: Kartografska vizualizacija (Map visualisation). Manuscript in preparation, www.geof.hr/kartogra/kart_viz.pdf

b) Additional

MacEachren, A.M.: How maps work – Representation, visualization and design. Guilford Press, New York 1995.

Heim, M.: Virtual realism. New York, Oxford 1998.

Mayhew, D.J.: The usability engineering lifecycle: A practicioner's handbook for user interface design. Morgan Kaufman Publishers, San Francisco, 1999.

Card, S.K., MacKinley, J.D., Shneiderman, B.: Readings in information visualisation – Using vision to think. Morgan Kaufman Publishers, San Franncisco, 1999.

c) Internet sources

http://129.187.175.5/materials/Master_Course/Meng_Liqui/designissue_script.pdf

http://129.187.175.5/materials/Visualization_I/mdmv.pdf

NAME OF THE COURSE: PRACTICAL CARTOGRAPHY – A PROJECT

Teacher's name: Assoc. Prof. Stanislav Frangeš, PhD
Assistant name: Robert Župan, MSc, Vesna Poslončec-Petrić, MSc

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Project of various cartographic presentations. Preparation for a cartographic project. Making an offer in the process of map production project. Course of map production – project realisation. Sequence of producing single cartographic plots. Basic technologies of map production.
Project, production and updating of various cartographic presentations that are made or have been made by the Institute for Cartography at the Faculty of Geodesy, University of Zagreb. Research of map graphics and map visualisation. Research of various cartographic software types.

Developed competence (knowledge and skills)

Project, production and updating of various cartographic presentations. Interpretation of geoinformation and their visualisation and comaunication by means of cartographic presentations.

Ways of teaching

Lectures ✖	Exercises ✖	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity ✖	Research ✓	Seminar ✓

References

a) Obligatory

Diploma theses made in the Institute for Cartography, at the Faculty of Geodesy, University of Zagreb.

Manuals of various program packages.

b) Additional

Hake, G., Grünreich, D., Meng, L.: Kartographie – Visualisirung raum-zeitlicher Informationen. Walter de Gruyter, Berlin, New York 2002.

Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, a.J., Guptill, S.C.: Elements of Cartography. New York, J. Wiley and Sons 1995.

c) Internet sources

http://www.lrz-muenchen.de/~t583101/WWW/index.html

NAME OF THE COURSE: ENGLISH FOR ACADEMIC PURPOSES

Teacher's name: Biserka Fučkan Držić, Prof.
Assistant name:

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: a pass mark in "English in Geodesy"**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course:

Developing language skills in the context of geodesy. Attending lectures in English for geodetic purposes. Studying the skills in making notes in English for special purposes. Case studies for various topics, e.g. Informatics and geodesy, importance of geoinformation systems, new challenges in geodesy, shape and size of the Earth as functions of time, map as a work of art, etc. Practising various types of presenting specialised topics. Techniques of efficient presentation, usage of visual tools. Team and individual presentation of material. Teaching the skill in reading specialized literature in English for special purposes. Improving the language for special purposes by means of Internet. Writing professional, i.e. scientific paper in English (organisation of the written material, sentence types characteristic for single parts of written material). Transfer of written material into oral presentation. Production of personal specialized glossaries on the basis of language corpus by means of computers. Business ethics and decision making (developing speech skills in foreign language).

Developed competence (knowledge and skills)

The students are expected to adopt communicative skills in English, as well as other skills necessary for independent participation in the studies and in working environment of the English speaking area. They are prepared to use the foreign language in situations they may come across during their studies or later on in their professional carreers.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar ✓

NAME OF THE COURSE: GERMAN FOR ACADEMIC PURPOSES

Teacher's name: Biserka Fučkan Držić, Prof.
Assistant name:

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: a pass mark in "German in Geodesy"**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course:

Developing language skills in the context of geodesy. Attending lectures in German for geodetic purposes. Studying the skills in making notes in German for special purposes. Case studies for various topics, e.g. Informatics and geodesy, importance of geoinformation systems, new challenges in geodesy, shape and size of the Earth as functions of time, map as a work of art, etc. Practising various types of presenting specialised topics. Techniques of efficient presentation, usage of visual tools. Team and individual presentation of material. Teaching the skill in reading specialized literature in German for special purposes. Improving the language for special purposes by means of Internet. Writing professional, i.e. scientific paper in German (organisation of the written material, sentence types characteristic for single parts of written material). Transfer of written material into oral presentation. Production of personal specialized glossaries on the basis of language corpus by means of computers. Business ethics and decision making (developing speech skills in foreign language).

Developed competence (knowledge and skills)

The students are expected to adopt communicative skills in German, as well as other skills necessary for independent participation in the studies and in working environment of the German speaking area. They are prepared to use the foreign language in situations they may come across during their studies or later on in their professional carreers.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar ✓

NAME OF THE COURSE: GLOBAL GEODESY

Teacher's name: Assist. Prof. Željko Hećimović, PhD
Assistant name: Assist. Prof. Željko Hećimović, PhD

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/ VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: no**
- **Number of weeks in a semester/number of classes in a week: 15 / 2 + 2**
- **(Total number of field classes): 0**
- **ECTS points: 6**

Description/contents of the course

Lecturing Program:
Physical and mathematical foundations of global geodesy. Coordinate systems in absolute space-time. Satellite measuring techniques of geosystem: Satellite-to-Satellite Tracking (SST), low-high SST, high-low SST, satellite gradiometry, satellite altimetry,... Satellite missions: CHAMP, GRACE, GOCE, TOPEX/POSEIDON, Jason-1, CRYOSAT, ERS-2, ENVISAT, TerraSAR-X, ICESAT, LAGEOS-1 & 2, SRTM,... Models of geosystem: global geoid, Earth tides, topography, geocenter, Earth crust, Mohorovičić discontinuity, loading effect, post glacial uplift,... Reduction of geodetic measurements considering geosystem models. Geodetic services. Services of International Association of Geodesy (IAG) and other institutions.
Exercises Contents:
Reduction of geodetic measurements considering geosystem models, using of data and services of international geodetic services.

Developed competence (knowledge and skills)

Mastering of knowledge and skills about geosystem models, satellite measuring techniques, satellite missions and sensors, reductions of geodetic measurements considering geosystem models, using of international geodetic services and data.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

1. Hećimović, Ž.: Global geodesy. Lecturing notes.

b) Additional

1. Kramer, H. J.: Observation of the Earth and Its Environment. Springer Verlag, Berlin, New York 2002.
2. Varger, F., I. Sourbes-Varger, R. Girardi: The Cambridge Encyclopaedia of Space Missions. Applications and Exploration, Cambridge University Press, Cambridge 1997.
3. Xu, G.: GPS. Theory, Algorithms and Applications. Springer Verlag, Berlin, New York 2003.

c) Internet sources

1. Global geodesy Internet pages - http://www.geof.hr/~zhecimovic
2. International Geoid Service - http://www.iges.polimi.it
3. International Gravimetric Bureau - http://bgi.cnes.fr
4. International Centre for Earth Tides - http://www.astro.oma.be/ICET/index.html
5. International GPS Service - http://igscb.jpl.nasa.gov
6. International Doris Service - http://ids.cls.fr/welcome.html
7. International Earth Rotation and Reference Systems Service - http://www.iers.org
8. Permanent Service for Mean Sea Level - http://www.pol.ac.uk
9. IAG Bibliographic Service - http://www.leipzig.ifag.de

NAME OF THE COURSE: GLOBAL GEODESY – A PROJECT

Teacher's name: Assist. Prof. Željko Hećimović, PhD
Assistant name: Assist. Prof. Željko Hećimović, PhD

- **(Subject oriented field):**
- **Year/semester: 5/ IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: no**
- **Number of weeks in a semester/number of classes in a week: 15 / 0 + 4**
- **(Total number of field classes): 0**
- **ECTS points: 6**

Description/contents of the course

Modeling of gravity field of idealized bodies (sphere, level ellipsoid) and modeling of gravity field of real Earth gravity field, e.g. geoid as fundamental Earth surface. Introduction in gravity fields data bases. Using official computer programs of International Association of Geodesy. Interpretation of modeled local geoid in Croatia.

Developed competence (knowledge and skills)

Mastering of knowledge and skills of gravity field modeling. Introduction in characteristic of gravity field data and associated databases. Using of official computer programs of International Association of Geodesy for modeling gravity field. Modeling of geoid as fundamental Earth surface. Interpretation of the model.

Ways of teaching

Lectures ✖	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

1. Hećimović, Ž.: Globalna geodezija. Lecture notes in preparation

b) Additional

2. Sanso, F. (ed.): Geodetic Theory Today. IAG Symposium No. 114. Springer Verlag, Berlin, New York 1994.
3. Sanso, F., R. Rummel (1997): Geodetic Value Problems in View of the One Centimeter Geoid. Springer Verlag. Berlin, Heidelberg.
4. Kramer, H. J.: Observation of the Earth and Its Environment. Springer Verlag, Berlin, New York 2002.

c) Internet sources

1. Global geodesy Internet pages - http://www.geof.hr/~zhecimovic
2. International Geoid Service - http://www.iges.polimi.it
3. Earth Sciences - http://www.jpl.nasa.gov/earth
4. International Association of Geodesy - http://www.iag-aig.org

NAME OF THE COURSE: DIGITAL PLANS

Teacher's name: Assoc. Prof. Mira Ivković, PhD
Assistant name:

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Application of computer technology in the production of digital plans. Hardware support. Graphic programs. The standards in the production of digital plans. Layers of geodetic data. Entities and attributes, their classification and encryption. Symbols. Digital plans as the basis for GIS. Digital relief model. Geodetic measurement needed for digital relief model. Software for drawing contour lines. Various calculations from digital data needed in geodetic practice and other professions.

Developed competence (knowledge and skills)

The students acquire the skills in the theory of producing topographic plans and in practical application of some graphic programs and using digital data for various geodetic calculations.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar ✓

References

a) Obligatory

Ivković, M.: Digitalni planovi (digital plans), Course material, Faculty of Geodesy
Internet pages dealing with these issues

NAME OF THE COURSE: DIGITAL PLANS – A PROJECT

Teacher's name: Assoc. Prof. Mira Ivković, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Production the seminar of project- Digital plans.

Developed competence (knowledge and skills)

Individual research.

Ways of teaching

Lectures	Exercises	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam	Written exam ✓	Seminar ✓	Essay	Active participation in education process

Supervision and grading students

Written exam	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar ✓

References

a) Obligatory

Ivković, M.: Digitalni planovi (digital plans), Course material, Faculty of Geodesy
Internet pages dealing with these issues

NAME OF THE COURSE: ENGINEERING GEODESY IN CIVIL ENGINEERING

Teacher's name: Prof. Zdravko Kapović, PhD
Assistant name: Rinaldo Paar, Ante Marendić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes): 3-4**
- **ECTS points: 6**

Description/contents of the course

Automatic measuring systems in geodesy. CAD in engineering geodesy. Bridges and over flies. Geodetic control. Hydrometric measurements. Bridge layout. Geodetic surveillance. Construction diary. Test bridge control. Tunnels. Geodetic base on the surface. Geodetic base in tunnels. Necessary accuracy of geodetic control. Underground polygonometry. Vertical control. Survey of transverse profiles in tunnels. Connection and orientation of geodetic control. Orientation by means of magnetic and gyroscope instruments. Accuracy and tolerances in tunnel cutting. Positional uncertainty of tunnel cutting point. Geodetic surveillance. Transmission lines. Project technical documentation. Pipe lines. Hydro technical objects. Geometry control of the machine engineering object. Railways.

Developed competence (knowledge and skills)

Students are skilled in performing geodetic works in civil engineering.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory

1. Kapović, Z. (2005): Manuscript
2. Moser, M, Muller, G, Schlemmer H, Werner H (2000): Handbuch Ingenieurgeodasie-Grundlagen

3. Hennecke, Muller, Werner (1994): Handbuch Ingenieurvermessung, Band 1, Grundlagen, 2. vollig überarbeitete und erweiterte Auflage,

b) Additional

1. Suvremeni postupci izvedbe (1995): Zbornik radova Društva hrvatskih građevinskih konstruktora, Zagreb
2. Radić, J (2003): Mostovi, Građevinski fakultet Sveučilišta u Zagrebu.

NAME OF THE COURSE: MOVEMENTS AND DEFORMATIONS

Teacher's name: Prof. Zdravko Kapović, PhD
Assistant name: Rinaldo Paar, Ante Marendić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: pass mark in all courses from previous year**
- **Number of weeks in a semester/number of classes in a week: 15/2 +2**
- **(Total number of field classes): 2-3**
- **ECTS points: 6**

Description/contents of the course

Introduction. Basic definition of movement, deformation. Causes of movements and deformations. Measurement of horizontal and vertical movements. Basic measuring processes of movements. Application of photogrammetry and GPS in movement measurements. Geodetic methods of movement measurement. Project of geodetic control and selection of measuring sites. Criteria for quality assessment of geodetic networks. Plandand programme of measurements. Measurement of movement and defomation with automated measuring devices. Kinematic measuring system. Digital scanners. Accuracy of movement measurement. Basic indications of deformation analysis. Variance homogeneity. Physical methods of movement measurement. Basic methods of final elements. Technical report.

Developed competence (knowledge and skills)
Studnets are skilled for measuring the movements of objects.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory
1. Kapović, Z. (2003): Pomaci i deformacije, rukopis

2. Caspar, W. F. (1996): Concept of network and deformation analiysis, The University of New South Wales, Kensigton, NSW, Australia, Monograph 11
3. Bathe, K. J. (1990): Finite-Elemente - Methoden, Berlin.
4. Moser, M, Muller, G, Schlemmer H, Werner H. (2000): Handbuch Ingenieurgeodasie - Auswertung geodätischer Überwachungsmessungen

b) Additional
Kapović, Z. (1993): Prilog određivanju i analizi pomaka i deformacija mostova s posebnim osvrtom na temperaturne utjecaje, disertacija, Geodetski fakultet Sveučilišta u Zagrebu.

NAME OF THE COURSE: GEODESY IN ENVIRONMENTAL PROTECTION

Teacher's name: Prof. Zdravko Kapović, PhD
Assistant name: Rinaldo Paar, Ante Marendić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week:15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Environmental protection and legislative. Ecological crisis as a moral problem. Codex of ecological ethics for engineers. Basic terms in ecology. Ecosystems. Ecological principles and planning in space development. Aesthetic and technical development of farming areas. Urban land consolidation in space development. Documents of space development. Development plan. Users of development plans. Urban plan. Characteristics of urbanisation. Urban and conservative plan. Ecological and technical development of rural areas. Hydro technical improvements. Irrigation systems. Polluter register. Polluter control. Waste and waste water management. Closed drainage. Sustainable development. Farming land development. Spatial information. National parks. Nature parks.

Developed competence (knowledge and skills)

Students are acquainted with the significance of geodesy in environmental protection.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory
1. Jukić T (2000): Prostorno planiranje i urbanizam, interna skripta, Geodetski fakultet, Zagreb
2. Marinović-Uzelac A. (2001): Prostorno planiranje, Dom i svijet, Zagreb

3. Zakon o građenju, Zakon o prostornom planiranju, Zakon o komori arhitekata i inženjera u graditeljstvu, Zakon o državnoj izmjeri i katastru nekretnina

NAME OF THE COURSE: ORGANISATION OF GEODETIC WORKS

Teacher's name: Prof. Zdravko Kapović, PhD
Assistant name:

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Organisation. Organisation design. Price list. Project of geodetic works organisation. Planning. Project phases. Principals of work organisation. Special characteristics of geodetic works. Planning methods. Prices, expenses. Profit. Cost calculation. Financing of the project. Financing of geodetic projects. Norms of consulting services in investment process. Research development. Consulting services in geodetic works. Methods for the calculation of prices of consulting services. General methods of price calculation. Calculation of prices for geodetic works. Chamber, society, economy. Basic geodetic laws. Financial management. Macroeconomic frame as a collection of conditions needed to realize enterprise activities. Fundamental (financial)documents of trade society. Management. Principals of inventive management. Management of the small and the big. Marketing as a thinking system. Marketing-information system. Personnel in marketing. Business hierarchy. Globalisation.

Developed competence (knowledge and skills)

Students are acquainted with the basic elements of financing and market competition.

Ways of teaching

Lectures ✓	Exercises	Seminar ✓	Practicum
Individual research	Field classes	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory

1. Dibb, S. i dr. (1995): Marketing, MATE d.o.o., Zagreb
2. Kapović, Z (2005): Organizacija geodetskih radova, rukopis
3. Marušić, J (1993.): Organizacija građenja, FS d.o.o. Zagreb, Masarykova 28

4. Osredečki, E (1996): Marketing iz dana u dan, Naklada EDO, Samobor
5. Srića V. (2003): Inventivni menadžer u 100 lekcija, Znanje d.d., Mandićeva 2, Zagreb

b) Additional

1. Priručnik za konzultantske usluge u investicijskoj izgradnji, Poslovna zajednica "Koprojekt-Zagreb, Gundulićeva 23/II
2. Zakon o građenju, Zakon o prostornom planiranju, Zakon o komori arhitekata i inženjera u graditeljstvu, Zakon o državnoj izmjeri i katastru nekretnina

NAME OF THE COURSE: ENGINEERING GEODESY IN CIVIL ENGINEERING – A PROJECT

Teacher's name: Prof. Zdravko Kapović, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week:15/0+4**
- **(Total number of field classes): 4-5**
- **ECTS points: 6**

Description/contents of the course

Field measurements. Preparation of the situation and designing a part of the alignment. Alignment layout. Calculation of geodetic control for a bridge with terrestrial and satellite methods. Project in testing bridges. Field measurements. Measurement of transverse profiles in tunnels. Jobs connected with geodetic surveillance.

Developed competence (knowledge and skills)

Independent work on a concrete geodetic task.

Ways of teaching

Lectures	Exercises	Seminar	Practicum
Individual research	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam	Written exam	Seminar ✓	Essay	Active participation in education process

Supervision and grading students

Written exam	Oral exam	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar ✓

References

a) Obligatory

1. Dibb, S. i dr. (1995): Marketing, MATE d.o.o., Zagreb
2. Kapović, Z (2005): Organizacija geodetskih radova, rukopis
3. Marušić, J (1993.): Organizacija građenja, FS d.o.o. Zagreb, Masarykova 28
4. Osredečki, E (1996): Marketing iz dana u dan, Naklada EDO, Samobor
5. Srića V. (2003): Inventivni menadžer u 100 lekcija, Znanje d.d., Mandićeva 2, Zagreb
6. Kapović, Z. (2005): Rukopis,
7. Moser, M, Muller, G, Schlemmer H, Werner H (2000): Handbuch Ingenieurgeodasie-Grundlagen

8. Hennecke, Muller, Werner (1994): Handbuch Ingenieurvermessung, Band 1, Grundlagen, 2. vollig uberarbeitete und erweiterte Auflage,

b) Additional

1. Suvremeni postupci izvedbe (1995): Zbornik radova Društva hrvatskih građevinskih konstruktora, Zagreb
2. Znanstveno-stručni projekti o mostovima i tunelima

NAME OF THE COURSE: MULTIMEDIA CARTOGRAPHY

Teacher's name: Prof. Miljenko Lapaine, PhD
Assistant name: Dražen Tutić, MSc, Ivka Kljajić, MSc, Rober Župan, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: no**
- **Number of weeks in a semester/number of classes in a week: 15/2 +2**
- **(Total number of field classes): 1**
- **ECTS points: 6**

Description/contents of the course

Real and virtual maps. Multimedia. Multimedia computer. Digitizing texts, images and sound. Devices for creating and presenting multimedia contents. Editing of multimedia contents. Interactive multimedia contents. Standards and protocols for the transfer of multimedia contents. Map visualisation in multimedia environment. Interactivity and dynamics of maps. Multimedia maps on CD and Internet. Microsoft Encarta. Web-atlases and web-maps. Multimedia cartography in GIS. Location based services. Multimedia mobile cartography.

Developed competence (knowledge and skills)
Basic knowledge and skills in collecting data and their processing for the purpose of making interactive and dynamic web-maps connected with multimedia contents.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory
Lapaine, M., Tutić, D.: Multimedijska kartografija, rukopis u pripremi

b) Additional

Cartwright, W., Peterson, M. P., Gartner, G. (urednici): Multimedia Cartography, Springer, Berlin 1999.

c) Internet sources
Hrvatsko kartografsko društvo
http://www.kartografija.hr

NAME OF THE COURSE: GEODETIC HERITAGE

Teacher's name: Prof. Miljenko Lapaine, PhD
Assistant name: Ivka Kljajić, MSc

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes): 3**
- **ECTS points: 6**

Description/contents of the course

Introduction into the history of techniques. Geodesy: name and task, skill and science. Status of surveyors through centuries, guilds, geodetic societies. Geodetic specialized journals. Measures and measurement in geodesy. Development of geodetic instruments. Development of geodetic methods and processing of measuring data. Grad measurement and triangulation development. From the sphere to spheroid and geoid, development of mathematical and physical geodesy. History of land register. Systematic topographic and cartographic surveys at the territory of Croatia. Epochs in the development of cartography. Development of photogrammetry. Development of satellite geodesy. Organisation of geodetic service and legal activity basis. Geodetic education, and textbooks of geodesy. Development of geodetic terminology. Geodetic archives and geodetic collections. Great names in geodesy.
Exercises: Visit to adequate collections in the Technical museum, National and University Library, State Archives and organising adequate exhibitions.

Developed competence (knowledge and skills)

Basic knowledge about Croatian and world history of geodetic theory and practice. Basic knowledge about organisation of exhibitions, museum and archive collections.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory

Lapaine, M.: Povijest geodezije, rukopis u pripremi
Macarol, S.: Praktična geodezija, Tehnička knjiga, Zagreb 1985.
Lovrić, P.: Geodezija u Hrvatskoj u 20. stoljeću, u: Razvitak i dostignuća tehničkih područja u Hrvatskoj, Sveučilište u Zagrebu, Zagreb 1994.

b) Additonal
Tehnička enciklopedija, sv. 1-13, Leksikografski zavod Miroslav Krleža, Zagreb 1963-1997.
Geodetski list i njegovi prethodnici.
Bialas, V.: Erdgestalt, Kosmologie und Weltanschauung, K. Wittwer, Stuttgart 1982
Schmidt, F.: Geschichte der geodätischen Instrumente und Verfahren im Altertum und Mittelalter, K. Wittwer, Stuttgart 1988.

c)Internet sources
Hrvatsko kartografsko društvo
http://www.kartografija.hr
Hrvatsko geodetsko društvo
http://www.geof.hr/hgd
Geodetski fakultet Sveučilišta u Zagrebu
http://www.geof.hr

NAME OF THE COURSE: SYSTEM OF SCIENTIFIC INFORMATION

Teacher's name: Prof. Miljenko Lapaine, PhD
Assistant name: Ivka Klajić, MSc

- **(Subject oriented field): Geodesy/Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Notion of science. Classificatin of sicence. Scientific cathegories. Scientific activity and scientific research. Classification of written material. The term and the types: scientific, scientific and specialized, and specialized works. The term and the types of works at the high education institutions. Methodlogy of scientific research. Making orientation plan of scientific research. Compilitng bibliography. Collecting, research and editing scientific information. Writing texts and technical processing of scientific and specilaized work. System of scientific information of the Republic of Croatia. Scientific and faculty libraries. Purchase of foreighn journal on-line. Bibliographic database on-line. Croatian scientific bibliography.

Developed competence (knowledge and skills)

Developing competences (knowledge and skills) in scientific activities, methodology and technology of scientific research. Knowledge about the existence and skills in using scientific information by means of libraries, journal, and available bibliographic databases.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory

Zelenika, R.: Metodologija i tehnologija izrade znanstvenog i stručnog djela. Ekonomski fakultet, Rijeka 1998.

b) Additional
Silobrčić, V.: Kako sastaviti, objaviti i ocijeniti znanstveno djelo. Medicinska naklada, Zagreb 1998.

c) Internet sources
Sustav znanstvenih informacija RH
http://www.szi.hr/
Nacionalna i sveučilišna knjižnica
http://www.nsk.hr/

NAME OF THE COURSE: CARTOGRAPHY AND NEW TECHNOLOGIES – A PROJECT

Teacher's name: Prof. Miljenko Lapaine, PhD
Assistant name: Ivka Klajić, MSc

- **(Subject oriented field):**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Within the project the students have the task to prepare, collect and process the data and interpret thee obtained results. The topics of the project are practice-oriented and connected with the application of the most recent technologies in cartography (digital cartography, Internet, multimedia)

Developed competence (knowledge and skills)

The project is intended to develop organisational and performable abilities in an independent task work applying previously adopted knowledge. The independence in executing the project also encourages the problem-oriented approach to the tasks and makes the student decide in the process of project realization.

Ways of teaching

Lectures	Exercises	Seminar ✓	Practicum
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam	Written exam	Seminar ✓	Essay	Active participation in education process

Supervision and grading students

Written exam	Oral exam	Essay	Practical work
Project ✓	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

Depending on the project topic.

NAME OF THE COURSE: APPLICATION OF LASER DEVICES

Teacher's name: Assoc. Prof. Zlatko Lasić, PhD
Assistant name: Loris Redovniković

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes): field work six times**
- **ECTS points: 6**

Description/contents of the course

Application of laser devices in geodetic practice as well as their usage in other professions. The operation principle and types of lasers. Laser devices as telescope addition. Application of laser in levels. Rotational laser levels. Application of laser in the production of levelling rod. Distance measurement using laser. Laser interferometers and their application for static and kinematic measurements in industry. Hand laser distance meters. Using of laser devices in the construction of tunnels and civil engineering. Laser devices for scanning. Application of GPS devices in combination with laser. Usage of laser for satellite distance measurement.

Developed competence (knowledge and skills)

Basic knowledge in the field of laser technology. Using laser devices in geodetic practice as well as the application in other professions.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes ✓	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory

Lasić, Z.: Predavanja – rukopis (Course material – manuscript)

b) Additional

Benčić, D.: Geodetski instrumenti. Školska knjiga, Zagreb 1990.

Fialovszky, L.: Surveying Instruments and their Operational Principles. Akademiai Kiado, Budapest 1991.
Kahmen, H.: Vermessungskunde (19. izdanje), Walter de Gruyter, Berlin 1997.
Deumlich, F.: Staiger, R.: Intrumentenkunde der Vermessugstehnik. Herbert Wichmann, Heidelberg 2002.

c) Internet sources
Internet pages of the world geodetic instruments producers

NAME OF THE COURSE: INFLUENCE OF ATMOSPHERIC MEASURING CONDITIONS ON OPTICAL FUNCTION OF THEODOLITE TELESCOPE – A PROJECT

Teacher's name: Assoc. Prof. Zlatko Lasić, PhD
Assistant name: Loris Redovniković

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Physical basics of problems in characterizing optical systems. Absorption and dispersion of light waves in the atmosphere. Atmosphere optics. Influence of the atmosphere in geodetic measurements. Visibility, contrast, refraction and turbulence of the atmosphere. The system telescope and atmosphere depending on the telescope construction and the situation in the atmosphere.

Developed competence (knowledge and skills)

In geodetic measurements one has to consider the fact that the atmosphere is an optical medium having the optical characteristics changing in space and time. On the basis of known meteorological parameters one can judge the limits of optical system resolution.

Ways of teaching

Lectures	Exercises	Seminar	Practicum
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar

References

a) Obligatory
Lasić, Z.: Predavanja – rukopis.
b) dopunska
Benčić, D.: Geodetski instrumenti. Školska knjiga, Zagreb 1990.

Kahmen, H.: Vermessungskunde (19 izdanje), Walter de Gruyter, Berlin 1997.
Deumlich, F.: Staiger, R.: Intrumentenkunde der Vermessugstehnik. Herbert Wichmann, Heidelberg 2002.
Cohen, A.: Horizontal Visibility and the Measurement of Atmosferic Optical Depth of Lidar, Appl. Opt., vol 14, 1975.
Good, R. E.: Atmosferic Models of Optical Turbulence. SPIE, Modeling of the Atmosfere, vol.928, 1988.

NAME OF THE COURSE: LAND CONSOLIDATIONS

Teacher's name: Assist. Prof. Siniša Mastelić Ivić, PhD
Assistant name: Hrvoje Tomić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/IX**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Historical overview of land consolidation with special emphasize on the the role and the development of land consolidation works. The law of land consolidation and urban subdivision. Phases of land consolidation works. The initiation of the procedure. Preparation works, harmonizing land registry and land registry book situation and definition of the existing situation (technical revision). Land consolidation estimation of land, definition of relative property value. Preactivities for the land consolidation project, geodetic and technical activities, conceptual design of new road and canal network, and the conceptual project of new tables, project documentation. Detailed survey needed for the land consolidation project. Land consolidation project, feasibility projects. Regulation of land consolidation area boundaries and boundary regulation of settlements. Transfer and layout of land consolidation project to the field. Division of land consolidation tables of various sizes, distribution discussion. Final works, layout of new properties, land consolidation decisions. Solving the complaints to: project, land evidence, land estimation, distribution of new properties.

Developed competence (knowledge and skills)

Skills in organising and performing the procedure of land consolidation and urban subdivision.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

a) Obligatory
Medić, V: Identifikacija nekretnina u komasaciji, Sveučilište u Zagrebu, Zagreb 1982.
Medić, V: Agrarne operacije I. Dio, Sveučilište u Zagrebu, Zagreb 1982.
Medić, V: Komasacija zemljišta, Sveučilište u Zagrebu, Zagreb 1978.
b) Additional
Batz, E: Neuordnung des laendlichen Raumes, Konrad Wittwer, Stuttgart 1990.

NAME OF THE COURSE: GEODETIC WORKS IN HYDROTECHNIQUES

Teacher's name: Assoc. Prof. Siniša Mastelić Ivić, PhD
Assistant name: Hrvoje Tomić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Water resources. Investigation works in the procedure of hydro technical designing. Survey methods and the contents of documents for hydro technical designing. Application of remote sensing data. Positional data accuracy. Hydrological studies and research. Observation of water level fluctuation. Building of water indication stations. Determination of water level fall. Accessories and instruments for measuring depths. Digital relief models. Acoustic depth measurements. Operation principle of ultra sound depth meters. Ultrasound frequencies in devices for depth measurement and calibration. Transducer and transponder. Analysis of reflected signal. Application of ultrasound depth meters. Sonar techniques for sediment delineation. Air laser relief survey. Satellite altimetry.Analysis of the accuracy of measuring elements for hydrological purposes. Determination of control points stabilized at the bottom. Determination of a position on water surface. GPS and inertial systems. Hydrographical measurements. Building of structures for water powers use. Production of sea technical constructions. Building a system of stabilized land moisture. Canal system. River net area. Numbering of hydrological streams. Hydrological network. Analysis of river network area. Hydrological information system.

Developed competence (knowledge and skills)

Skills in organising and performing the procedure in hydro techniques.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

a) Obligatory

Janković, M.: Inženjerska geodezija III, SNL, Zagreb, 1981.
Ingham, A. E.: Sea Surveying, John wiley and Sons, London

NAME OF THE COURSE: REAL ESTATE ESTIMATION

Teacher's name: Assist. Prof. Siniša Mastelić Ivić, PhD
Assistant name: Hrvoje Tomić

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Introduction into basic terms of real estate value estimation. Procedure of real estate estimation by means of comparable values, real value of the profit amount. Collecting, surveying and verifying the necessary data. Determination of the most optimal real estate use. Description of the real estate. Land use. Influence of the shape and location of the real estate. Pedological research. Morphological properties of the soil. Types of land according to the value. Report with final value estimation. Growth of value along with the local economic development. Land rent, term, forms. Fall of the value through amortisation. Rate policy. Additional expenses. Income elements. The rest of the value. Loads and estimations of load value on real estate. The role and tasks of the institutions and persons participating in the estimation process. Real estate market and analysis. Influence of globalisation and state policy on the real estate market. Real estate tax policy. Costs and benefits of administration over real estate. Investment estimation investment-profit analysis. Financing and sources of investment in real estate. Systems of automatic real estate estimation.

Developed competence (knowledge and skills)

Knowledge in estimating real estate value.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research	Field classes	Tutorial	Consultations ✓
Workshops	Discussion ✓	Internet	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

a) Obligatory
Ross, F.W., Brachmann, R., Holzner, P.: Ermittlung des Bauwertes von Gebaeuden und Grundstue
Vogels, M.: Grundstuecks-und Gebaueudebewertung – marktgerecht, Bauverlag, Wiesbaden
Gerardy T., Möckel R., Troff H. (1997.): Praxis der Grundstücks bewertung, Verlag Moderne Ind

b) Additional
Racz, Z. (1980): Meliorativna pedologija, Geodetski fakultet, Zagreb.

NAME OF THE COURSE: RISK MANAGMENT

Teacher's name: Assist. Prof. Siniša Mastelić Ivić, PhD
Assistant name: Vlado Cetl, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Geoinformation – important factor in preventing natural and man-caused catastrophes. Risk management at local, state, regional and global level. Risk analysis tools. Risk estimation. Catastrophe prevention. Preparation. Reconstruction after catastrophes. Geoinformation with regard to space and time. Monitoring 3 basic elements in risk management: earth, water, air. The connection between land management and risk management. Risk management in rural area. 3D geoinformation and risk management in urban areas. Infrastructure of spatial data in risk management.

Developed competence (knowledge and skills)

Using spatial data for preventing damage in risk circumstances.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations
Workshops ✓	Discussion	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar

References

a) Obligatory
Casale, R., Claudio, M. (2004): Natural Disasters and Sustainable Development
Dufay, J., P. ed. (2005): Geographic information systems and disaster management. France.
Longley, P.A., Goodchild, M.F., Maguire, D.J., Rhind, D.V. (1999): Geographical Information Systems, management and applications. Wiley, New York.

b) Additional
c) Internet sources
Global Disaster Information Network. www.gdin.org

NAME OF THE COURSE: SPACE DEVELOPMENT – A PROJECT

Teacher's name: Assist. Prof. Siniša Mastelić Ivić, PhD
Assistant name: Hrvoje Tomić

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Space management as a resource. Overview of measures and technical activities influencing the change of the situation in the space, especially farming and construction areas. Growth of world population, distribution of natural resources, synthetic and health conditions and distribution of income in the population. Rural and urban development. Characteristics of sustainable development. Land economy as an estimation of value, demand and availability of land. Natural resources management. Project planning and influence monitoring. Management of counter demands and the possibilities of bringing them into accordance. Estimation of investments, investment-profit analysis. Land policy. Globalisation of land information systems.

Developed competence (knowledge and skills)
Development of knowledge about geodetic support in the realisation of spatial plans.

Ways of teaching

Lectures	Exercises	Seminar ✓	Practicum
Individual research	Field classes	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam✓	Oral exam ✓	Essay	Practical work ✓
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research	Seminar ✓

References

a) Obligatory

Medić, V.: Agrarne operacije I. dio, Sveučilište u Zagrebu, Zagreb 1982.

Medić, V.: Komasacija zemljišta, Sveučilište u Zagrebu, 1978.
Batz, E.: Neuordnung des ländlichen Raumes, Verlag Konrad Wittwer Stuttgart 1990.
Zakon o prostornom uređenju
Pravilnik o izradi prostornih planova
Zakon o poljoprivrednom zemljištu
Zakon o izvlaštenju
Zakon o komasacijama

b) Additional

Ross, F.W., Brachmann, R., Holzner, P.: Ermittlung des Bauwertes von Gebaeuden und Grundstuecken, Opperman Verlag, Hannover, 1991.
Vogels, M.: Grundstuecks- und Gebaueudebewertung – marktgerecht, Bauverlag, Wiesbaden und Berlin, 1996

NAME OF THE COURSE: SPATIAL DATABASES

Teacher's name: Assoc. Prof. Damir Medak, PhD
Assistant name: Ivan Medved, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Spatial database management systems. Physical data management. Vocabulary in geospatial databases. Theme. Geographic objects. Typical operations in geoinformation systems. DBMS in GIS. Application of relational model. Integrated approach. Logical models and query languages. Schemes and queries. Abstract datatypes – ADT. Extending of data models with ADT. Geometric datatypes as extensions of basic datatypes. SQL3. Development of spatial ADT. Topological predicates in exploring relationships between spatial objects. Spatial Access Methods – SAM. B+ tree. Spatial data structures. Linear quadtree. z-ordering tree. R-tree. R* tree. R+ tree. Query processing. Optimal input-output algorithms. Spatial join. Complex queries. Commercial and free spatial database management systems.

Developed competence (knowledge and skills)

Theoretical background and practical application of advanced commercial and free spatial database management systems in networket computer environment. Distinction between monolithic geoinformation software packages and spatial database management systems.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay ✘	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory

Rigaux, Scholl, Voisard (2002): Spatial Databases with application to GIS. Morgan Kaufmann.

b) Additional
Shekhar, Chawla (2004): Spatial Databases – A Tour. Prentice Hall.

NAME OF THE COURSE: SOFTWARE ENGINEERING IN GEOMATICS

Teacher's name: Assoc. Prof. Damir Medak, PhD
Assistant name: Ivan Medved, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Importance of specifications in production of geosoftware applications: efficiency and security. Specification, implementation, constructor and observer functions. Abstract datatypes (ADT). Spatial data, storage and processing algorithms. Recursive definitions of spatial data. Object-oriented modeling: object, classes, inheritance. Seven-steps method. Comparison of object and relational models. Visual modeling in geomatics. Unified modeling language (UML): class diagrams, user cases. Open Geodata Interoperability Specification (OpenGIS). OGC procedure for spatial data standardization. Implementation of object-oriented concepts in java. Application of Java in geomatics: graphical user interfaces, platform independence, internet programming language, combination with mobile communications and satellite positioning.

Developed competence (knowledge and skills)

Notion of software specificationa as a link between the expert knowledge (geodesy and geoinformation) and computer scientists or programmer. Introduction to modern standardization technologies for building of general specifications (UML), geoinformation specifications (OGC) and its implementation in object-oriented programming language Java.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory

Fowler, M., Scott, K. (2000): UML Distiled – Applying the Standard Object Modeling, Addison Wesley.
OGC (2001): OpenGIS Implementation Specification Documents.

b) Additional
Eckel, B. (2000): Thinking in Java – 2nd edition, Prentice Hall.

NAME OF THE COURSE: SPATIAL DATA ANALYSIS

Teacher's name: Assoc. Prof. Damir Medak, PhD
Assistant name: Ivan Medved, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Analytic functionality of geoinformation systems. Definition of interactive and exploratory spatial data analysis. Spatial queries. Overlays. Reclassification. Spatial proximity: adjacency and connectivity. Distances and lengths. Buffers. Geoalgorithms: point in polygon, line intersection, polygon intersection. Shapes, slope, and aspect. Transformations.
Graphic operations. Programming of analytic operations.

Developed competence (knowledge and skills)

Understanding of operations for analytic functionality of geoinformation systems and its application in computer environment.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory
Worboys, M. (2003): GIS – a Computing Perspective

b) Additional
Bartelme, N. (2002): Geoinformatik

NAME OF THE COURSE: COMPUTER PROGRAMMING FOR GIS – A PROJECT

Teacher's name: Assoc. Prof. Damir Medak, PhD
Assistant name: Ivan Medved, MSc

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

The objective of this subject is to provide students with competence in scripting for and customisation of Geographic Information System (GIS) and database technology. The subject will include: structure and syntax of a visual programming language; development of GIS functionality in general programming environments using GIS function libraries; customisation of GIS using a scripting language; introduction to databases and SQL; and programming with databases.

Developed competence (knowledge and skills)

The ability to write computer programs that enhance the function of GIS and database software, and write computer programs that provide GIS and database functionality independently of more general programs.

Ways of teaching

Lectures	Exercises ✓	Seminar ✓	Practicum ✓
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✖	Written exam ✖	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory
ESRI (2001): Avenue Manual. ESRI Press.
ESRI (2004): Visual Basic for Application and GIS. ESRI Press.

NAME OF THE COURSE: ORGANISATIONAL THEORY

Teacher's name: Assoc. Prof. Branka Mraović, PhD
Assistant name:

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Within this subject, the attention of students is focused on the modes of retreat of the organisation paradigm against the paradigm of global network organising. When employing a person, employers increasingly give preference to experts who, in addition to specialist knowledge, also have basic knowledge in the areas of organisational theory and human resources management. This subject is accordingly articulated in such a way as to focus on complex problems of business organisations in the context of an extremely fast development of information and communication technologies. This issue is approached in a comparative way during the teaching process by providing students with information about recent research in the area of business organisations, behaviour of managers and characteristics of entrepreneurs and entrepreneurial firms, as well as international corporations from a variety of cultures – Europe, USA, Japan and the new industrial countries in the Pacific. Also, during lectures and seminars, the specific features of organisations and managers in Croatia are addressed, especially those falling within the scope of activities of engineers in geodesy, and their experiences are compared with those from Europe and the world. *Themes*: The foundations of organisational theory. Technology and organisation: the development of workgroups. Efficiency and Effectiveness. Organisational Behaviour. Rationalist theories of organisational behaviour: the intervention strategy model; business process re-engineering; critique of programmed change. The new forms of organising. Modernist and post-modernist organisation. Virtual organisation. The learning organisation. Power. Decision-making. Motivation theory. Management: science, theory and practice. Technology and management. Teamwork. Management and organisational culture. Business communication. Planning: goals, strategies and politics. Leadership. Control: systems and processes. Semiotics: signs and meanings; links between signifier and signified; the functions of symbols; textuality; intersubjectivity. Organisational behaviour and semiotics. This subject can be taught in Croatian and in English. The examination includes a written and an oral part.

Developed competence (knowledge and skills)

- The foundations of organisational theory;
- Human resource management in the technical environment;
- Organisational behaviour;
- Teamwork.
- Organisational design;
- Understanding financial reports;
- Knowledge management;

- The new forms of organising;
- Modernist and postmodernist organisation;
- Virtual organisation;
- The learning organisation.

Ways of teaching

Lectures ✓	Exercises	Seminar ✓	Practicum
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

1. Mraović, B. (1996.) *Pobjednici i gubitnici, Organizacijske implikacije tehnološkoga razvoja*, Zagreb: Globus.
2. Mraović, B. (2004) «The Power of Networks: Organising versus Organisation», in Crowther, D. And Rayman-Bacchus, L. (Eds.) *Perspectives on Corporate Social Responsibility*, Aldershot: Ashgate, pp. 59-82.
3. Crowther, D., Mraović, B. (2005) «Network semiology: a vehicle to explore organisational culture», in D. Crowther, Jatana, R. (Eds.) *The International Dimensions of Corporate Social Responsibility, Vol. 2*, Hyderabad: ICFAI University Press, pp. 70-107.
4. Holmes, L., Hosking, D. M. & Grieco, M. (2002) (Eds.) *Organising in the Information Age*, Aldershot: Ashgate.

b) Additional

1. Crowther, D., Green, M. (2004) *Organisational Theory*, London: Chartered Institute of Personel and Development.
2. Jackson, N., Carter, P. (2000) *Rethinking Organisational Behaviour*, Harlow: Prentice Hall.
3. Hosking, D. M., Dachler, H. P., Gergen, K. J. (1995) *Management and Organization: Relational Alternatives to Individualism*, Aldershot: Avebury.

c) Internet sources

1. CorpWatch – «About us»: http://www.corporatewatch.org.uk
2. Standing Conference on Organisational Symbolism: http://www.scos.org.uk
3. Professor David Crowther, London Metropolitan University:
http://www.davideacrowther.com
http://www.davideacrowther.org
http://socialresponsibility.biz

NAME OF THE COURSE: HOW MARKETING OPERATES – ITS TOOLS AND TECHNIQUES – A PROJECT

Teacher's name: Assoc. Prof. Branka Mraović, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the project

Students are given an opportunity to do their own research in the field of marketing and public relations in companies which might be their potential employers. All excellent companies are close to their clients and customers. Today's sophisticated marketing tools and techniques have well-thought-out and precisely scheduled marketing plans for products. These plans outline two key points: 1. The overall objectives for the marketing plan – what is to be achieved?; 2. The strategies to be employed – how is the objective to be reached? The marketing mix represents the resources one has as a marketer to encourage exchanges with customers and clients. There are four components of the marketing mix: product, pricing, distribution and promotion. Products involve more than just the obvious features of goods and services; they can also include customer service, warranties, repair, prestige, and other components of value. The pricing element serves the obvious function of generating revenue and profit, but it is also used to stimulate purchases at certain times, create images for products, and build competitive advantage. Distribution focuses on getting products from producers to final customers. Finally, promotion is the process of communicating with customers and other members of the public, using variety of techniques and media. *Themes*: 1. How public relations is managed – planning, administering, budgeting, evaluating; 2. Strategic marketing planning and forecasting; 3. Analysis of marketing environment; 4. Marketing research and marketing information systems; 5. Ethics and social responsibility in the marketing environment.

Developed competence (knowledge and skills)

After undertaking a piece of field research, students will be able to:

- List the most common objectives of marketing in geodesy and geoinformatics;
- Define the utilities that marketers can offer customers and clients;
- Discuss the categories of services and products;
- Outline the process of developing a marketing strategy;
- Describe the marketing mix and its major components.

Ways of teaching

Lectures ✓	Exercises	Seminar ✓	Practicum
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓

Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

1. Bovee, C. L., Thill, J. V. (1992) *Marketing*, New York: McGraw-Hill.
2. Cantor, B. (1984) *Inside Public Relation*, New York: Longman Inc.
3. Sillars, S. (1988) *Success in Commmunication*, London: John Murray.

b) Additional

1. Kane, E. (1987) *Doing your own Research*, London & New York: Marion Boyars.

NAME OF THE COURSE: GEODETIC NETWORKS FOR SPECIAL PURPOSES

Teacher's name: Assoc. Prof. Gorana Novaković, PhD
Assistant name: Rinaldo Paar, Ante Marendić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course:

Scope, application and characteristics of geodetic networks for special purposes. Types of networks and their dimensionality. Deformation analysis. Design of the deformation networks. The *a priori* accuracy analysis of observations. Testing and calibration of measuring equipment (according to ISO standards). Methods of establishing the networks – terrestrial, satellite and the combination. Data pre-processing: corrections and reductions of observations. Pre-adjustment data screening. Review of adjustment models. Gauss-Markov model. The datum problem in network design. Minimally, fully and partially constrained adjustment. Inner constraints - adjustment of free network. Quality assessment of networks. Global and local measures of precision. Internal and external reliability. Outlier detection: Baarda's global test of the model and data snooping, Tau-test. Sensitivity of the network. Design, establishment and data processing of GPS networks. Testing of GPS measuring equipment. Reliability of GPS data. Technical report.
Application of S-transformation in networks for special purposes. All orders of network optimisation. Optimisation of GPS networks.

Developed competence (knowledge and skills):

Capability of designing and establishing the independent geodetic network used as geodetic reference for high precise engineering works as well as deformation monitoring of man-made and natural features of the Earth's surface.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory
Novaković,G.: Geodetic networks for special purposes, Zagreb, 2004.

b) Additional
Caspary, W. F.: Concepts of Network and Deformation Analysis. J. M. Rüger, Kensington, 2000.
Kuang, S.: Geodetic Network Analysis and Optimal Design, Ann Arbor Press, Inc., Chelsea, 1996.
Wolf, P. R., Ghilani, C. D.: Adjustment computations - Statistics and least squares in surveying and GIS. John Wiley & Sons, New York, 1997.

c) Internet sources:
actual sources

NAME OF THE COURSE: GEODETIC NETWORKS FOR SPECIAL PURPOSES – A PROJECT

Teacher's name: Assoc. Prof. Gorana Novaković, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course:

The project deals with a theme or tasks related to the concept of the optimum design, adjustment methods and quality analysis of independent geodetic networks. The task can be connected with the theme of diploma thesis.

Developed competence (knowledge and skills):

Adoption of theoretical and practical skills through independent work on a concrete task in the field of geodetic networks for special purposes.

Ways of teaching

Lectures	Exercises ✓	Seminar ✓	Practicum
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Project ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References:

Actual literature (books, scripts, papers, Web) connected with the project theme.

NAME OF THE COURSE: MARINE GEODESY

Teacher's name: Assist. Prof. Boško Pribičević, PhD
Assistant name: Almin Đapo, MSc

- **(Subject oriented field): Geodesy**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Definition and scope of marine geodesy. Tides and tidal currents. Measurements of currents. Tsunami. High and low water. Tide-generating forces. Prediction of tides. Tide-gauges. Determination of means sea-level. Geodetic and hydrographic zero-level. The problem of two media. Wave propagation in water. Basics of underwater acoustic. Short baseline systems. Supershort baseline systems. Long baseline systems. Combined systems. Calibration and error sources. Underwater networks. Multi-beam echosounders. Side-scan sonar. Two-frequency bathymetry. Computer programs for hydrographic survey. Subbottom profiler. Airborne laser methods. LIDAR bathymetry. SHOALS system. Nautical charts. Electronic nautical charts and systems: standards, visualization and content. Exploration of underwater mineral resources. Layout of underwater infrastructure. Research of archeologic findings. Oceanographic satellite missions and implications for climate change.

Developed competence (knowledge and skills)

Understanding the link between tide-gauge measurements and height system. Theoretic background of underwater acoustic and its application for underwater positioning. Introduction into moder systems for electronic marine navigation, underwater research, and oceanographic satellite missions.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory
Pribičević, B. (2005): Pomorska geodezija. Sveučilišni udžbenik. Sveučilište u Zagrebu – Geodetski fakultet.

b) Additional
Lurton, X. (2004): An Introduction to Underwater Acoustic – Principles and Applications. Springer and Praxis.
Lachapelle, de Jong, Scone, Elema (2002): Hydrography. Delft University Press.

NAME OF THE COURSE: PRESENTATION TECHNIQUES

Teacher's name: Assist. Prof. Boško Pribičević, PhD
Assistant name: Ivan Medved

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Basics of communications. Information. Levels of communication. Success factors in presentations. Behavior of the speaker. Non-verbal signs: sitting, standing, public relations, movements, gestures, eye-contact, voice, appearance. Verbal signs: avoiding repeating phrases and negative words. Rhetoric communication. Structure and links in contents. Usage of concrete numbers. Argumentation techniques. Common sense arguments. Arguments against critics. Arguments with majority and authority. Tradition. Tactical argumentation. Preparation of presentations. Audience analysis. Description of the goal. Dividing the presentation. Visual aids. Technology: flipchart, projector, written materials. Self-presenting. Marketing presentations.

Developed competence (knowledge and skills)

Self-confidence in preparation and performing scientific and professional presentations of projects and papers. Recognition of personal presentation waknesses and avoiding them.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory
Alley M. (2003): The Craft of Scientific Presentations. Springer.
Peter-Erik Czak (2004): Praesentationstechnik. Seminarunterlage. FH Technikum Kaernten, Villach.

NAME OF THE COURSE: GEODETIC BUSINESS ACTIVITY

Teacher's name: Assoc. Prof. Boško Pribičević, PhD
Assistant name: Alkmin Đapo

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Types of professiona associations. Croatian Chamber of Architects and Civil Engineers: role, acts and tasks. Licenced engineer of geodesy. System of State Geodetic Administration: structure and competences. Geodetci activity licence. Private geodetic business. Legal aspects in founding a firm. Economic aspects of firm activitiy: salaries, income, taxes, amterial costs, amortization. Investments, business risk. Market value of spatial information. Agreements, annexes, subcontracting. Technical documents of business process: form and contents. Shematic presentation of projects. Gantt diagram. Optimizing the schedule of activities in single project phases. Business process management. PERT method. Business re-egnineering. Business at global market. Business aethics. Exercises: Calculation of practical tasks in the field of firm business economy (Service price calculation program – version 2.0, HKAIG). Use of computer programs in project managmetn (Microsoft Project 2002).

Developed competence (knowledge and skills)

The students are acquainted with all legal, economic and aethical bases of geodetic firm business activity at national and global level. The graduates are skilled to get integrated into the business world of geodesy and geoinformatics.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar	Practicum
Individual research ✓	Field classes	Tutorial	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work
Project	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar

References

a) Obligatory
Pribičević, B. (2004): Geodetsko poduzetništvo, interna skripta. Geodetski fakultet Sveučilišta u Zagrebu.
Šnajder i dr. (1999): Uvod u poduzetništvo ovlaštenih arhitekata i ovlaštenih inženjera. HKAIG, Zagreb 1999.

b) Additional
Brügemann, H. (1995): Project Management. Chapter 18, Vol. 3, 803-826. Department of Geoinformation, Technical University of Vienna.
FIG (1998): FIG Publication 17: Statement of Ethical Principles and Model Code of Professional Conduct (Izjava o etičkim načelima i kodeksu ponašanja geodetskih stručnjaka)
FIG (2002): FIG Publication 29: Business matters for Professionals (Poslovne stvari za stručnjake)

c) Internet sources
Global Disaster Information Network. www.gdin.org

NAME OF THE COURSE: GEODYNAMICS OF ADRIATIC MICROPLATE – A PROJECT

Teacher's name: Assist. Prof. Boško Pribičević, PhD
Assistant name: Almin Đapo, MSc

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Precise satellite GPS-observations within the EUREF-Permanent project. Permanent GPS-stations in Croatia and movements of Adriatic Microplate. Permanent stations on tide-gauges. Geodynamic network of the City of Zagreb. Processing and interpretation of the results.

Developed competence (knowledge and skills)

Contribution of geodesy to geodynamic research of the territory of Croatia, especially on the coast and in Zagreb area.

Ways of teaching

Lectures	Exercises ✓	Seminar ✓	Practicum ✓
Individual research ✓	Field classes	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✖	Written exam ✖	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✖	Oral exam ✖	Essay ✖	Practical work ✓
Project ✓	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

Keller E.A., Pinter N. *Active Tectonics, Earthquakes, Uplift and Landscape*. Second Edition. Prentice Hall, Upper Saddle River, New Jersey, 2002.

Mantovani E., Albarello D., Babbucci D.R., Tamburelli C. Recent Geodynamic Evolution of the Central Mediterranean Region. Tipografia Senese, 1-88, Siena, 1992.

Medak, Damir; Pribičević, Boško. Croatian Permanent stations within International GPS-service for Geodynamics. // Hvar Observatory Bulletin. 25 (2001) , 1; 31-73.

Pribičević, Boško; Medak, Damir; Prelogović, Eduard. Geodinamika prostora Grada Zagreba. // Geodetski list. 58(81) (2004) , 1; 51-65.

b) Additional

Turcotte, D. L., Schubert, G. (2001): Geodynamics, Second Edition. Cambridge University Press.

NAME OF THE COURSE: GEOMATHEMATICS

Teacher's name: Nikol Radović, MSc
Assistant name:

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2 + 2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

The Mathematics in GPS. Leveling Networks. Random Variables and Covariance Matrices. Nonlinear Problems. Linear Algebra for Weighted Least Squares. Constraints for Singular Normal Equations. Problems With Explicit Solutions. Global Positioning System. Processing of GPS Data. Kalman Filters.

Developed competence (knowledge and skills)

Training how to combine mathematical theory, geodesy and GPS.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory
H. Kenner: *Geodetic Math and how to use it,* University of California Press, Berkley and Los Angeles, 2003.
b) Additional
Gilbert Strang, Kai Borre: *Linear Algebra, Geodesy, and GPS*, Wellesley – Cambridge Press, 1997.

NAME OF THE COURSE: SPATIAL MANAGMENT SUPPORT

Teacher's name: Prof. Miodrag Roić, PhD
Assistant name: Hrvoje Matijević, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Survey and modelling of 3D objects and subdivision of real estate for the purpose of their being entered in official registers. Realisation of space development support system. 3D surveys and measurements processing. Official registering of objects and parts. Subdivision and preparation of studies. Strategy of introducing information system for the purpose of managing larger objects (airports, river ports, business objects, stations). Special characteristics of such objects. Spatial survey and geometry modelling. 3D modelling (CSG, b-rep). 3D topological models. 3D GIS. 3D Databases. 3D data formats (VRML, X3D, GML). Modular creation of information system. Using of different data types. The connection with the data from digital land registry and communal information systems. Maintenance and supplementation of information system. Using the system. Visualisation and presentation.

Developed competence (knowledge and skills)

The students acquire the knowledge in theory and practice of residential and industrial management.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✓
Individual research ✓	Field classes ✓	Tutorial	Consultations
Workshops	Discussion	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay	Practical work ✓
Project	Continuous evaluation of knowledge or grading of activity	Research	Seminar ✓

References

a) Obligatory

Roić, M.: Podrška upravljanju prostorom – interna skripta, Geodetski fakultet, Zagreb 2005.
Teicholz, E.: Facility Design and Management Handbook, McGraw-Hill, New York, 2001.
Narodne novine: Propisi
b) Additional
Longley, P.A., Goodchild, M.F., Maguire, D.J., Rhind, D.V. (1999): Geographical Information Systems, management and applications. Wiley, New York.

NAME OF THE COURSE: LAND INFORMATION MANAGEMENT – A PROJECT

Teacher's name: Prof. Miodrag Roić, PhD
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Adopting the knowledge through independent production, study and technical report creation, and public presentation of the produced project.

Developed competence (knowledge and skills)

Ways of teaching

Lectures	Exercises	Seminar ✓	Practicum ✓
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✓	Discussion ✓	Internet ✓	

Student obligations

Oral exam	Written exam	Seminar ✓	Essay	Active participation in education process ✓

Supervision and grading students

Written exam	Oral exam	Essay	Practical work ✓
Project ✓	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar ✓

References

a) Obligatory
Recent professional journals and books in the field of land information managment

b) Additional

c) Internet sources
Land information portals

NAME OF THE COURSE: GEOKINEMATICS

Teacher's name: Prof. Nevio Rožić, PhD
Assistant name: Marija Repanić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: Physical geodesy, State survey**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes): 0**
- **ECTS points: 6**

Description/contents of the course

Definition and significance of geodynamics. Geodynamics and geodesy mutual relation in frame of geosciences. Recent trends of global organization and integration of geodynamics and geokinematics activities. Global, continental, regional and local geodynamics processes. Structure of Earth body, plate theory, tectonics and tectonic forces, tectonic forms on Earth surface and near depth. Modeling of the plate movements. Global and regional endogenous and exogenous forces. Recent movements of the Earth surface. Izostasy. Methods systematization and concepts of the geodetic positioning regarding quantification, measuring and interpretation of geodymacs and geokinematics effects. Satellite and terrestrial positioning methods. Influence of geodynamics and geokinamtics processes on stability of the geodetic reference frames. Influence of geodynamics and geokinematics forces on topographic surface and build objects. Influence of geodynamic and geokinematics forces on geodetic high accuracy positioning techniques results and elimination of their systematic effects.

Developed competence (knowledge and skills)

Knowledge about geodynamics and geokinematics global, continental, regional and local processes. Knowledge about geodetic positioning methods and techniques appliance regarding quantification of geodynamics and geokinematics influences on topographic surface and buided objects. Knowledge about ways of geodynamics and geokinematics influence on stability of the geodetic reference frames. Appliance skills of geodetic positioning regarding quantification of geodynamics and geokinamatics movements and deformations of Earth surface at regional and local level.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✖	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge	Research ✓	Seminar ✓

	or grading of activity ✓		

References

a) Obligatory
Rožić, N: Geodynamics. Lecture notes, Zagreb, 2001.
Scheidegger, A. E.: Principles of Geodinamics, 1982.
Stuve, K.: Geodynamics of the Litosphere - an Introduction. Springer, 2002.
b) Additional
Lichtenegger, H. 1995: Seminar on Geodynamics. Graz, 1995.
c) Internet sources
http://www.geo.ucalgary.ca/~wu/Geodyn.html
http://vmsg.geo.uu.nl/Info/researchplan.shtml

NAME OF THE COURSE: OPTIMIZATION OF GEODETIC NETWORKS

Teacher's name: Prof. Nevio Rožić, PhD
Assistant name: Marija Repanić

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): Optional**
- **Conditions of course enrolling: State survey**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes): No**
- **ECTS points: 6**

Description/contents of the course

Introduction to the optimization of geodetic networks. Fields of appliance and scope of geodetic networks optimization. Review of optimization methods and procedures. Purpose and optimization methodologies. Classification, systematization and characteristics of geodetic networks regarding optimization. Optimization like integral part of the network design. Mathematical modeling of geodetic networks (functional model, stochastic model) like fundament for optimization. Mathematical modeling and recent methods of optimization. Global and local accuracy criteria. Homogeneity and isotropy of geodetic networks. Objective functions and criterion matrices like elements in optimization process. Optimization criteria (accuracy, reliability, economy, testability). Classification, definition and features of different optimization orders. Optimization of zero order – network datum. Optimization of first order – network configuration. Optimization of second order – observation plan. Optimization of third order – already existing networks. Appliance of computer systems and software in network optimization execution.

Developed competence (knowledge and skills)

Knowledge and skills of design and optimization of geodetic networks.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✖	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✖	Internet ✖	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory

Rožić, N.: Geodetic network optimization. Lectures, Zagreb, 2000.
Kuang, S.: Geodetic Network Analysis and Optimal Design. Ann Arbor Press Inc., Michigan, 1996.
Grafarend, E. et all: Optimization of Geodetic Networks. New York, 1985.
b) Additional
Pelzer, H.: Geodaetische Netze in Landes- und Ingenieurvermessung. Konrad Wittwer, Stuttgart, 1985.

NAME OF THE COURSE: OPTIMIZATION OF GEODETIC NETWORKS – A PROJECT

Teacher's name: Prof. Nevio Rožić, PhD
Assistant name: Marija Repanić

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): Optional**
- **Conditions of course enrolling: State survey**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes): No**
- **ECTS points: 6**

Description/contents of the course

Concrete design and optimization project of special purpose geodetic network, including all significant fazes of: network design specification, network purpose and user requirements, network configuration, measurement requirements, observation plan, optimization criteria, optimization method, analysis of optimization results and reporting with special attention on developing of systematic and creative engineers designing knowledge, documenting of solved works and active initiative for investigating and gathering information necessary for project execution.

Developed competence (knowledge and skills)

Knowledge and skills of design and optimization of geodetic networks.

Ways of teaching

Lectures ✖	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✖	Internet ✖	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity	Research ✓	Seminar ✓

References

a) Obligatory

Rožić, N.: Geodetic network optimization. Lectures, Zagreb, 2000.
Kuang, S.: Geodetic Network Analysis and Optimal Design. Ann Arbor Press Inc., Michigan, 1996.
Grafarend, E. et all: Optimization of Geodetic Networks. New York, 1985.

b) Additional

Pelzer, H.: Geodaetische Netze in Landes- und Ingenieurvermessung. Konrad Wittwer, Stuttgart, 1985.

NAME OF THE COURSE: SPACE GEODESY

Teacher's name: Assist. Prof. Drago Špoljarić, PhD
Assistant name: –

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: no**
- **Number of weeks in a semester/number of classes in a week: 15/2 + 2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Lectures:
Subject of space geodesy. Geodesy and astrometry. Basic conceptions and the main problems of space geodesy. Atomic time and frequency standards. Stability, accuracy and dissemination of time and frequency. Ultra precise time and frequency applications.
Observational techniques of space geodesy. CCD. Global Navigation Satellite Systems (GNSS). Satellite Laser Ranging (SLR). Lunar Laser Ranging (LLR). Very Long Baseline Interferometry (VLBI). Space astrometry satellites (HIPPARCOS).
Scientific investigation of the Earth and planets with space geodetic approaches and studies of space geodetic techniques.
Precise position on the Earth. Earth's orientation: pole position (pole motion), irregularity Earth's rotation. Space geodesy contributes to the understanding of the Earth/Atmosphere/Oceans. Celestial reference systems and frames (ICRS, ICRF). Future project of space geodesy.
Astrogeodetic services. Services International Astronomical Union (IAU) and other institutions.

Developed competence (knowledge and skills)

Mastering basic knowledge and skills about space geodesy and observational and computational techniques, and using of international astrogeodetic services and data.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✓	Research ✓	Seminar ✓

References

a) Obligatory
Špoljarić, D. Svemirska geodezija, Lecturing notes.
Špoljarić D.: Primjena dugobazisne radiointerferometrije u položajnoj astronomiji i geodeziji, Zagreb 1999.

b) Additional
Kovalevsky J., Seidelmann K.: Fundamentals of Astrometry, Cambridge University Press, Cambridge 2004.
Kovalevsky J.: Modern Astrometry, Springer Verlag, Berlin, New York 2001.
Audoin, C., Guinot, B.: The Measurement of Time, Time, Frequency and Atomic Clock, Cambridge University Press, Cambridge 2001.
Schodlbauer A.: Geodätische Astronomie, W. De Gruyter, Berlin, New York, 2000.

c) Internet sources
Špoljarić, D. Svemirska geodezija, presentation, http://www.geof.hr/~dspoljar
International Laser Ranging Service, http://ilrs.gsfc.nasa.gov/
International VLBI Service for Geodesy and Astrometry, http://ivscc.gsfc.nasa.gov/
International Earth Rotation and Reference Systems Service, http://www.iers.org
International Astronomical Union (IAU), http://www.iau.org/

NAME OF THE COURSE: GEODETIC ASTRONOMY – A PROJECT

Teacher's name: Assist. Prof. Drago Špoljarić, PhD
Assistant name: –

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: no**
- **Number of weeks in a semester/number of classes in a week: 15/0 + 4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Visualization of astronomic data for Internet (production of the star sky map intended for Internet).

Production of program package for the recalculation of time scales, calendars and Julian Datum (JD) and its adjustment for Internet.

Testing the precision of simultaneous determination of astronomic coordinates with astrolabe along with the synchronized receipt and correction of time by means of GPS signal receipt.

Development of the program for automated azimuth (bearing angle) determination of some side with Leica electronic tachometer and field computers.

Production of specialized web pages with the list of astrogeodetic services, institutions and organizations.

Developed competence (knowledge and skills)
Broadening of knowledge in modern geodetic astronomy and astrometry. Practice in precise astrogeodetic measurement. Programming and adjustment (development of applications for Internet).

Ways of teaching

Lectures ✖	Exercises ✖	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✓	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam✖	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam✖	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity ✖	Research ✓	Seminar ✓

References

a) Obligatory
Špoljarić D.: Geodetska astronomija, Svemirska geodezija, Lecturing notes.

b) Additional
Kovalevsky J., Seidelmann K.: Fundamentals of Astrometry, Cambridge University Press, Cambridge 2004.
Kovalevsky J.: Modern Astrometry, Springer Verlag, Berlin, New York 2001.
Seidelmann K.: Explantory supplement to the astronomical almanac, University science book, Sausalito, 1992.
Audoin, C., Guinot, B.: The Measurement of Time, Time, Frequency and Atomic Clock, Cambridge University Press, Cambridge 2001.
Mueller, I.: Spherical and practical astronomy as applied to geodesy. Frederick Ungar Publishing Co., New York, 1969.
Schodlbauer A.: Geodätische Astronomie, W. De Gruyter, Berlin, New York, 2000.
Sigl, R.: Geodätische Astronomie, H. W. Verlag, Karlsruhe, 1991.

c) Internet sources
numerous Internet pages (geodetic, astronomic, time-related and others)

NAME OF THE COURSE: COMPUTER CARTOGRAPHY

Teacher's name: Assist. Prof. Nada Vučetić, PhD
Assistant name: Ivka Kljajić, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): obligatory**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Cartographic data. Types of data. Processing of vector data. Length of lines and area of polygons on topographic maps in different scales and map projections. Relationship between point and polygon. Intersection of line and polygon. Processing of raster data. Graphic programms. Text in the map. Thematic maps. Chorogram. Determination of classes boundaries. Dot maps. Digital elevation models. Relief shading. Visibility map. Application of remote sensing in cartography. Digital cartographic systems. National topographic-cartographic database. Electronical maps and atlases. Cartography, GIS and Internet. 3D-cartographic modelling.

Developed competence (knowledge and skills)

Application of digital methods for cartography

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✖	Practicum ✖
Individual research ✖	Field classes ✖	Tutorial ✖	Consultations ✖
Workshops ✖	Discussion ✖	Internet ✖	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✖	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✖	Research ✖	Seminar ✖

References

a) Obligatory

Frančula, N.: Digitalna kartografija, 3. prošireno izdanje, Skripta, Geodetski fakultet, Zagreb 2001.

b) Additional
Kraak, M. J., Ormeling, F. J.: Cartography – Visualization of Spatial Data, Longman, Harlow 1996.
Stoll, H.: Computergestützte Kartographie, Kartografische Publikationsreihe Nr. 15, Schweizerische Gesellschaft für Kartographie 2001.

c) Internet sources
http://www.ika.ethz.ch/cgi-bin/pub_public.pl

NAME OF THE COURSE: CARTOGRAPHY AND GIS

Teacher's name: Assist. Prof. Nada Vučetić, PhD
Assistant name: Dražen Tutić, MSc

- **(Subject oriented field): Geodesy**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Raster-data scanning and processing. Geocoding, georeferencing. Data accuracy. Basics of creating, editing, managing, querying, analysing, presenting and plotting maps in GIS. Choosing a map projection and choosing and assigning a global coordinate system. Editing the maps in digital cartography using various tools for cleaning, transforming and generalizing a map objects. Ability of GIS for executing a various analysis of data stored in a map or with it. Defining, editing and executing various queries. Data stored in map, i.e. object data, and data stored in external databases. Thematic map and GIS. Example: population map. Topology relationships: connectivity, adjacency and relative position. Relationships between nodes, links and polygons. Types of topology: node, network and polygon topology. Defining and editing a topology, and executing a various queries and analysis using topology. Mobile cartography and GIS.

Developed competence (knowledge and skills)

Theoretical and practical knowledge of relationship between cartography and GIS

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✖	Practicum ✖
Individual research ✖	Field classes ✖	Tutorial ✖	Consultations ✖
Workshops ✖	Discussion ✖	Internet ✖	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✖	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✖	Research ✖	Seminar ✖

References

a) Obligatory
Jones, Ch. B.: Geographical Information Systems and Compuer Cartography, Pearson Education Limited, Harlow 1997.
Lapaine, M., Vučetić, N., Tutić, D.: Kartografija i AutoCAD Map, Geodetski fakultet, Zagreb, 1999, izdanje 2001.

b) Additional
Clarke, K. C.: Getting started with GIS, Pearson Education Limited, Harlow 2001

c) Internet sources
The NCCIA Core Curriculum in GIScience: http://www.ncgia.ucsb.edu:/giscc/

NAME OF THE COURSE: CARTOGRAPHIC GENERALIZATION

Teacher's name: Assist. Prof. Nada Vučetić, PhD
Assistant name: Ivka Kljajić, MSc

- **(Subject oriented field): Geoinformatics**
- **Year/semester: 4/VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Semantic and geometric generalization. Factors which influence generalization. Model (database) generalization. Cartographic generalization. Conceptual framework of generalization. Vector- and raster-based generalization. Methods for generalization of point, line, area, volume features. Positional accuracy of generalized features. Generalization in GIS. Accuracy of topology and attributes. Generalization in mobile cartography. 3D-generalization.

Developed competence (knowledge and skills)

Theoretical and practical knowledge in cartographic generalization

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✖	Practicum ✖
Individual research ✖	Field classes ✖	Tutorial ✖	Consultations ✖
Workshops ✖	Discussion ✖	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✖	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✖	Continuous evaluation of knowledge or grading of activity ✖	Research ✖	Seminar ✖

References

a) Obligatory

Frančula, N.: Kartografska generalizacija, Skripta, Geodetski fakultet, Zagreb 2003.
João, E.M.: Causes and consequences of map generalisation. Research Monographs in Geographical Information Systems. Taylor & Francis, London 1998.

McMaster, R.B.; Shea, K.S.: Generalization in digital cartography. Association of American Geographers, Washington 1992.

b) Additional

Müller J.-C.; Lagrange, J.P.; Weibel, R. (urednici): GIS and Generalization, Methodology and Practice. GISDATA, Taylor & Francis, London 1995.

Speiss, E.; Baumgartner, U.; Arn, S.; Vez, C.: Topografische Karten – Kartengrafik und Generalisierung. Kartografische Publikationsreihe Nr. 16, Schweizerische Gesellschaft für Kartographie 2002.

c) Internet sources

ICA Commission on Generalisation and Multiple Representation, Bibliography on generalisation and multiple representation: http://www.icaci.org.

NAME OF THE COURSE: GENERALIZATION OF GEOINFORMATION – A PROJECT

Teacher's name: Assist. Prof. Nada Vučetić, PhD
Assistant name: Ivka Kljajić, MSc

- **(Subject oriented field):**
- **Year/semester: 5/IX**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling:**
- **Number of weeks in a semester/number of classes in a week: 15/0+4**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Generalization of geoinformation for certian purposes. Project inludes collecting of geoinformation, analyzing its quality, finding out of generalization rules and methods.

Developed competence (knowledge and skills)

Solving assignment in area of geoinformation generalization

Ways of teaching

Lectures ✖	Exercises ✖	Seminar ✓	Practicum ✖
Individual research ✓	Field classes ✖	Tutorial ✓	Consultations ✓
Workshops ✖	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓	Seminar ✓	Essay ✖	Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Essay ✖	Practical work ✖
Project ✓	Continuous evaluation of knowledge or grading of activity ✖	Research ✓	Seminar ✓

References

a) Obligatory

Theacher recommends in keeping with project problem.

b) Additional

c) Internet sources

ICA Commission on Generalisation and Multiple Representation, Bibliography on generalisation and multiple representation: http://www.icaci.org.

NAME OF THE COURSE: COMPLEX ANALYSIS

Proposer's name: Vida Zadelj-Martić, MSc
Assistant name:

- **(Subject oriented field):**
- **Year/semester: 4/ VII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: Mathematical analysis**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

- Complex Functions
- The Elementary Functions
- Analytic Functions
- Cauchy – Riemann Equations
- Conformal Mapping
- Integration in the Complex Plane
- Cauchy's Integral Formula
- Applications in Geodesy
- Applications in Cartography

Developed competence (knowledge and skills)

Understanding of the key topics and problems of Complex Analysis and developing the necessary techniques and skills for solving exercises and problems that are met in Geodesy.

Ways of teaching

Lectures ✓	Exercises ✓		
			Consultations ✓
	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam ✓			Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Two non-obligatory colloquia with exercises and theoretical questions.	
	To pass the exam, the student must collect at least 50% of all possible		

	points that can be collected by solving exercises and at least 50% of all possible points that can be collected by answering the theoretical questions, both linked with colloquia. Otherwise, or if not content with the proposed mark, the student can take the written part and afterwards the oral part of the exam.		

References

a) Obligatory:
M. R. Spiegel; Complex Variables, Schaum's Outline series, McGraw-Hill, New York

H. A. Priestley; Introduction to Complex Analysis, Oxford, University Press

b) Additional:
E. Kreyszig; Advanced Engeering Mathematics, J. Wiley&Sons Inc., Ohio

NAME OF THE COURSE: NUMERICAL ANALYSIS

Teacher' s name: Vida Zadelj-Martić, MSc
Assistant name:

- **(Subject oriented field): Geodesy, Geoinformatics**
- **Year/semester: 4/VIII**
- **Course status (obligatory/optional): optional**
- **Conditions of course enrolling: Mathematical analysis**
- **Number of weeks in a semester/number of classes in a week: 15/2+2**
- **(Total number of field classes):**
- **ECTS points: 6**

Description/contents of the course

Some Basic Concepts of Numerical Analysis, Numerical Differentiation, Numerical Integration: The Trapezoidal Rule, Simpson's rule, Newton-Cotes Integration Formulas, Gaussian Quadrature. Numerical methods for Ordinary Differential Equations: Predictor – Corrector Methods, Runge – Kutta Methods. Systems of Ordinary Differential Equations.

Developed competence (knowledge and skills)

Understanding of the key topics and problems of Numerical Analysis and developing the necessary techniques and skills for solving exercises and problems that are met in Geodesy.

Ways of teaching

Lectures ✓	Exercises ✓	Seminar ✓	
			Consultations ✓
	Discussion ✓	Internet ✓	

Student obligations

Oral exam ✓	Written exam✓	Seminar ✓		Active participation in education process ✓

Supervision and grading students

Written exam ✓	Oral exam ✓	Two non-obligatory colloquia with exercises and theoretical questions.	
	To pass the exam, the student must collect at least 50% of all possible points that can be collected by solving exercises and at least 50% of all possible points that can be collected by answering the theoretical questions, both linked with colloquia. Otherwise, or if not content with the proposed mark, the student can take the written		

	part and afterwards the oral part of the exam.		

References

a) Obligatory:
A. Ralston and P. Rabinowitz; A First Course in Numerical Analysis, Dover Publication, Inc., Mineola, New York
W. A. Smith; Elementary Numerical Analysis, Harper & Row, New York

b) Additional:
E. Kreyszig; Advanced Engeering Mathematics, J. Wiley&Sons Inc., Ohio