UNIVERSITY OF RIJEKA
FACULTY OF CIVIL ENGINEERING

GF

ACADEMIC GRADUATE PROGRAMME IN

CIVIL ENGINEERING

Rijeka, April 2008

STUDY PROGRAMME AND CURRICULUM

ACADEMIC GRADUATE PROGRAMME
IN CIVIL ENGINEERING

Information on the proposing party:

Građevinski fakultet
Viktora Cara Emina 5, HR-51000 Rijeka
Telefon: + 385 51 352 111
Telefaks: + 385 51 332 816
e-mail: dekanat@gradri.hr
http://www.gradri.hr/

CONTENTS

page

1. INTRODUCTION

During the implementation of the Bologna process the Faculty of Civil Engineering of the University of Rijeka plans to reform the current study programmes (academic, vocational and postgraduate programmes) in line with the principles of the Bologna Declaration, namely in accordance with the propositions of the European Credit Transfer System (ECTS). This will be performed in order to promote student mobility in the Integrated European Higher Education Area.
The Faculty of Civil Engineering of the University of Rijeka organized and started carrying out civil engineering studies as an independent institution in 1976. During a thirty-year activity a total of **1120 Diploma Engineers** graduated from the Academic Programme, and **1360 Engineers** from the Vocational Programme.

In structuring the new study programmes, the Faculty has followed its experience in educating civil engineering personnel. For the purpose of integrating Croatia into the European Higher Education and Labour Area, the needs of the labour market have been considered, and the demands that will be set on prospective students, the Faculty, its staff and specialists in civil engineering, have been assessed. **.** Consideration has been given to the fact that the Faculty of Civil Engineering in Rijeka is the only higher education institution in the greater area (the Primorsko-goranska County, the Istrian County, and the Lika-Senj County) that educates civil engineering professionals.
Due to the present-day intense activity in planning, designing and constructing the infrastructure (transportation systems, housing development, water supply systems, etc.) there is a great need for highly educated professionals in civil engineering.
It is safe to say that the trend toward an intense infrastructure construction will also continue in the years to come (during the process of approach and admission of Croatia to the European Union). In the longer term, the need to plan and design new civil engineering structures will be transformed into the need to manage, maintain and reconstruct the infrastructure systems. Therefore, part of the curriculum has also been adapted to meet this demand.
In the course of structuring the study programmes, the Faculty cooperated closely with the related Faculties of Civil Engineering in Croatia. The study programme at the undergraduate level was brought into tune, in a part of the core curriculum, with the identical programmes of the other Faculties of Civil Engineering in Croatia in order to enable student mobility, primarily, at the national level.

In the course of structuring the undergraduate and graduate programmes, the programmes of respectable foreign institutions that educate professionals of the same profile (the University of Engineering of Prague, the University of Engineering of Munich: Technische Universität München-Studienplan für Studierende des Bauingenieurwesens, Eigenossiche Technische Hochschule Zürich-ETH-Abteilung für Bauingenieurwesen in Zürich), were analysed and the recommendations of the association of European Faculties of Civil Engineering (European Civil Engineering Education and Training – EUCEET) were accepted. This was performed through coordination inside the TEMPUS Project «Restructuring and Updating of Civil Engineering Curriculum» (in which the 4 Faculties of Civil Engineering from Croatia, along with international experts and scientists, were, and still are, cooperating).

The **Faculty teachers** were actively included in structuring the study programmes, and the **students** were consulted, too. The structure of the study programme was accepted at the Board of the Faculty of Civil Engineering.
The scheme adopted according to education cycles is «3+2+3», namely:
- Three-year Undergraduate Programme
- Two-year Graduate Programme
- Three-year Postgraduate Programme.

The *graduate programmes* are based on all the facts mentioned above. They are organised through the modules of the particular civil engineering branches. As compared to the current branch programmes in the final year of study ***(Hydraulic, Construction and Transportation Engineering)***, new scientific and practical knowledge has been applied in a particular academic branch programme by introducing new courses and modifying the curricula of the current courses.

Special consideration has been given to the fact that a certain number of Diploma Engineers and even Engineers in Civil Engineering find employment with, and perform a wide variety of jobs, for local self-government units in all three counties covered by the Faculty. Therefore, a new branch of ***Urban Engineering*** has been included in the programmes. It will train students for the jobs of planning, managing and maintaining the infrastructure systems. Due

to the needs and demands noticed in the labour market and science, modules from the branches of ***Geotechnical Engineering and Engineering Modelling*** have been included, too.

The programmes offer the possibility of combining the modules from two different branches of civil engineering, thus enabling students' flexibility in creating their own study programmes and choosing from a large number of optional courses.

2. GENERAL INFORMATION

2.1. PROGRAMME NAME

The name of the programme is **Academic Graduate Programme in Civil Engineering**.

2.2. PARTY MANAGING AND CARRYING OUT STUDY PROGRAMMES

The party managing and carrying out all the proposed programmes will be the Faculty of Civil Engineering of the University of Rijeka with its basic organisation units: the Sections for Mathematics, Geotechnical Engineering, Hydraulic Engineering, Structures, Modelling Structures and Materials, Construction Engineering, Construction Management, Transportation Engineering, Engineering Mechanics, Physics and other courses.

2.3. PROGRAMME DURATION

The duration of the Academic Graduate Programme is two (2) academic years and the student obtains a minimum of 120 ECTS credits.

2.4. PROGRAMME ENTRANCE REQUIREMENTS

The citizens of the Republic of Croatia, foreign citizens and persons without citizenship have the right to apply for enrolment under the same conditions.
A Graduate Study Programme can be enrolled by a candidate who has completed an Academic Undergraduate Programme at the Faculty of Civil Engineering of the University of Rijeka (with a total of 180 ECTS credits) or has completed an Undergraduate Programme at some of the Faculties of Civil Engineering (with which the Faculty of Civil Engineering in Rijeka has an agreement on student mobility), or at a related Faculty of Engineering (with which the Faculty of Civil Engineering in Rijeka has an agreement on student mobility), at which the candidate has obtained 180 ECTS credits.

2.5. COMPETENCES ACQUIRED BY THE STUDENT WITH COMPLETION OF THE STUDY PROGRAMME

With completion of the *Academic Graduate Programme* the student acquires the basic competences to understand the general phenomena and problems connected with civil engineering and particularly with a specific branch of civil engineering (Geotechnical Engineering, Hydraulic Engineering, Engineering Modelling, Structures, Transportation Engineering and the interdisciplinary area of Urban Engineering). He is able to apply general knowledge, acquire new knowledge and ideas, and draw conclusions based on science and his profession as well as to develop his scientific and applied scientific-research competences.
He is qualified for the design, construction and maintenance of civil engineering structures and systems in terms of bearing capacity, stability, safety, environmental protection and cost.
With completion of the Graduate Programme, the student is specially qualified for understanding and solving problems in a specific branch of Civil Engineering.
During his studies, the student learns how to prepare and formulate complex civil engineering solutions in written and oral form. At the same time, he develops the ability to communicate his own ideas, analyses and conclusions, connected with specific civil engineering problems, to the professional and non-professional public. He is able to manage a group of people preparing and executing complex civil engineering projects.

2.6. ACADEMIC TITLE OR DEGREE ACQUIRED ON COMPLETION OF THE PROGRAMME

According to the proposed study programme, the academic title or degree acquired on completion of the Academic Graduate Programme is Master in Civil Engineering

3. PROGRAMME DESCRIPTION

3.1. LIST OF COMPULSORY AND OPTIONAL COURSES

The Academic Graduate Programme is organised so that students enrol part of the common courses in their I semester, while the optional part of the programme is dependent on the branch programme that he wants to study. The branch programme courses are organised through the modules of the specific branches of civil engineering:

- Geotechnical Engineering
- Hydraulic Engineering
- Engineering Modelling
- Structures
- Transportation Engineering
- The interdisciplinary branch of Urban Engineering

The list of Compulsory and optional courses is arranged according to the above-mentioned structure and branches from which the modules are organised.

3.1.1. List of Compulsory and optional courses in I semester

List of compulsory courses

	Course code	***Compulsory courses***	***Hours of active classes (L+E+S)***	***ECTS***
1.	M-550	Probability Theory and Statistics	30+30+0	5,0
2.	MK-300	Numerical Modelling	30+30+0	5,0
3.	MK-301	Theory and Technology of Concrete	30+15+15	5,0
4.	OA-450	Project Management	30+15+15	5,0

List of optional courses

	Course code	***Optional courses***	***Hours of active classes (L+E+S)***	***ECTS***
5.	H-250	Hydraulics (Hydraulic Engineering Module)	30+30+0	5,0
6.	G-203	Engineering Rock Mechanics (Modules of Geotechnical Engineering, Urban Engineering and Transportation Engineering Module)	30+15+15	5,0
7.	P-500	Road Design (Transportation Engineering Module, Urban Engineering Module)	20+20+10	5,0
8.	NK-352	Concrete and Masonry Structures (Modules of Structures and Engineering Modelling of Structures)	45+30+0	6,0
9.	TM-400	Theory of Elasticity (Modules of Structures and Engineering Modelling of Structures)	35+0+10	4,0
10.	G-201	Theoretical Soil Mechanics (Geotechnical Engineering Module, Transportation Engineering Module)	40+10+25	5,0

3.1.2. List of compulsory courses and optional courses in modules

3.1.2.1. List of compulsory and optional courses in modules – Modules from the branch programme of Geotechnical Engineering

List of compulsory courses

	Course code	***Compulsory courses***	***Hours of active classes (L+E+S)***	***ECTS***
11.	G-202	Foundation Engineering	30+15+15	6,0
12.	G-204	Soil Dynamics	30+15+15	6,0
13.	G-205	Numerical Modelling in Geotechnical Engineering	15+15+30	6,0
14.	G-209	Geotechnical Structures	30+10+20	6,0
15.	G-210	Underground Structures and Tunnels	30+30+0	6,0
16.	G-211	Slope Stability	30+15+15	6,0

List of optional courses

	Course code	***Optional courses***	***Hours of active classes (L+E+S)***	***ECTS***
17.	G-200	Environmental Protection	15+0+30	4,0
18.	G-208	Testing and Monitoring in Geotechnical Engineering	30+15+15	4,0
19.	G-214	Reinforcing Soil and Rocks	30+15+15	4,0
20.	G-207	Seepage and Consolidation of Soil	30+15+15	4,0
21.	G-212	Geohazards	15+10+20	4,0
22.	G-213	Geotechnical Engineering in Road	25+5+15	4,0

3.1.2.2. List of compulsory and optional courses –Hydraulic Engineering Module

List of compulsory courses

	Course code	***Compulsory courses***	***Hours of active classes (L+E+S)***	***ECTS***
23.	H-251	Water Supply and Drinking Water	30+30+0	6,0
24.	H-252	Drainage and Wastewater Treatment	30+30+0	6,0
25.	H-253	Hydraulic Structures	30+30+0	6,0
26.	H-257	Engineering Hydrology	30+30+0	6,0
27.	H-258	Hydraulic Regulations and Meliorations	30+30+0	6,0
28.	H-259	Coastal Engineering	30+15+15	6,0

List of optional courses

	Course code	***Optional courses***	***Hours of active classes (L+E+S)***	***ECTS***
29.	H-262	Experimental Hydraulics	30+30+0	4,0
30.	H-255	Water Resources Management	30+0+30	4,0
31.	H-256	Karst Hydrosystems	30+0+30	4,0
32.	H-263	Waste Management	30+10+5	4,0
33.	H-260	Hydraulic Modelling	30+30+0	4,0
34.	H-261	Water Power Development	30+30+0	4,0

3.1.2.3. List of compulsory and optional courses –Engineering Modelling Module

List of compulsory courses

	Course code	*Compulsory courses*	*Hours of active classes (L+E+S)*	*ECTS*
35.	MK-302	Inverse Modelling in Structural Evaluation	30+0+30	6,0
36.	MK-303	Operational Research and Linear	30+0+30	6,0
37.	MK-308	Structural Modelling	30+0+30	6,0
38.	MK-309	Finite Element Method	30+0+30	6,0
39.	MK-306	Computer Aided Design	30+0+30	4,0
40.	MK-310	Numerical Modelling in Materials	30+0+30	4,0

List of optional courses

	Course code	*Optional courses*	*Hours of active classes (L+E+S)*	*ECTS*
41.	MK-313	Computer Modelling of Geometric Surfaces	30+0+30	4,0
42.	MK-312	Building Physics	20+0+10	2,0

3.1.2.4. List of compulsory and optional courses – Structures Module

List of compulsory courses

	Course code	*Compulsory courses*	*Hours of active classes (L+E+S)*	*ECTS*
43.	NK-351	Steel Structures	45+30+0	6,0
44.	TM-402	Dynamics of Structures	30+15+0	4,0
45.	NK-357	Timber Structures	45+26+4	6,0
46.	NK-353	Prestressed Concrete	30+15+0	4,0
47.	NK-355	Solid Bridges	30+30+0	5,0
48.	NK-354	Introduction to Composite Structures	30+10+5	5,0

List of optional courses

	Course code	*Optional courses*	*Hours of active classes (L+E+S)*	*ECTS*
49.	TM-401	Theory of Plates and Shells	24+0+6	3,0
50.	TM-405	Theory of Plasticity	24+0+6	3,0
51.	TM-404	Variational Methods	24+0+6	3,0
52.	TM-403	Stability of Structures	30+15+0	4,0
53.	NK-352	Special Chapters of Concrete Structures	30+15+0	4,0
54.	OA-463	Design of Buildings	15+30+0	4,0
55.	NK-358	Precast Concrete Structures	30+10+5	4,0
56.	NK-361	Earthquake Engineering	30+15+0	4,0
57.	NK-360	Testing of Structures	30+15+0	4,0
58.	NK-363	Reliabilty of Structures	24+0+6	3,0
59.	NK-359	Special Chapters of Lightweight Structures	30+5+10	4,0
60.	NK-356	Steel Bridges	30+15+0	4,0

3.1.2.5. List of Compulsory and optional courses – Traffic module

List of compulsory courses

	Course code	*Compulsory courses*	*Hours of active classes (L+E+S)*	*ECTS*
61.	P-501	Road Intersections and Crossroads	20+15+15	5,0
62.	P-503	Urban Traffic	20+20+10	6,0
63.	P-502	Traffic Engineering	45+0+15	5,0
64.	P-508	Flexible Pavement Structures	30+15+15	6,0
65.	P-509	Rigid Pavement Structures	25+10+5	4,0
66.	P-510	Roadbed design	30+20+10	4,0

List of optional courses

	Course code	*Optional courses*	*Hours of active classes (L+E+S)*	*ECTS*
67.	P-512	Railway Design	45+15+0	5,0
68.	P-504	Traffic, Space and Environment	30+0+15	3,0
69.	P-505	Traffic Safety	30+15+0	3,0
70.	P-507	Technology of Traffic Building	30+15+0	3,0
71.	OA-462	Traffic Buildings	30+30+0	4,0
72.	P-511	Maintenance and Repair of Roads	30+10+5	3,0
73.	P-513	Airports	20+10+0	3,0
74.	OA-456	Construction Machinery	30+30+0	4,0

3.1.2.6. List of compulsory and optional courses – Urban Engineering Module

List of compulsory courses

	Course code	*Compulsory courses*	*Hours of active classes (L+E+S)*	*ECTS*
75.	OA-459	Spatial planning	40+10+10	5,0
76.	P-514	Geographic Information Systems in Municipal Infrastructure Planning	30+15+15	6,0
77.	OA-460	Public Buildings and Spaces	30+0+30	6,0
78.	H-254	Urban Water Systems	30+15+15	6,0

List of optional courses

	Course code	*Optional courses*	*Hours of active classes (L+E+S)*	*ECTS*
79.	OA-458	Civil Engineering Regulations	30+0+0	4,0
80.	OA-457	Management in Civil Engineering	30+0+15	3,0
81.	OA-455	Investment policies	30+15+0	5,0
82.	OA-461	Building Maintenance	30+15+0	4,0

3.1.2.7. List of courses - IV semester

	Course code	*Compulsory course*	*Hours of active classes (L+E+S)*	*ECTS*
83.		Final year project	30+0+0	30,0

In total, the programme provides 85 courses:
- Compulsory courses: 39
- Optional courses: 46

3.2. COURSE DESCRIPTION

Explanation of ECTS credits, the quality assessment and the courses delivery success are given in chapters 3.2.2. and 3.2.3. for all subjects.

3.2.1. Description of mandatory and optional courses

Course:	**PROBABILITY THEORY AND STATISTICS**

Course code: MK-550	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 5

Course objectives	Students will: – become familiar with the concepts such as event, probability of an event, random variable, probability distribution, mean and variance of a distribution, – learn to use samples to make inferences about the unknown parameters of a distribution, – learn to perform statistical tests in order to accept or reject a given probability model.
Syllabus	Experiments, outcomes, events. Probability of an event. Basic theorems for probability. Conditional probability. Independent events. Factorials, binomial coefficients, permutations and combinations. Random variables, discrete and continuous. Probability distributions. Expectation and variance. Moments. Most important discrete distributions: binomial, geometric and Poisson distributions. Normal distribution. Binomial distribution approximated by normal distribution. Two-dimensional random variables, two-dimensional probability distributions. Marginal distributions of a two-dimensional distribution. Independence of random variables. Functions of random variables. Addition of means and (non)addition of variances. Correlation coefficient. Estimation of parameters. Maximum likelihood method. Confidence intervals. Testing of hypotheses, decisions. Chi-square test. Nonparametric tests. Regression analysis and correlation analysis. Markov processes.
Student obligations	Attending at lectures and exercises.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Notes taken at the classes. 2. E. Kreyszig, Advanced Engineering Mathematics, Wiley, New York, 8th edition, 1999. **Recommended:** 1. S. Lipschutz, M. Lipson, Probability, Schaum's Series, McGraw-Hill, New York, 2nd edition, 2000. 2. S. Bernstein, R. Bernstein, Elements of Statistics I: Descriptive Statistics and Probability, Schaum's Series, McGraw-Hill, New York, 1999. 3. S. Bernstein, R. Bernstein, Elements of Statistics II: Inferential Statistics, Schaum's Series, McGraw-Hill, New York, 1999. 4. R. A. Johnson, G. K. Bhattacharyya, Statistics: Principles and Methods, Wiley, New York, 4th edition, 2001.

Course:	**NUMERICALAL MODELLING**

Course code: MK-300	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 5

Course objectives	Enabling student to independently solve practical engineering problems from the field of the course.
Syllabus	Introduction. Programming languages in graphic programs. Polynomial interpolation, numerical derivatives and integration. Linear and non-linear equations, systems of equations and solution methods. Introduction in evolutionary algorithms and artificial intelligence.
Student obligations	Three assignments to be done with software by prof. I.Kožar, program MathCAD and a CAD program (DesignCAD ili AutoCad).
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Chapra, S.C., Canale, R.P.: Numerical Methods for Engineers, McGraw Hill, 1988. 2. MathCAD 2001 user manual. 3. Kožar, Ivica: Neke subroutine od značaja za inženjerske programe, s listingom programa, FRaK, No.9, 1984., str.6-10. 4. Kožar, Ivica: Sistemi nelinearnih jednadžbi, s listingom programa, FRaK, No.7, 1983., str.36-39. **Recommended:** 1. Smith, A., Hinton, E., Lewis, R.W.: Civil Engineering Systems Analysis and Design", John Wiley & Sons, 1983 2. Kožar, Ivica: Umjetna inteligencija u inženjerskoj praksi, FRaK, No.17, 1986., str.5-8.

Course:	**THEORY AND TECHNOLOGY OF CONCRETE**

Course code: MK-301	**Pre-requisites:** Materials 2	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 5

Course objectives	To provide fundamental understanding of structures and properties of concrete, and latest advancements in concrete mechanics and technology. Student should have information of concrete constituent materials and their effect on both fresh and hardened concrete properties.
Syllabus	Introduction to Concrete. The Structure of Concrete. Modeling of Concrete Materials. Strength. Behaviour of Concrete under Various Stress State. Dimensional Stability. Durability. Fresh Concrete. Portland Cement. Aggregates. Admixtures. Proportioning Concrete Mixtures. Concrete at Early Ages. Progress in Concrete Technology. Advances in Concrete Mechanics. The Future of Concrete.
Student obligations	Participation in all lectures and scheduled group laboratories. Submit a final laboratory reports. Submit and give presentation of the seminar work.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Ukrainczyk V: Beton – struktura, svojstva, tehnologija, Alcor, Zagreb, 1994. 2. Mehta P K., Paulo J M. Monteiro: Concrete, Microstructure, Properties and Materials, 2001, http://www.ce.berkeley.edu/~paulmont/book.pdf 3. Neville A M.: Properties of Concrete, Prentice Hall, 1995., 4. Bjegović D, i dr.: Auditorne vježbe, Praktikum, Aktivna nastava, Građevinski fakultet Sveučilišta u Zagrebu, 1994. **Recommended:** 1. Illston J M, Domone P L J (ed.): Construction materials – their nature and behaviour, E & FN SPON Chapman & Hall, 1994. 2. Maekawa K, Chaube R P, Kishi T: Modelling of Concrete Performance, Hydration, Microstructure and Mass Transport, Spon Press, 2000. 3. Dewar J: Computer Modelling of Concrete Mixtures, Spon Press, 2000.

Course:	**PROJECT MANAGEMENT**

Course code: OA-450	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 5

Course objectives	Acquiring basic project management knowledge and skills, especially in construction projects.
Syllabus	1. Fundamental knowledge of project management 2. Basics of project management 3. Management in preliminary phases 4. Management in executional phases 5. Construction project manager 6. Team work 7. Risk management in construction projects 8. Change managemnt 9. Human resources management 10. Quality/costs/time management 11. Management ofinformations and communication in construction projects 12. New trends and the future of project management
Student obligations	Attending at lectures and exercises.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Radujković,M., Pienaru, A., i skupina koautora PM Toolkit, Hrvatska udruga za upravljanje projektima, Zagreb, 2004. 2. Skendrović, V., Upravljanje projektima, Građevinski fakultet Osijek, Osijek, 2002. **Recommended:** 1. Burke, R., Project Management, J. Wiley, Chicester, 2003

Course:	**HYDRAULICS**

Course code: H-250	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 5

Course objectives	The main objective of this course is to educate future engineers to understend the unsteady flow in open channels, pressure piping systems (pipe networks) and ground waters, transport of contaminants in porous media and in coastal seas. Hydrodynamic processes will be described in the macroscopic sense, and some examples will be presented.
Syllabus	Introduction. Characteristics of fluids. The energy principle. Modelling of hydrodinamic processes. Open channel flow. Non-uniform flow. Unsteady flow. Gradually varied unsteady flow. Rapidly varied unsteady flow. Dam-break problem. Weirs. Stilling basins. Pressure piping systems. Steady flow in pipe networks. Unsteady flow (mass oscillations, surge tank and water hammer). Pums and turbines. Groundwater modelling. Regional groundwater flow modelling. Wells (steady and unsteady flow, test pumping analysis). Transport in porous media. Phenomena to be considered and basic equations. Regional pollutant transports models. Ocean disposal of wastewater. Wind effect on structures.
Student obligations	– Attendance to lectures and exercises as defined by the faculty regulations. – Attendance to laboratory exercises.. – Preparing and delivering of a program from exercises
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Gjetvaj, G.: Eksperimentalna Hidraulika (interna skripta), 2003. 2. Chow, V.T.: Open Channel Hydraulics, Mc Graw-Hill Kogakusha, 1959. 3. Kobus, H: Hydraulic Modelling, German Association for Water Resources and Land Improvement, Verlag PaulParcy, Hamburg, 1980. 4. Chang, H.H.: Fluvial Proces i River Engeneering, Krieger Publishing Company, 1998. **Recommended:** 1. Novak, P.; Cabelka, J.: Models in Hydraulic Engineering, Physical Principles and Design Applications, Pitman Advanced Publishing Program, Boston, 1981.

Course:	**ENGINEERING ROCK MECHANICS**

Course code: G-203	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 5

Course objectives	Introducing the rock mechanics principles in engineering practice. Understanding the rock and rock mass properties and pre-existing boundary conditions. Select the adequate laboratory and in-situ test to obtain the parameter values. Apply the methods of analyses for rock support designe (open and underground excavations).
Syllabus	Rocka mass description and classification Tectonic deformation and weathering of rocks Index and physical propperties of rocks Mechanical properties of rock and rock masses: rock strength and failure criteria; constitutive laws; shear strength of discontinuities Analysis and design in rock mechanics Excavation and stabilization principles Instability machanisms in open and underground excavations Stabilization techniques: rockbolts and cables, shotccrete support Rock properties testing methods and site characterization Stress and stress measurements methods (in situ and induced stress) Rock slope stability, modes of failure, 2D and 3D analysis Applications of rock mechanics to foundation engineering and tunnelling
Student obligations	Attendance to lectures and exercises (on faculty and on site). Preparing and delivering a program from exercises.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Vrkljan, I., 2001., Inženjerska mehanika stijena (digitalna verzija skripti), Građevinski fakultet u Rijeci 2. Hoek, E.: Rock Engineering, A Course Notes, http://www.rocscience.com 3. Hudson, J.A. and Harrison J.P., 2000., Engineering Rock Mechanics, An introduction to the principles, Pergamon, 444 p. **Recommended:** 1. Harrison, J.P., Hudson, J.P., 2000., Engineering Rock Mechanics, Illustrative Worked Exsamples, Pergamon, 506 p. 2. Miščević, P., 2004., Uvod u inženjersku mehaniku stijena ; Sveučilište u Splitu – Građevinsko arhitektonski fakultet; Split 3. Hudson, J.A., (editor-in-chief), 1993., Comprehensive Rock Engineering, Volume 1,2,3,4 i 5 4. Bell, F.G., 1995. Engineering Geology. Blackwell Science, Cambridge.

Course:	**ROAD DESIGN**

Course code: P-503	**Pre-requisites:**	**Hours of Active Classes:** 50 lectures: 20 exercises: 20 seminars: 10
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 5

Course objectives	With successfully acquired matter, students are expected to have theoretical an practical knowledge required for road designing. They are trained for computer aided road design by itself.
Syllabus	1. Theory of road design: methodology of road design horizontal and vertical alignment of road; cross sections of road stopping sight distance and passing sight distance methods of surfaces determination and mass haul diagrams alternative solutions and selection of optimal solution 2. Computer aided road design (based on road building standards) – digital terrain models – horizontal and vertical alignment of road designed by computer – elaboration of cross-sections – calculation of volume of road troop.
Student obligations	– attendance to practice class – road project made by computer and its presentation – accepted project work before the end of term or before specified date
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Priručnik za računalni program koji se koristi u nastavi 2. Pravilnik o osnovnim uvjetima kojima javne ceste izvan naselja i njihovi elementi moraju udovoljavati sa stajališta sigurnosti prometa (NN br. 110/2001 g.) **Recommended:** 1. H. Lorenz, Trassierung und Gestaltung von Strassen und Autobahnen, Bauverlag GMBH, Wiesbaden und Berlin, 1970. g. 2. Geometric Design Guide for Canadian Roads, part 1, 1999.

Course:	**CONCRETE AND MASONRY STRUCTURES**

Course code: NK-352	**Pre-requisites:**	**Hours of Active Classes:** 75 lectures: 45 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	Acquired knowledge of working concepts and properties of various bearing structures of concrete enable the competency in independent designing of concrete structures. It is also a background for further practical and scientific education in the field of concrete structures and structural engineering in general.
Syllabus	Lectures: Shear and diagonal tension in beams. Serviceability, calculation of deflection. Flexural, thermal and shrinkage cracking. Design of reinforced concrete beams and slabs. Colman Classification and failure modes. Column design, reinforcement details. Foundations and retaining walls. Analysis and design masonry construction at the ultimate limit state, EC6. The masonry structures in the seismic areas. Practices: Auditor demonstration of characteristic systems ascording to the types and building technology.
Student obligations	Practical elaboration of practices contents: working out of the major project of concrete structure in a space concept (disposition, static structure model, resistance and stability of structure elements and the entire. Working out of programmes is adjusted to a firmly set auditor (40%) and constructive practices (60%). Second signature conditions are a successful programme.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Tomičić, I.: Betonske konstrukcije, DHGK, Zagreb, 1996. 2. Tomičić, I.: Betonske konstrukcije – odabrana poglavlja, DHGK, Zagreb, 1990. 3. Tomičić, I.: Priručnik za proračun armiranobetonskih konstrukcija, DHGK, Zagreb, 1993. 4. Mosley W.H., Hulse R., Bungey J.H.: Reinforced concrete Design to Eurocode 2, Macmillan Press LTD, 1996. 5. Nilson A.H., Winter G.: Design of concrete structures, McGrau-Hill, Inc., 1987. 6. Sorić Z.: Zidane konstrukcije I, HSGI, Zagreb, 1999. **Recommended:** 1. Beckett D., Alexandrou A.: Introduction to Eurocode 2. E&FN SPON, 1997. 2. Sahnovski, K.V.: Armiranobetonske konstrukcije, Građevinska knjiga, Beograd, 1962. 3. Ulicki, I.I.: Armiranobetonske konstrukcije, Građevinska knjiga, Beograd, 1977. 4. Park R., Paulay T.: Reinforced Concrete Structures, John Wiley, New York, 1975. 5. Aničić D., Tomažević M.: Konstruiranje i proračun zidanih konstrukcija, Građevinski kalendar 1990. i 1991.

Course:	**THEORY OF ELASTICITY**

Course code: TM-400	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 35 exercises: 0 seminars: 10
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	Fundamentals of continuum mechanics, theory of elasticity, solution of boundary problemes in the framework of the elasticity theory, nonlinear theories: visco-elasticity, plasticity and damage mechanics.
Syllabus	Introduction Stress at a point Strain at a point Stress-strain relations - linear elasticity Basic equations of elasticity for solids Visco-elasticity Plasticity Damage mechanics Applications to simple problems
Student obligations	Attenance of lectures Seminar work - condition for the attendance of the exam Exam
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Valliappan, S. Continuum mechanics - fundamentals, 2. Scool of Civil Engineering, The University of New South Wales 3. Ed. A.A.Balkema, Rotterdam, 1981. **Recommended:** 1. Timoshenko, S. and Goodier, N. Theory of elasticity, McGraw-Hill, 1970.

Course:	**THEORETICAL SOIL MECHANICS**

Course code: G-201	**Pre-requisites:**	**Hours of Active Classes:** 75 lectures: 40 exercises: 10 seminars: 25
Course status: optional	**The course consists of:** lectures excercises seminars	**ECTS:** 5

Course objectives	The student is expected to acquire a basis knowledge and understending of the nonlinear continuum mechanics. Describe a critical state concept in mechanical behaviour of real soils. Explane theoretical behaviour for different models of soils. Provide students learning experience in acceptance of theoretical models in practical aspects of soil behaviour.
Syllabus	Critical state concept and mechanical behaviour of soils Non-linear mechanics of continuum and constitutive laws Multiphase continuum Elasticity and elastoplasticity Yield surface and plastic potentional, isotropic strengening models Complex soil models: Duncan's and Chang's model, Cam-Clay, variations, multisurface yieldening models, kinematic strengening models Ideal plasticity and limit analysis Practical problems
Student obligations	Lecture course attendance Seminare course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Atkinson, J.H., Bransby, P.L.: The Mechanics of Soil - An Introduction to Critical State Soil Mechanics, McGraw-Hill Book Company (UK) Limited, London, 1978, p. 376. 2. ISSMFE: Constitutive Laws of Soils, Report of ISSMFE Subcommittee on Constitutive Laws of Soils and Proceedings of Discussion Session 1A, ed.: S. Murayama, XI International Conference on Soil Mechanics and Fundation Engineering, San Francisco, Japanese Society od Soil Mechanics and Fundation Engineering, Tokyo, 1985, p. 175. **Recommended:** 1. Schofield, A.N., Worth, C.P.: Critical State Soil Mechanics, McGraw-Hill Book Company, London, 1968, p. 310. 2. Desai, C. S., Siriwardane, H.J.,: Constitutive Laws for Engineering Materials with Emphasis on Geologic Materials, Prentice-Hall, In., Englewood Cliffs, New Jersey, 1984, p. 468.

Course:	**FOUNDATION ENGINEERING**

Course code: G-202	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	The student is expected to acquire a basic knowledge of foundation structures. The main objective of this course is to educate future engineers in foundation of analysis and develop competences in the design of diferent types of foundations as well as to prepare studenst for other applied courses.
Syllabus	Shallow foundations, bearing capacity Shallow foundatons, rigid structures Shallow foundations, elastic foundations Deep foundations, bearing capacity Deep foundations: piles and slurry walls Deep foundations, lateraly loaded piles Deep foundations: caissons, pneumatic caissons and box Complex foundation structures Dynamically loaded foundations
Student obligations	Lecture course attendance Exercise course attendance Seminar course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Nonveiller, E.: Mehanika tla i temeljenje građevina, Školska knjiga, Zagreb, p.780, 1979. 2. Bowles, J.E.: Foundation analysis and design, Mc. Graw Hill, III. Ed. Int. Student ed., New York, p 816, 1986. **Recommended:** 1. Naval Facilities Engineering Command: Foundation, Design Manual 7.01, Alexandria, VI, 1986.

Course:	**NUMERICAL MODELLING IN GEOTECHNICAL ENGINEERING**

Course code: G-205	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 15 exercises: 15 seminars: 30
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	Educated future engineers in understending of the nonlinear continuum mechanics and constitutive laws application in describe of real soil in real problem and their numerical descriptions. The student is expected to acquire a knowledge about available geotechnical software.
Syllabus	Non-linear models of soil and finite element method Numerical modelling software: avaliable software programs Input parameters Critical approach in problem simplification Critical approach in analysis of numerical results Numerical modelling of complex geotechnical structures: earth structures, anchored retaining structures, excavations etc. Rewiev of tipical geotechnical problems
Student obligations	Lecture course attendance Excercise course attendance Seminare course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Bathe, K.J.: Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, New Jersey, 1984. 2. Desai, C.S., Abel, J.F.: Introduction to The Finite Element Method, A Numerical Method for Engineering Anaylisis, Van Nostrand Reinchold Company, New York, 1972, p.477. **Recommended:** 1. Naylor, D.J., Pande, G.N., Sompson, B., Tabb, R.: Finite Elements in Geotechnical Engineering, Pineridge Press Ltd., Swansa (UK), 1981, p. 245. 2. Zienkiewicz, O.C.: The Finite Element Method, 3rd Edition, McGraw-Hill Book Company, NY, 1977.

Course:	**SOIL DYNAMICS**

Course code: G-204	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	This course introduces the student to the fundamentals of soil dynamics, including the behaviour of soils and structures under cyclic and dynamic loading. The course should enable the student to formulate, in a realistic way, the solutions to real engineering problems; either by direct analytical or numerical methods.
Syllabus	Fundamentals of vibration Waves in elastic medium Properties of dynamically loaded soils Foundtion and ground vibration Earthquake vibration Compressibillty of solis under dynamic loads Liquefaction of soil
Student obligations	course attendance, accepted project work
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Das, B. M. (1992) Principles of Soil Dynamics. PWS-KENT 2. Gazetas,G. (1983) Analysis of ,machine Foundation Vibrations:State of art,soil Dynamics and Eartiquake Engineering.CML Publications,Vol.2.1.:2-42. **Recommended:** 1. Ishihara, K., (1996): Soil Behaviour in Earthquake Geotechnics. Clarendon Press - Oxford University Press 2. Novak,M. (1987) State of the art in analysis and Design Of Machine Foundations,Soil structure interaction.Elsevier Science Publications :171-192,

Course:	**GEOTECHNICAL STRUCTURES**

Course code: G-209	**Pre-requisites:** Foundation	**Hours of Active Classes:** 60 lectures: 30 exercises: 10 seminars: 20
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	The student is expected to acquire a basis knowledge of reinforcing of soil and rocks. The main objective of this course is to educate future engineers in basic analysis and develop competences in designs and constructions of diferent types of soil and rocks reinforcing.
Syllabus	Design conditions and design method Selection of geotechnical parameters Modelling of geotechnical problems Selection of geotechnical structure Methods of numerical modelling Critical approach to analysis of numerical results Content of geotechnical design Active design approach Executing of geotechnical works Geotechnical supervising Accepting of geotechnical monitoring
Student obligations	Lecture course attendance Excercise course attendance Seminare course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Koerner, R.M.: Construction and Geotechnical Methods in Foundation Engineering, McGraw -Hill Book Company, NY, 1984, p. 496. 2. Bowles, J.E.: Foundation analysis and design, Mc. Graw Hill, III. Ed. Int. Student ed., New York, p 816, 1986. 3. Kovari, K.: Methods of Monitoring Landslides, 5th. Int. Symp. on Landslides, Lausanne, Special print, 1988, pp.1-14.. **Recommended:** 1. Stillborg, B.: Professional Users Handbook for Rock Bolting, Trans Tech Publications, Series on Rock and Soil Mechanics, Vol. 18, 2nd Edn., Clausthal-Zellerfeld, 1994, p164. 2. Windsor, C.R., Thompson, A.G.: Terminology in Rock Reinforced Practice, Proc. 2nd North American Rock Mechanics Conference NARMS'96 – Tools and Techniques, Montreal, Eds. M. Aubertin, F. Hassani and H. Mitri, V1, Rotterdam: A. A. Balkema, 1996, pp. 225 – 232. 3. Hoek, E., Bray, J.W.: Rock Slope Engineering, 2nd. Edn., The Institute of Mining and Metallurgy, London, 527 p., 1977..

Course:	**UNDERGROUND STRUCTURES AND TUNNELS**

Course code: G-210	**Pre-requisites:** Engineering Rock Mechanics	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	Students should be able to understand and explain the techniques and principles of geotechnical design, monitoring, excavation and ground stabilization as well as select methods appropriate for specific ground conditions and types of underground project.
Syllabus	Classification of rock masses Stress around the underground excavations Underground excavation failure mechanisms Analysis of structurally controlled instability Support designe for overstressed rock (convergence-confinement method) Stabilization techniques: rockbolts and cables, shotccrete support Tunnel boring machines Blasting in underground excavation Ventilation of the tunnel Drainage and tunnel sealing system Uses of underground space Disposal of radioactive & other wastes (overview) Instrumentation during tunneling
Student obligations	Attendance to lectures and exercises (on faculty and on site). Preparing and delivering a program from exercises.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Vrkljan, I.,: 2001., Inženjerska mehanika stijena (digitalna verzija skripti). Građevinski fakultet u Rijeci 2. Hoek, E.: Rock Engineering, A Course Notes, http://www.rocscience.com 3. Hoek, E., Kaiser, P.K., Bawden, W.F., 1995., Support of Underground Excavations in Hard Rock, Balkeme, 215 p. **Recommended:** 1. Hudson, J.A., (editor-in-chief), 1993., Comprehensive Rock Engineering, Volume 1,2,3,4 i 5

Course:	**SLOPE STABILITY**

Course code: G-211	**Pre-requisites:** Theoretical Soil Mechanics	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	The student is expected to acquire a basic knowledge of soil and rocks slope stability. Abbility to identify, formulate and solve engineering problems, accept competences for adecvate approach to analyse and learn expiriences in field of slope stability problems. The student is expected to acquire a knowledge of the methods of slope stability analysis.
Syllabus	Principles and definitions Landslide types and processes Investigation works Measurings and obseravations Strength of soil and rock mass Soil slope stability analysis Rock slope stability analysis Stabilization of soil slopes Stabilization of rock slopes Earth structures Applied software for stability analysis Special cases and meterials
Student obligations	Lecture course attendance Excercise course attendance Seminare course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Nonveiller, E.: Kliženje i stabilizacija padina, Školska knjiga, Zagreb, 1987. 2. Hoek, E., Bray, J.W.: Rock Slope Engineering, 2nd. Edn., The Institute of Mining and Metallurgy, London, 527 p., 1977. **Recommended:** 1. Turner, A.K., Schuster, R.L.: Landslides, Investigation and Mitigation, Special report 247, Transportation Research Board, National Research Council, National Academy Press, p. 675, 1996. 2. Nonveiller, E.: Mehanika tla i temeljenje građevina, Školska knjiga, Zagreb, 1979. 3. Erismann, T.H. and Abele, G. (2001): Dyamics of Rockslides and Rockfalls. Springer-Vrelag, Berlin-Heidelberg -New York.

Course:	**ENVIRONMENTAL PROTECTION**

Course code: G-200	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 15 exercises: 0 seminars: 30
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	Preparing students for basic understanding of global ecosystem, importance of biological diversity and biogeochemical cycles, basic principles of environmental protection and possible negative impact of constuction works. Students will be prepared for supplementary courses: Geohazards, Traffic and environment and Waste menagement.
Syllabus	Basic principles of environmental protection, Biological diversity and biogeochemical cycles Global ecosystem: interaction of geosphere, hydrosphere, atomosphere, biosphere. Human activity and environmental change Climatic changes Air pollution and Pollution of surface water and groundwater Pollution of seas and oceans Pollution of soil Construction works and environmental protection Nature protection in Republic of Croatia Environmental protection in Republic of Croatia Planning for sustainable future
Student obligations	Course attendance One seminar during term of course
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Benac, Č. ZAŠTITA OKOLIŠA ZA STUDENTE GRADITELJSTVA. Građevinski fakultet Sveučilišta u Rijeci, 2004. www.gradri.hr 2. Glavač, V., UVOD U GLOBALNU EKOLOGIJU. Hrvatska sveučilišna naknada, Ministarstvo zaštite okoliša i prostornog uređenja, Pučko otvoreno učilište-Zagreb. Zagreb, 2001. **Recommended:** 1. Springer, P.O., ed., EKOLOŠKI LEKSIKON. Ministarstvo zaštite okoliša i prostornog uređenja, Barbat, Zagreb. Zagreb, 2001. 2. Botkin, D.B.and Keller, E.A. ENVIRONMENTAL SCIENCE, John Wiley and Sons (4. ed.), 2003 3. Prohić, E., GEOKEMIJA. Targa Zagreb, Zagreb, 1998. 4. Črnjar, M.,: EKONOMIKA I POLITIKA ZAŠTITE OKOLIŠA. Ekonomski fakultet Sveučilišta u Rijeci, Glosa Rijeka. Rijeka, 2002.

Course:	**SEEPAGE AND CONSOLIDATION OF SOIL**

Course code: G-207	**Pre-requisites:** Theoretical Soil Mechanics	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 4

Course objectives	This course is concerned with the flow of water in incompressible and compressible soil strata. The course should enable the student to formulate, in a realistic way, the solutions to real engineering problems; either by direct analytical or numerical methods.
Syllabus	Water in soils: capillarity, shrinkage, swelling, frost action Effective stresses in soil Water flow through soil: permeability, flow nets, seepage force, critical hydraulic gradient Measurements of permeability Control of seepage and filters Consolidation process Oedometer testing Preconsolidation pressure Time rate of consolidation Consolidation settlement calculations
Student obligations	course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Harr, M. E. (1991) Groundwater and Seepage. Dover Publications 2. Holtz, R.D. & Kovacs, W.D. (1981) An Introduction to Geotechnical Engineering. Prentice Hall 3. Nonveiller, E.: Mehanika tla i temeljenje građevina, Školska knjiga, Zagreb, p.780, 1979. **Recommended:** 1. Azizi, F. (1999) Applied Analyses in Geotechnics. Brunner-Routledge 2. Šuklje, L. (1969) Reological aspects of soil mechanics, London

Course:	**TESTING AND MONITORING IN GEOTECHNICAL ENGINEERING**

Course code: G-208	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 4

Course objectives	Introducing the laboratory and in-situ testing methods of soil and rock in geotechnical practice. Describing the role of geotechnical instrumentation during the construction and operation phases of civil engineering projects, including embankments, dams, excavated and natural slopes, underground excavations, driving piles, and drilled shafts.
Syllabus	Laboratory and in situ testing of soils, rock and rock masses Application of geophysical methods to the solution of geotechnical, geo-environmental and earthquake engineering problems Planing monitoring programs Monitoring methods and recommends instruments (monitoring groundwater pressure, deformations, total stress in soil, stress change in rock, temperature, stress and strain in structural members) Introducing the Eurocode 7 (ENV 1997-1:1994) General guidelines on the execution of monitoring programs Examples of instrumentation
Student obligations	Attendance to lectures and exercises (on faculty and on site). Preparing and delivering a program from exercises.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Vrkljan, I., 2001., Inženjerska mehanika stijena (digitalna verzija skripti). Građevinski fakultet u Rijeci 2. Dunnicliff, J., 1993., Geotechnical instrumentation for monitoring field performance, John Wiley and Sons, Inc, 577 p. 3. Hudson, J.A. and Harrison J.P., 2000., Engineering Rock Mechanics, An introduction to the principles, Pergamon, 444 p. **Recommended:** 1. Harrison, J.P., Hudson, J.P., 2000., Engineering Rock Mechanics, Illustrative Worked Exsamples, Pergamon, 506 p. 2. Hudson, J.A., (editor-in-chief), 1993., Comprehensive Rock Engineering, Volume 1,2,3,4 i 5

Course:	**REINFORCING SOIL AND ROCKS**

Course code: G-214	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 4

Course objectives	The student is expected to acquire a basis knowledge of reinforcing of soil and rocks. The main objective of this course is to educate future engineers in basic analysis and develop competences in designs and constructions of diferent types of soil and rocks reinforcing.
Syllabus	Design conditions and method selection Consolidation of soil, preparatory loading and drainage Deep compaction (vibroflotation, dynamic compaction) Reinforced embankments and geosynthetics Grouting of soil and rocks Reinforced soil and rocks (anchors and bolts) Stability and stress-strain analysis Design of reinforcing of soil and rocks Probe fields Technical conditions and regulations
Student obligations	Lecture course attendance Excercise course attendance Seminare course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Nonveiller, E.: Injiciranje tla, Školska knjiga, Zagreb, 1989, p. 274. 2. Koerner, R.M.: Construction and Geotechnical Methods in Foundation Engineering, McGraw -Hill Book Company, NY, 1984, p. 496.. **Recommended:** 1. Hobst, L., Zajic, L.: Anchoring in Rock, Developments in Geotechnical Engineering, Vol. 13, Amsterdam: Elsevier Scientific Publishing Co., 1977, p. 390. 2. Stillborg, B.: Professional Users Handbook for Rock Bolting, Trans Tech Publications, Series on Rock and Soil Mechanics, Vol. 18, 2nd Edn., Clausthal-Zellerfeld, 1994, p164. 3. Windsor, C.R., Thompson, A.G.: Terminology in Rock Reinforced Practice, Proc. 2nd North American Rock Mechanics Conference NARMS'96 – Tools and Techniques, Montreal, Eds. M. Aubertin, F. Hassani and H. Mitri, V1, Rotterdam: A. A. Balkema, 1996, pp. 225 – 232..

Course:	**GEOHAZARDS**

Course code: G-212	**Pre-requisites:** Environmental Protection	**Hours of Active Classes:** 45 lectures: 15 exercises: 10 seminars: 20
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 4

Course objectives	Basic understanding a connection between endodynamics and exodynamics of the Earth and geohazard phenomena, Assessment, mitigation and avoidance of geohazard, and also the influences of land-use planning and constructions works for the changing of hazard and risk level. Students will bo prepared for supplementary courses in geotechnics and hydrotehnics.
Syllabus	Introduction: hazard and risk Huge natural disaster Volcanic and seismic activity River erosion, accumulation and floods Marine erosion and accumulation Soil erosion and mass movements Drought and fires Hazard mapping and monitoring Assessment, mitigation and avoidance of geohazard Land-use planning and geohazard Construction and geohazard
Student obligations	Course attendance One seminar during term of course
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Bell, G.F. GEOLOGICAL HAZARD. Their Assessment, avoidance and mitigation. Spon Press, London-New York, 2003. 2. Bell, G.F. ENVIRONMENTAL GEOLOGY, Principles and Practice. Blackwell Science, Cambridge, 1998. **Recommended:** 1. Botkin, D.B.and Keller, E.A. ENVIRONMENTAL SCIENCE, John Wiley and Sons (4. ed.), 2003. 2. Bell, G.F. ENGINEERING GEOLOGY. Blackwell, 1995. 3. van Westen, C.J., Application of geographic information systems to landslide hazard zonation. Vol. 1: Theory.- ITC Publication No. 15, Enschede, 1993.

Course:	**GEOTECHNICAL ENGINEERING IN ROAD STRUCTURES**

Course code: G-213	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 25 exercises: 5 seminars: 15
Course status: optional	**The course consists of:** lectures excercises seminars	**ECTS:** 4

Course objectives	The student is expected to acquire a basis knowledge of geotechnical problems in road structures. The main objective of this course is to educate future engineers in basic geotechnical problems during road construction and expected to acquire a knowledge of the methods and processes in this field of civil engineering.
Syllabus	Geotechnical investigations for road structures Classifications of soils and rocks in road constructions Soil compaction Earth structures Retaining constructions Slope stability Erosion protections Earth structures Drainage constructions Geotechnical aspect of pavaments constructions Geotechnical aspect in tunneling
Student obligations	Lecture course attendance Seminare course attendance
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Nonveiller, E.: Mehanika tla i temeljenje građevina, Školska knjiga, Zagreb, p.780, 1979. 2. Opći tehnički uvjeti za radove na cestama, Institut građevinarstva Hrvatske, Zagreb, 2001. **Recommended:** 1. Rodrigez, A.Rico, Del Castillo, H., Sowers, G.F.: Soil Mechanics in Highway Engineering, Trans Tech publications, Clausthal Zellerfeld, p.843, 1988. 2. Nonveiller, E.: Kliženje i stabilizacija padina, Školska knjiga, Zagreb, p.204, 1987. 3. Hoek, E., Bray, J.W.: Rock Slope Engineering, 2nd. Edn., The Institute of Mining and Metallurgy, London, 527 p., 1977. 4. Hoek, E.: Rock Engineering, A Course Notes, http://www.rocscience.com, p. 313, 2000.

Course:	**WATER SUPPLY AND DRINKING WATER TREATMENT**

Course code: H-251	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	- To provide that students during the course acquire the knowledge needed for solving complex engineering problems in the field of water supply and drinking water treatment. - To develop students ability for independent realization of complex tasks in the field of water supply and drinking water treatment.
Syllabus	Introduction: significance of water and problems of water supply. Water sources in nature. Protection areas. Water quality indicators. Water consumers, quality and quantity requirements. Catchment structures. Water supply systems: function and design. Water reservoirs and tanks: function, volume calculation, design and construction. Pumping stations: function, power calculation and pump choice. Water supply pipes, fittings and valves. Pipelines: hydraulic calculations and construction. Hydrostatic pressure testing. Distribution network: allowed pressures, supply zones, dimensioning, construction. Connections to building plumbing. Plumbing in buildings as a final part of water supply systems. Water supply in states of emergency. Drinking water treatments. Disinfection. Desalinization.
Student obligations	- Course attendance in accordance to University/Faculty regulations. - Completed and accepted project work before the end of the term.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Gulić, I.: Opskrba vodom, HSGI, Zagreb, 2000. 2. Gulić, I: Kondicioniranje vode, HSGI, Zagreb, 2003. **Recommended:** 1. Vuković, Ž.: Osnove hidrotehnike (prvi dio, druga knjiga), Akvamarine, Zagreb, 1996. 2. Margeta, J.: Opskrba vodom I dio, Građevinski fakultet u Splitu, Split, 1985. 3. Steel, E. W., Mc Ghee T. J.: Water Supply and Sewerage, Mc Graw Hill Book Company, London, 1988.

Course:	**DRAINAGE AND WASTEWATER TREATMENT**

Course code: H-252	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	- To provide that students during the course acquire the knowledge needed for solving complex engineering problems in the field of drainage and sewage systems and wastewater treatment. - To develop students ability for independent realization of complex tasks in the field of drainage and sewage systems and wastewater treatments.
Syllabus	Problems and fundamental principles of wastewater and rainwater drainage. Types and characteristics of wastewaters. Types of drainage and sewerage systems. Recipient's characteristics and conservation of water resources. Schemes of drainage/sewage systems. Calculations of relevant wastewater and rainwater quantities. Designing drainage/sewage systems. Limitations in designing. Dimensioning drainage/sewage networks. Structures of drainage/sewage systems: relieving structures, pumping stations, retentions etc. Construction of sewage systems. Testing water tightness of sewers. Wastewater disposal structures: types, dimensioning, calculation and construction. Drainage/sewage systems maintenance and management. Wastewater treatment plants. Treatment processes (mechanical, biological and physical-chemical processes). Sludge treatment.
Student obligations	- Course attendance in accordance to University/Faculty regulations. - Completed and accepted project work before the end of the term.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Margeta, J.: Kanalizacija naselja; Građevinski fakultet u Splitu, Građevinski fakultet u Osijeku i Institut građevinarstva Hrvatske, Split i Osijek, 1998. 2. Tedeschi, S.: Zaštita voda, HDGI, Zagreb, 1997. **Recommended:** 1. Vuković, Ž.: Osnove hidrotehnike (prvi dio, druga knjiga), Akvamarine, Zagreb, 1996. 2. Steel, E. W., Mc Ghee T. J.: Water Supply and Sewerage, Mc Graw Hill Book Company, London, 1988.

Course:	**HYDRAULIC STRUCTURES**

Course code: H-253	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	– To provide that students during the course adopt the basic knowledge of hydrology and hydraulics, water supply and sewage systems, river regulations and hydraulic land reclamations and improvements. – To present students the connections between natural water resources and hydrotehnic solutions.
Syllabus	– Definitions, goals and tasks of hydrotechnics. – Water resoursces management: water use, water conservation, flood control. Planning. Legislation. – Basics of hydrology (hydrologic cycle, hydrometeorology, characteristics of catchment areas, hydrometrics). – Basics of hydraulics (hydromechanics, pressure flow, open channel flow, flow over spillways and under gates, hydraulic jump, underground flow). – Basics of water supply systems (types of water supply systems, categories of water use, water sources and water catchment, pumping stations, water treatment, water reservoirs and tanks, water supply nets). – Basics of sewage systems (types of sewage systems, types of wastewaters, sewerage nets, structures, wastewater treatment, disposal of wastewater). – Basics of applied hydraulics (morphology of river beds, river regulations, hydraulic land reclamations and improvements, pedology, crop rotation).
Student obligations	– Course attendance in accordance to University/Faculty regulations. – Writing and presenting a paper.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Vuković, Ž.: Osnove hidrotehnike (prvi dio, prva knjiga), Akvamarine, Zagreb, 1994. 2. Vuković, Ž.: Osnove hidrotehnike (prvi dio, druga knjiga), Akvamarine, Zagreb, 1996. **Recommended:** 1. Žugaj, R.: Hidrologija, RGN fakultet, Zagreb, 2002. 2. Margeta, J.: osnove gospodarenja vodama, Građevinski fakultet u Splitu, Split, 1992.

Course:	**ENGINEERING HYDROLOGY**

Course code: H-257	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	- To provide that students during the course adopt basic knowledges and concepts of discharge processes and models - To present students the insights to stochastic and time series - Enabling students for independent performing of basic regional hydrologic analyses
Syllabus	Processes in atmosphere and hydrologic appearances. Precipitations: analysis of time-spatial distribution of precipitations, variations of short termed intensive precipitations during the time, modeling of intensive precipitations, storms for project making. Infiltration of water into the soli. Processes of interrelations between precipitations and runoffs: linear and non-linear modeling of discharge processes. Analyzes of hydrograms. Regional hydrologic analyzes. Hydrologic prognoses. Multiple function of distribution. Stochasti processes and time series. Stochastic analysis of extreme appearances. Spectral analyzes. Markow's processes. Generation of syntectic time series. Autoregression models. ARMA and ARIMA models. Multiple regression models. Regionalisation of stochastic properties of water appearances in water catchments.
Student obligations	- Attendance to lectures and exercises as defined by the faculty regulations. - Attendance to exercises with computer use in hydrologic analyzes. - Preparing and delivering of a program from exercises (application of statistic and parametric methods in hydrologic calculations)
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Hrelja, H.: Vjerovatnoća i statistika u hidrologiji, Građevinski fakultet, Sarajevo, 2000. 2. Bras, R.L.: Hydrology, Addison - Wesley Publ. Comp., Massachusetts, 1990. 3. Ward, R.C.; Robinson, M.: Principles of hydrology, McGraw-Hill book Comp., 1990. 4. Chow, V.T.; Maidment, D.R.; Mays, L.W.: Applied hydrology, McGraw-Hill, 1988. 5. Singh, V.P. (editor): Computer Models of Watershed Hydrology, Water Resource Publications, Hihglands Ranch, Colorado, 1995. 6. Salas, J.D.and all.: Applied Modeling of Hydrologic Time Serias, Water Resources Publication, Fort Collins, Colorado, 1986. **Recommended:** 1. Suhir, E.: Applied Probability for Engineers and Scientists. McGraw-Hill, New York, 1997. 2. Srebrenović, D.: Primjenjena hidrologija, Tehnička knjiga, Zagreb, 1986. 3. Bonacci, O.: Karst Hydrology, Springer Verlag, Heidelberg, 1989. 4. Bonacci, O.: Oborine - glavna ulazna veličina u hidrološki ciklus, Sveučilišni udžbenik, Geing, Split, 1994. 5. Ožanić, N.(editor).: Priručnik za hidrotehničke melioracije, III kolo, Knjiga 1, Građevinski fakultet u Rijeci, Rijeka, 2003.

Course:	**HYDRAULIC REGULATIONS AND MELIORATIONS**

Course code: H-258	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 30 exercises: 30 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	- To provide that during the course students adopt elements of engineers foreseeing, conclusion making and hydrotechnic tasks solving from the domain of regulation and melioration constructions - Enabling students for independent solving of tasks and calculations from the domain of river bed regulation and melioration
Syllabus	The purpose, problems and tasks of water flow regulations. Morphology of river bed. Suspended and drawed sediment; sediment's function. Longitudinal and transversal constructions; dams. Regulation constructions. Regulation of water regime; accumulations, retentions; outlet chanels. Flood protection; legislation; technique. Construction materials for regulations. Erosion processes; division and clasification of torrents. Basics of catchment regulation; technical and biological measures. Phases of torrents regulations and torrent's constructions. Relations plant-soil-water. Drainage systems. Detailed drainage systems. Planning of detailed systems of underground drainage. Construction of drainage systems. Irrigation. Quality and the origine of water for irrigation. Calculation of water demands for irrigation. Elements of irrigation systems. Motive power for irrigation. Methods of irrigation. Planning and designing of irrigation systems.
Student obligations	- Attendance to lectures and exercises as defined by the faculty regulations. - Preparing and delivering of a program from exercises (designing of the solution for water flow regulation and/or melioration)
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Gjurović, M.: Regulacija rijeka, Tehnička knjiga Zagreb, 1967. 2. Svetličić, E.: Otvoreni vodotoci - regulacije. Fakultet građevinskih znanosti Sveučilišta u Zagrebu, 1987. 3. Kos, Z.: Hidrotehničke melioracije tla - Navodnjavanje, Školska knjiga Zagreb, 1987. 4. Kos, Z.: Hidrotehničke melioracije tla - Odvodnjavanje, Školska knjiga Zagreb, 1989 **Recommended:** 1. Chin A.D.:2000, Water – Resources Enginnering, Prentice Hall, New Jersey.

Course:	**COASTAL STRUCTURE ENGINEERING**

Course code: H-259	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	To develop specific competences in statistical methods in coastal engineering field, determining the design conditions, geotechnical aspects of construction in coastal zone, dynamic impacts of waves on coastal and off-shore structures, structured coastal structures, properties and behaviour of building materials exposed to sea conditions.
Syllabus	Statistical methods in coastal engineering Foundations, consolidation and settlement in coastal zone Natural sediment scour and structure-induced sediment scour Dynamic impact of waves on vertical walls, piles and plates in the sea Elastic submarine sea lines (pipelines) - design and sizing calculations Structured coastal structures - design and sizing calculations Properties and behaviour of building materials exposed to sea conditions
Student obligations	course attendance, exercise/project work preparation, seminar work preparation
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. USACE Engineering manuals http://www.usace.army.mil/inet/usace-docs/eng-manuals/em.htm 2. M.B.Abbot & W.A.Price, "Coastal, Estuarial and Harbour Engineer's Reference Book", 1994 3. T.A.Karlsen, "Submarine Installation of Polyethylene Pipes", design manual, 2002 **Recommended:** 1. M.K.Ochi, "Applied Probability and Stohastic Processes", 1990 2. Braja M. Das, "Principles of Geotechnical Engineering", 1994 3. P.Y.Julien, "Erosion and Sedimentation", 1998. 4. B.M.Summer & J.Fredsoe, "The Mechanics of Scour in the Marine Environment", 2002.

Course:	**EXPERIMENTAL HYDRAULICS**

Course code: H-262	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	The main objective of this course is to educate future engineers to understend the unsteady flow in open channels, pressure piping systems (pipe networks) and ground waters, transport of contaminants in porous media and in coastal seas. Hydrodynamic processes will be described in the macroscopic sense, and some examples will be presented.
Syllabus	Introduction. Measurement equipment. Planning, optimization and construction of models. Hydraulic models. Model techniques. Hydraulic similitude and model laws. Hydraulic laboratory. Case studies. Measurement of fundamental quantities. Field measurements. Organization and measurement technic for water level, velocity, discharge, pressure, forces, temperature, concentration,... Collecting and processing of measured values. Gas or liquid flows, probes, data analysis and process guiding, multi-channel concept, AD converter, accompanying software and data presentation. Errors in measurements - data correction. Correlation problems. Analysis and application of obtained results .
Student obligations	- Attendance to lectures and exercises as defined by the faculty regulations. - Attendance to laboratory exercises. - Preparing and delivering of a program from exercises
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Kobus, H: Hydraulic Modelling, German Association for Water Resources and Land Improvement, Verlag PaulParcy, Hamburg, 1980. 2. Holman, D.: Experimental Methods for Engineers, McGraw-Hill Book company, 1987. 3. Smiljanović, G.: Računala i procesi, Školska knjiga, Zagreb, 1991. 4. Gjetvaj, G.: Eksperimentalna Hidraulika (interna skripta), 2003.. **Recommended:** Novak, P.; Cabelka, J.: Models in Hydraulic Engineering, Physical Principles and Design Applications, Pitman Advanced Publishing Program, Boston, 1981.

Course:	**WATER RESOURCES MANAGEMENT**

Course code: H-255	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	- Introducing students to the complexity and multidisciplinary of water management problematic. - Introducing students to different aspects of water manifestations in nature and in constructed system. - Develop students' skills for solving problems in the field of water resources management and planning.
Syllabus	- Basic concepts of water management: history, integral approach, sustainable development. - Water resources. Catchment area as basic unit for water resources management. - Natural water resources characteristics: surface waters and underground waters, sea, transitional waters. - Water demands. Water resources and demands balance. - Water resources use, conserving water resources and flood protection. - Types and characteristics of water management structures. Reservoirs as the most complex multipurpose structures. Man influence in changing water regime. - Water's role in socio-economic systems. Ecological components of hydrotehnical solutions. - Water resources management: basics, goals and objectives, criteria and measures, methodology of generating alternative water management solutions and decision making. - Use of simulation and optimization methods in decision making. Information support. - Water resources management modelling. - Legislative regulations. Water management plans.
Student obligations	- Course attendance in accordance to University/Faculty regulations. - Writing and presenting a paper.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Margeta, J.: Osnove gospodarenja vodama. GF Split, 1992. 2. Margeta, J.: Integralni pristup gospodarenju vodama. U: Građevni godišnjak '99 , HDGI, Zagreb, 1999. 3. Gereš,D., Filipović, M.: Program vodnogospodarskog planiranja u Hrvatskoj. U: Građevni godišnjak 2000 , HDGI, Zagreb, 2000. 4. Margeta, J.; Azzopardi, E.; Iacovides, I.: Smjernice za integračni pristuo razvoju, gospodarenju i korištenju vodnih resursa, PPA, Split, 1999. 5. Bonacci, O.: Ekohidrologija vodnih resursa i otvorenih vodi otvorenih vodotoka, GAF u Splitu, IGH, 2003.. **Recommended:** 1. Gereš, D.: Modeliranje upravljanja vodnim resursima na slivnom području. U:Građevinski godišnjak '01/'02, HDGI, Zagreb, 2002. 2. Đorđević, B.: Vodoprivredni sistemi. Naučna knjiga - GF Beograd, 1990. 3. Hrelja, H.: Vodoprivredni sistemi. Svjetlost , Sarajevo, 1995. 4. Grigg, N.S.: Water Resources Management: Principles, Regulations and Cases. McGraw-Hill, New York, 1996. 5. Mays, L.W.(ed.): Water Resources Handbook. McGraw-Hill, New York, 1996. 6. Biswas, A.K.: Water Resources: Environmental Planning, Management and Development,, McGraw-Hill Book Comp.Inc., New York, 1997.

Course:	**KARST HYDROSYSTEMS**

Course code: H-256	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	- Providing basic knowledges regarding karst surroundings and patterns of the appearance and movements of water in them. Development of capabilities for the recognition of paricularities of water managemental characteristics in karst - Enabling students for independent solving of basic tasks from the domain of planning and utilising of water from karst
Syllabus	- Geological basis of karst. Basic principles of water movement in karst. Karst hydrology. - Cavities in karst rocks. Hydraulic conduction. Karst aquifers. - Water springs in karst. Curves of springs runoffs. Analysis of components of runoff hydrograms. - Principles of salinization of coastal karst springs and aquifers. - Water channels and fields in karst. Balance of karst fields. Analysis of sinking and capacities of sinking zones. - Dynamics of underground waters in karst aquifers. Analyzes of water level fluctuations. - Water temperatures in karst. Sediment drawing in karst aquifers and the influence on the water quality. Hydrological models of karst aquifers. Human influence on the water regime in karst. - Specificities of water use in karst. Water capture from karst springs and aquifers. - Water bed regulations in karst. Accumulations in karst. - Water protection in karst. Hydrological elements of determination of zones of sanitary protection in karst. Karst water management
Student obligations	- Attendance to lectures and exercises as defined by the faculty regulations. - Attendance to the field courses. - Preparing and delivering of a paper from seminars
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Bonacci, O.: Karst hydrology, Springer Verlag, 1987. 2. Bonacci, O., Roje-Bonacci,T: Posebnosti krških vodonosnika, Građevinski godišnjak 03-04, Hrvatski savez Građevinskih inžinjera, Zagreb, 2004. 3. Breznik, M.: Storage reservoirs and deep wells in karst regions. Balkema, Rotterdam - Brookfild, 1998. **Recommended:** 1. Petrič, M.: Characteristic of recharge-discarge relations in karst aquifer, Slovene academy of scieneces and arts, Karst research institute, Postojna – Ljubljana, 2002. 2. Trček, B.: Epikarst Zone and the Karst Aquifer Behaviour, Geološki zavod Slovenije, Ljubljana, 2003. 3. Bogli, A.: Karst Hydrology and Physical Speleology, Springer Verlag, Berlin, 1980. 4. Milanović, P.: Karst Hydrology, WRP, Littletoon, 1981. 5. Dreydroat, W.: Processes in Karst Systems, Springer Verlag, Berlin, 1988.

Course:	**WASTE MENAGEMENT**

Course code: H-263	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 10 seminars: 5
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 4

Course objectives	Introdicing students to basic knowledge and understanding of the problems of waste in modern society, problems of waste menagement, methods of reduce, reuse and recycle of waste, problems of land and water conmtaminations by waste, understanding engineering problems in design and construction of sanitary lanfills
Syllabus	Modern civilization and waste problems Types of waste Domestic waste Hazardous waste Radiactive waste Problems of land and water contaminations Integrated waste menagement (reduce, reuse and recycle) Design and construction of sanitary landfills Monitoring of leachate and gas Legislative regulations
Student obligations	Course attendance One seminar during term of course
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Milinović, Z. Deponij. ZGO-ZAGREB, Zagreb, 1992. 2. Maregeta, J. Kruti otpad, Građevinski fakultet Split, 1988. 3. Wilson, D.G. Handbook of Solid Waste Menagemet. Van Nostrand, New York, 1977. **Recommended:** 1. Botkin, D.B.and Keller, E.A. ENVIRONMENTAL SCIENCE, John Wiley and Sons (4. ed.), 2003.

Course:	**HYDRAULIC MODELLING**

Course code: H-260	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	- To provide that during the course students adopt elements of engineers foreseeing, conclusion making and tasks solving from the domain of hydrotechnical modeling - Enabling students for independent realisation of tasks from the domain of hydrotechnical modeling
Syllabus	Movements equations. Dominant forces. Stacionary and non-stacionary processes. Border layer. Models of border layer description. Methods of fluid movement modeling. The significance for hydrotechnical objects planning. Types and choice of the model. Physical models. Simmilarity law. Limitations and advantages. Stability and reliability of models. Hybrid models. Remote and close field of modeling. Other types of modeling. Biphasic models. Liquid phases. Mixed phases. Substance carrying through. Correlation analysis model-nature.
Student obligations	- Attendance to lectures and exercises as defined by the faculty regulations. - Attendance to laboratory exercises. - Preparing and delivering of a program from exercises.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Kobus, H.: Hydraulic Modelling, German Association for Water Resources and Land Improvement, Verlag PaulParcy, Hamburg, 1980. 2. Novak, P.; Cabelka, J.: Models in Hydraulic Engineering, Physical Principles and Design Applications, Pitman Advanced Publishing Program, Boston, 1981. **Recommended:** 1. Jović, V.: Uvod u modeliranje hidrauličkih procesa, Aquarius, Split, 1983.

Course:	**WATER POWER DEVELOPMENT**

Course code: H-261	**Pre-requisites:** Hydraulic Structures	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	- To introduce students to the basic principles of water power use, hydropower plants and equipment, and the environmental impact of this structures. - To develop student's problem solving skills in the area of water power development and use.
Syllabus	Water energy and power. Basic principles in water power development. Power and energy needs, water power role. Types of hydroelectric plants. Field research from the water power use view. Hydroenergetic calculations and analysis of water flows. Power and energy calculations with changing heads and flows. Economic characteristics of hydropower plants. Environmental impact. Low, middle and high head power plants. Structures by hydropower plants. Water turbines: basic characteristics and application area. Other equipment of hydropower plants: generators, transformations, electrical equipment. Management and maintenance of hydropower plants. Examples of existing hydropower plants. Small hydropower plants. Using tides and vaves energy.
Student obligations	- Course attendance in accordance to University/Faculty regulations. - Completed and accepted project work before the end of the term.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Stojić, P.: Hidroenergetika, Građevinski fakultet u Splitu, Split, 1995. 2. Đorđević, B.: Korišćenje vodnih snaga - Osnove hidroenergetskog korišćenja voda, Građevinski fakultet u Beogradu, Beograd, 1981. 3. Đorđević, B.: Korišćenje vodnih snaga – Objekti hidroelektrana; Naučna knjiga i Građevinski fakultet u Beogradu, Beograd, 1989. 4. Žugaj, M.: Posebne analize u hidrotehnici, Građevinski institut, Zagreb, 1981. **Recommended:** 1. Mosony, E.: Water Power Development, Vol. I-II, Budapest, Akademiai Kiado, 1987; Third Ed. 2. Civil Engineering Guidelines for Planning and Designing Hydroelectric Developments; Vol 1-3; New York, American Society of Civil Engineers, 1989.

Course:	**INVERSE MODELLING IN STRUCTURAL EVALUATION**

Course code: MK-302	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 6

Course objectives	Enabling student to independently solve practical engineering problems from the field of the course.
Syllabus	Introduction. Fundamentals of inverse problems with examples. Inverse systems in matrix form. Inversion by singular value decomposition. Solution by optimization.
Student obligations	Two assignments to be done with software by prof. I.Kožar and programs MathCAD and MATLAB.
Exam	Two assignments to be done with software by prof. I.Kožar and programs MathCAD and MATLAB.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Liu, G.R., Han, X.: Computational Inverse Techniques in Nondestructive Evaluation, CRC Press, 2003. **Recommended:** 1. Kožar, Ivica: Kompjuterski programi, Građevni godišnjak 1997, str.565-574. 2. MathCAD 2001 user manual. 3. MATLAB and SYMULINK user manual.

Course	**OPERATIONS RESEARCH AND LINEAR PROGRAMMING**

Course code: MK-303	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 30 exercises: 0 seminars: 30
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 6

Course objectives	The main goal of the course is to help students in making decisions through linear **and nonlinear programming.**
Syllabus	Linear programming. The Simplex Method. Duality and sensitivity. Integer Programming. The transportation algorithm. Inventory models. Forecasting. Nonlinear programming. Multivariable otimization with and without constraints. Network Analysis. Dynamic programming. Decision theory. Markovian processes.
Student obligation	Students are obliged to attend lessons.
Exam	Exam exists in seminar form.
Assessment	70% during semester, 30%final exam.
Literature	Essential: 1. Martić, Lj.; Matematičke metode za ekonomske analize, NN, Zagreb, 1972. 2. Schaum's Outline of operations Research: Bronson, R., Naadimuthu, G.; The McGraw-Hill Companis, 1997. **Recommended:** 1. Martić, Lj.: Nelinearno programiranje, Informator, Zagreb, 1973.

Course:	**STRUCTURAL MODELLING**

Course code: MK-308	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 6

Course objectives	Enabling student to independently solve practical engineering problems from the field of the course.
Syllabus	Introduction. Modelling with bar elements, modeling of walls, plates and shells, modeling of dynamical loadings, stability analysis, soil-structure interaction, modeling of prestressing, building phases and special loadings, structural details and stress concentration.
Student obligations	Three assignments to be done with software by prof. I.Kožar and program MathCAD.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Cook, R.D., Malkus, D.S., Plesha, M.E., Witt, R.J., Concepts and Applications of Finite Element Analysis, Wiley, 2002. 2. Kožar, Ivica: Kompjuterski programi, Građevni godišnjak 1997, str.565-574. 3. Ghali, A. and Neville, A.M.: Structural Analysis - A Unified Classical and Matrix Approach, Chapman and Hall, London, 1979. 4. MathCAD 2001 user manual. **Recommended:** 1. Zienkiewitz, O.C., Taylor, R.L.: The Finite Element Method Vol. I i II, McGraw-Hill 1989. i 1991. 2. Toniolo, G.: Analisi Numerica, Heopli, Milano, 1981.

Course:	**FINITE ELEMENT METHOD**

Course code: MK-309	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 6

Course objectives	Enabling student to independently solve practical engineering problems from the field of the course.
Syllabus	Introduction. Finite elements based on displacement theory, bar finite elements, triangle finite elements, quadrilateral and isoparametric finite elements, finite elements for axisymmetric problems, for plates and shells. Finite elements in dynamic analysis, in partial differential equations and equations of fluid dynamics.
Student obligations	Three assignments to be done with software by prof. I.Kožar and program MathCAD.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Cook, R.D., Malkus, D.S., Plesha, M.E., Witt, R.J., Concepts and Applications of Finite Element Analysis, Wiley, 2002. 2. Chapra, S.C., Canale, R.P.: Numerical Methods for Engineers, McGraw Hill, 1988. 3. MathCAD 2001 user manual. 4. Kožar, Ivica: Neke subroutine od značaja za inženjerske programe, s listingom programa, FRaK, No.9, 1984., str.6-10. **Recommended:** 1. Zienkiewitz, O.C., Taylor, R.L.: The Finite Element Method Vol. I i II, McGraw-Hill 1989. i 1991. 2. Toniolo, G.: Analisi Numerica, Heopli, Milano, 1981.

Course:	**NUMERICAL MODELLING IN MATERIALS ENGINEERING**

Course code: MK-310	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	Familiarize the student with numerical simulation in materials engineering using traditional numerical methods (finite differences and finite elements) and stochastic method (cellular automata).
Syllabus	Continuous Media. Finite Difference Method. Finite Elements Method. Elements of Numerical Algorithms. Inverse Methods. Cellular Automata Method. Cellular Automata and Differential Equations Creating Virtual Microstructure of Portland Cement and Concrete. Prediction of Mechanics and Transport Properties by Virtual Microstructure.
Student obligations	Participation in all lectures and exercises. Submit and give presentation of the project work.
Exam	Final presentation of the project work.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Rappaz M, Bellet M, Deville M: Numerical Modeling in Materials Science and Engineering, Springer, 2002. **Recommended:** 1. Raabe D: Computational Materials: The Simulation of Materials Microstructures and Properties, John Wiley & Sons Inc 1998. 2. Margolus N, Toffoli T: Cellular Automata Machines. A new environmet for modeling, MIT Press, 1987. 3. http://ciks.cbt.nist.gov/monograf/ 4. http://www.stephenwolfram.com/publication/articles/

Course:	**COMPUTER AIDED DESIGN**

Course code: MK-306	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	Enabling student to independently solve practical engineering problems from the field of the course.
Syllabus	Introduction. Application of software in civil engineering with examples. Drawing in CAD programs using programming. GIS.
Student obligations	Three assignments to be done with software by prof. I.Kožar and programs MathCAD and DesignCAD.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Kožar, Ivica: Kompjuterski programi, Građevni godišnjak 1997, str.565-574. 2. MathCAD 2001 user manual. 3. DesignCAD 3000 user manual. **Recommended:** 1. Kožar, Ivica: Slobodno oslonjena ploča, s listingom programa, FRaK, No.5, 1983., str.37-41. 2. Kožar, Ivica: Greda na elastičnoj podlozi, s listingom programa, FRaK, No.6, 1983., str.33-39. 3. Kožar, Ivica: Neke subroutine od značaja za inženjerske programe, s listingom programa, FRaK, No.9, 1984., str.6-10. 4. Kožar, Ivica: Dinamička analiza konstruikcija, s listingom programa, FRaK, No.14, 1985., str.4-9. 5. Kožar, Ivica: Kompleksno opterećeni štapovi, s listingom programa, FRaK, No.18/19, 1987., str.52-61. 6. Smith, A., Hinton, E., Lewis, R.W.: Civil Engineering Systems Analysis and Design", John Wiley & Sons, 1983

Course:	**COMPUTER MODELLING OF GEOMETRIC SURFACES**

Course code: MK-313	**Pre-requisites:**			**Hours of Active Classes:** 60 lectures: 30 exercises:0 seminars:30
Course status: optional	**The course consists of:** lectures	-	seminars	**ECTS:** 4

Course objectives	Students will learn higher order surfaces, their properties and possibilities for their constructive elaboration, using CAD. Students will creatively apply surfaces in buildings.
Syllabus	Modelling techniques and transformation. Bezier's and spline curves. Modelling of general and ruled quadrics. Modelling of 3rd and 4th degree surfaces. Constructive processing of surfaces using CAD. Helical surfaces with the application. Conoid higher order with the application. Realistic modelling techniques, animations, light, materials.
Student obligations	- course attendance - accepted project work before the end of the term - seminars .
Exam	- written exam, - oral exam
Assessment	70% during semester, 30% final exam.
Literature	**Essential:** 1. Babić; Gorjanc; Sliepčević; Szirovicza: Konstruktivna geometrija, IGH, Zagreb, 2004. 2. Pletenac, Lidija: Geometrijsko modeliranje u CAD-u, repetitorij. 3. Priručnik za software DesignCAD (na računalu u "help"-u) **Recommended:** 1. Niče, dr. Vilko: Deskriptivna geometrija I i II, Školska knjiga, Zagreb, 1992. 2. Stanko Turk: Računalna grafika. Osnovi teorije i primjene, Školska knjiga, Zagreb, 1987. 3. John Vince: 3-D computer animation, Addison –Wesley Publishing Company, New York 1994 4. Alan Watt, Mark Watt: Advanced Animation and Rendering Techniques, Addison –Wesley Publishing Company, New York 1996. 5. Alan Watt, 3D Computer Graphics, Addison –Wesley , Workingham, 1993. 6. Časopisi i zbornici

Course:	**BUILDING PHYSICS**

Course code: MK-312	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 20 exercises: 0 seminars: 10
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 2

Course objectives	Enabling student to independently solve practical engineering problems from the field of the course.
Syllabus	Introduction. Modelling of fundamental equations in difusion and heat transfer. Modelling of Helmholz wave equation. Computer programs for Assessment of heat and sound resistance in buildings.
Student obligations	Two assignments to be done with software by prof. I.Kožar and program MathCAD.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Kožar, Ivica: Kompjuterski programi, Građevni godišnjak 1997, str.565-574. 2. Chapra, S.C., Canale, R.P.: Numerical Methods for Engineers, McGraw Hill, 1988. 3. MathCAD 2001 user manual. **Recommended:** 1. Gertis, K., Mehra, S-R., Veres, E., Kießl, K.: Bauphysikalische Aufgabensammlung mit Lösungen, Teubner, Stuttgart, 1996. 2. Ožbolt, J., Kožar, I., Eligehausen, R., and Periškić, G., (2005). "Instationäres 3D Thermo-mechanisches Modell für Beton," Beton und Stahlbetonbau, in press (to be published in January, 2005).

Course:	**STEEL STRUCTURES**

Course code: NK-351	**Pre-requisites:**	**Hours of Active Classes:** 75 lectures: 45 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 5

Course objectives	Acquired knowledge of working concepts and properties of various bearing steel structures enable the competency in independent designing of steel structures. It is also a background for further practical and scientific education in the field of steel structures and structural engineering in general.
Syllabus	Theory of plasticity - application in the field of Steel structures. Compound compressing-prone profiles. Fatigue: general principles of dimensioning. Thin-walled profiles. Composite steel structures: basic rules of design. Structural properties of elements and connecting: according. Frame systems. Unstiffened joints. Steel manufacturing halls: principles of design. Steel halls with cranes. Crane girders: design rules. Spatial truss structures. Suspension and cable-stayed steel structures. Multi-storey skeletal steel structures.
Student obligations	Working out of the detailed project of spatial steel structure (disposition draft, static model of structure, resistance and stability of the entire structure and its elements, joint design and drafts). Realisation of programmes is adjusted to a firmly set dynamics of exercises. The second signature conditions are successfully passed programme stages and short seminar paper elaboration (chosen sections of the lectures) accompanied by public presentation and discussion.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Androić, B., Dujmović, D., Džeba, I.: Metalne konstrukcije 1, IGH, Zagreb, 1994. 2. Džeba, I., Androić, B., Dujmović, D.: Metalne konstrukcije 3, IAP, Zagreb, 1998. 3. Androić, B., Dujmović, D., Džeba, I.: Metalne konstrukcije 4, IAP, Zagreb, 2003. 4. Dujmović, D., Androić, B., Džeba, I.: Modeliranje konstrukcija prema EUROCODE 3, AGM, Zagreb, 2004. **Recommended:** 1. Eurocode 3: Designo of Steel Structures, Part 1, Final Draft, 1990.

Course:	**THEORY OF PLASTICITY**

Course code: TM-405	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 24 exercises: 0 seminars: 6
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 6

Course objectives	Fundamentals of continuum mechanics, theory of elasticity, solution of boundary problemes in the framework of the elasticity theory, nonlinear theories: visco-elasticity, plasticity and damage mechanics.
Syllabus	Introduction Stress at a point Strain at a point Stress-strain relations - linear elasticity Basic equations of elasticity for solids Visco-elasticity Plasticity Damage mechanics Applications to simple problems
Student obligations	Attenance of lectures Seminar work - condition for the attendance of the exam Exam
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 4. Valliappan, S. Continuum mechanics - fundamentals, 5. Scool of Civil Engineering, The University of New South Wales 6. Ed. A.A.Balkema, Rotterdam, 1981. **Recommended:** 2. Timoshenko, S. and Goodier, N. Theory of elasticity, McGraw-Hill, 1970.

Course:	**TIMBER STRUCTURES**

Course code: NK-357	**Pre-requisites:**	**Hours of Active Classes:** 75 lectures: 45 exercises: 26 seminars: 4
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	Acquired knowledge of working concepts and properties of various bearing structures of wood and wood-based materials enable the competency in independent designing of timber structures. It is also a background for further practical and scientific education in the field of timber structural engineering and structural engineering in general.
Syllabus	Manufacturing of laminated wood. Plate wood-based elements. New materials based on wood. Glulam girders: design of standardised girders of special geometry. Glulam structures: structural design and characteristic details. Glulam reinforcement at exceeding tension capacity vertically to grains. 2D glulam systems: frame and arch girders. 3D glulam systems. Traditional and modern timber roof systems. Basics of design and construction of wooden buildings: manufacturing, frame and panel systems, details. Wooden bridges: historical and modern systems (types, design, details). Spatial concepts: domes, grid systems, hypers, fans, lattice vaults. Compound cross-sections of bending-prone timber elements. Yielding. Basics of composite wooden systems: bonding of wood with other materials, bonding wood/wood and wood/wood-based materials. Prestressing (pretensioning) in timber structures: Howe and Cruciano truss systems. Transverse prestressed systems.
Student obligations	Working out of the detailed project of spatial timber structure (disposition draft, static model of structure, resistance and stability of the entire structure and its elements, joint design and drafts). Second signature conditions are a successful programme and a short seminar paper elaboration (chosen section of the lectures) accompanied by a public presentation with teacher-student discussion.
Exam	Written and oral.
Assessment	70% during semester, 30%final exam.
Literature	**Essential:** 1. Bjelanović, A., Rajčić, V.: Drvene konstrukcije prema europskim normama, Hrvatska sveučilišna naklada, Zagreb, 2005. 2. Žagar, Z. Drvene konstrukcije I i II, Pretei d.o.o., Zagreb, 2002./03. 3. Žagar, Z. Drveni mostovi, Pretei d.o.o., Zagreb, 2003. 4. Lecture and practice notes **Recommended:** 1. Gojković, M., Stevanović, B., Komnenović, M. Kuzmanović, S., Stojić, D.: Drvene konstrukcije - Riješeni primjeri, Građevinski fakultet, Beograd, 2000. 2. DIN 1052: Teil 1, Teil 2, Teil 3, Teil 4, 2000.Informationdienst Holz: Düsseldorf, 1995. 3. Werner, G., Zimmer, K.: Holzbau 1, Holzbau 2, Springer - Verlag, Berlin, 1995. 4. Halas, R., Scheer, C: Holzbau-Tachenbuch, IES, Verlag, Berlin, 2000. 5. Götz-Mohler_Natterer: Holzbauatlas, CMA, München, 1999. 6. Internet pages

Course:	**PRESTRESSED CONCRETE**

Course code: NK-353	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	Acquired knowledge of working concepts and properties of various bearing structures of concrete enable the competency in independent designing of prestressed concrete structures. It is also a background for further practical and scientific education in the field of prestressed concrete structures and structural engineering in general.
Syllabus	Lectures: Principles of prestressing. Methods of prestressing. Analysis of concrete section under working loads. Design for the serviceability limit state. Analysis and design at the ultimate limit state. Partial prestressing. Loss of prestress. Anchorage zone design. Practices: Auditor demonstration of characteristic systems ascording to the types and building technology.
Student obligations	Practical elaboration of practices contents: working out of the major project of prestressed structure in a space concept (disposition, static structure model, resistance and stability of structure elements and the entire. Working out of programmes is adjusted to a firmly set auditor (40%) and constructive practices (60%). Second signature conditions are a successful programme.
Exam	Written part is in numerical and theoretical form. If positive, the written part is a pre-requisite for the oral exam.
Assessment	Results of exams and grades of the programme.
Literature	**Essential:** 1. Lecture and practice notes. 2. Tomičić, I.: Betonske konstrukcije, DHGK, Zagreb, 1996. 3. Tomičić, I.: Betonske konstrukcije – Odabrana poglavlja, DHGK, Zagreb, 1990. 4. Tomičić, I.: Priručnik za proračun armiranobetonskih konstrukcija, DHGK, Zagreb, 1993. 5. Mosley W.H., Hulse R., Bungey J.H.: Reinforced concrete Design to Eurocode 2, Macmillan Press LTD, 1996. 6. Nilson A.H., Winter G.: Design of concrete structures, McGrau-Hill, Inc., 1987. **Recommended:** 1. Leonhardt, V.: Vorlesungen über Massivbau, Fünfter Teil, Springer-Verlag, Berlin, Heidelberg, New York, 1979.

Course:	**SPECIAL CHAPTERS OF CONCRETE STRUCTURES**

Course code: NK-352	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 5

Course objectives	Acquired knowledge of working concepts and properties of various bearing structures of concrete enable the competency in independent designing of concrete structures. It is also a background for further practical and scientific education in the field of concrete structures and structural engineering in general.
Syllabus	Lectures: Circular spirally reinforced columns. Short columns resisting moments and axial forces. Biaxial bending of short columns. Design of slender columns. Walls. Two-Way column- supported slabs, shear design. Application of plastic methods to reinforced concrete structures. Yield-line analysis for reinforced concrete slabs. Practices: Auditor demonstration of characteristic systems ascording to the types and building technology.
Student obligations	Practical elaboration of practices contents: working out of the major project of concrete structure in a space concept (disposition, static structure model, resistance and stability of structure elements and the entire. Working out of programmes is adjusted to a firmly set auditor (40%) and constructive practices (60%). Second signature conditions are a successful programme.
Exam	Written part is in numerical and theoretical form. If positive, the written part is a pre-requisite for the oral exam.
Assessment	Results of exams and grades of the programme.
Literature	**Essential:** 1. Lecture and practicce note. 2. Tomičić, I.: Betonske konstrukcije, DHGK, Zagreb, 1996. 3. Tomičić, I.: Betonske konstrukcije – odabrana poglavlja, DHGK, Zagreb, 1990. 4. Tomičić. I.: Priručnik za proračun armiranobetonskih konstrukcija, DHGK, Zagreb, 1993. 5. Mosley W.H., Hulse R., Bungey J.H.: Reinforced concrete Design to Eurocode 2, Macmillan Press LTD, 1996. 6. Nilson A.H., Winter G.: Design of concrete structures, McGrau-Hill, Inc., 1987. **Recommended:** 1. Sahnovski, K.V.: Armiranobetonske konstrukcije, Građevinska knjiga, Beograd, 1962. 2. Ulicki, I.I.: Armiranobetonske konstrukcije, Građevinska knjiga, Beograd, 1977. 3. Park, R., Paulay, T.: Reinforced Concrete Structures, John Wiley, New York, 1975.

Course:	**SOLID BRIDGES**

Course code: NK-355	**Pre-requisites:** Concrete and Masonry Structures	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 5

Course objectives	Acquired knowledge of working concepts and properties of various bearing structures of concrete enable the competency in independent designing of concrete bridges. It is also a background for further practical and scientific education in the field of concrete bridgest and structural engineering in general.
Syllabus	Lectures: Bridges and their mayor components: slabs, beams, boxes, frames, arches, suspension and cable-stayed bridges. Methods of analysis – superstructures and substructures. Numerical and finite element techniques and solutions i static, dynamic, seismic, wind and blast effects. Analysis of prestressed concrete bridges: slab, beam and slab, in sitn multi-cell box grider, in sitn single-cell box grider bridges. Precast segmental box griders. Precast full-length box griders. Incrementally launched box grider bridges. Practices: Auditor demonstration of characteristic systems ascording to the types and building technology.
Student obligations	Practical elaboration of practices contents: working out of the major project of concrete bridges in a space concept (disposition, static structure model, resistance and stability of structure elements and the entire. Working out of programmes is adjusted to a firmly set auditor (40%) and constructive practices (60%). Second signature conditions are a successful programme.
Exam	Written part is in numerical and theoretical. If positive, the written part is a pre-requisite for an oral exam as extended check of theoretical knowledge.
Assessment	Results of exams and grades of the programme.
Literature	**Essential:** 1. Lecture and practice notes 2. Tonković, K.: Masivni mostovi – opća poglavlja, Školska knjiga, Zagreb, 1977. 3. Tonković, K.: Masivni mostovi – građenje, Školska knjiga, Zagreb, 1989. 4. Bangash M.Y.H.: Prototype bridge structures: Analysis and design, Thomas Telford, 1996. 5. Hewson N.R.: Prestressed concrete bridges: Design and construction, Thomas Telford, 2003. 6. Podolny W., Muller J.M.: Construction and Design of Prestressed Concrete Segmental Bridges, John Wiley & Sons, 1982. **Recommended:** 1. Leonhardt, V.: Vorlesungen über Massivbau, Springer-Verlag, Berlin, Heidelberg, New York, 1979.

Course:	**STEEL BRIDGES**

Course code: NK-356	**Pre-requisites:** Steel Structures II	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	Acquired knowledge of working concepts and properties of various bearing systems enable the competency in designing of steel bridges. It is also a background for further practical and scientific education in the field of bridges and structural engineering in general.
Syllabus	Historical development of steel bridges structures. Modern steel bridges systems. Dispositions. Concepts of safety: mechanical resistance and stability. Main-girders: solid-walled, narrow-flange, wide-flange, cell-box. Gridal and torsional resistance. Optimisation of dimensions. Truss main-girders: types, theory, basic rules of structural design and shaping, details, modern variants. Pavement structures of railway and highway steel bridges. Bracing: in general, spatial stability, interaction with main-girders. Composite structures: steel-concrete. Ultimate limit states: bearing and serviceability. Stress-distribution: creep and tight, elastic and plastic analysis. Steel ortothropic plates: in general, basic rules of structural design and shaping, basics of analysis. Fixed and pinned bearings and joints: steel parts, elastomers, teflon, dimension control.
Student obligations	Working out of the detailed project of spatial structure of steel bridge (disposition draft, static model of structure, resistance and stability of the entire structure and its elements, joint design and drafts). Second signature condition is a successful programme.
Exam	Written part is in numerical and theoretical. If positive, the written part is a pre-requisite for an oral exam as extended check of knowledge.
Assessment	Results of exams and grades of the programme.
Literature	**Essential:** 1. Horvatić, D.: Metalni mostovi, Školska knjiga, Zagreb, 1988. **Recommended:** 1. Tonković, K.: Mostovi, Sveučilišna naklada Liber, Zagreb, 1981.

Course:	**THEORY OF PLATES AND SHELLS**

Course code: TM-401	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 24 exercises: 0 seminars: 6
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 3

Course objectives	1. To understand the basic mechanical properties of different 2D structures: walls, membranes, plates, and shells. 2. To learn the fundamental principles of the two main theories of plates including their analytical and approximate solutions. 3. To acquire some preliminary skills for the course Finite-element method.
Syllabus	Introduction to the theory of 2D structures. Geometry of curved spaces. Different 2D structures and their governing equations: walls, membranes, plates, and shells. Kirchhoff´s theory of plates. Plate on an elastic foundation. Mindlin--Reissner´s theory of plates. Closed-form solution and the solutions using the finite-difference method and the finite-element method. Dynamics of plates and the finite element solution with an example. Numerical examples using the finite-element method. Comparison of solutions using bars, triangular plate elements and isoparametric 3D elements. Energy formulations and the principle of virtual work in 2D structures. Approximate solution using the Rayleigh--Ritz method. Finite-element method as a special case of the Rayleigh--Ritz method with localy defined shape functions. Application to 2D structures.
Student obligations	Understanding of the course material is periodically checked through seminars, the results of which are being added to the results of the written exam.
Exam	The exam consists of the written and the oral part. Minimum of 40% of the aggregate result of the seminarss and the written part is a condition for the oral part of the exam.
Assessment	The students are marked according to the aggregate result of the seminars, the written and the oral part of the exam.
Literature	**Essential:** 1. P.L. Gould, Analysis of Shells and Plates, Springer Verlag, 1988. 2. H.-C. Juang, Static and Dynamic Analysis of Plates and Shells, Springer Verlag, 1988. 3. S. Timoshenko, Theory of Plates and Shells, McGraw--Hill, 1959. **Recommended:** 1. A.E.H. Love, A Treatise on the Mathematical Theory of Elasticity, Dover, New York, 1944. 2. T.J.R. Hughes, The Finite Element Method, Dover, New York, 2000. 3. I. Kožar, M. Novaković, E. Pavlovec, Analysis of plate on elastic foundation using 8-node serendipity element, International Journal for Engineering Modelling 8 (1995) 65-70.

Course:	**DYNAMICS OF STRUCTURES**

Course code: TM-402	**Pre-requisites:** Undergraduate level	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	The student is expected to acquire a basic knowledge and understanding of the methods of Dynamics of Structures for implementation in Earthquake Engineering, Concrete Structures, Bridges
Syllabus	Single-degree-of- freedom systems: equations of motion and solutions for free and forced undamped and damped oscillations; Response to harmonic and periodic excitations; Vibration isolation; Response to ground motion; Lumped -mass and continuous-mass systems; Duhamel's integral; Multi-degree-of-freedom systems: equation of motions and solution methods (matrix approach); Orthogonality of modes; Shear buildings; Normal coordinates; Modal analysis; The solution of modal equation using Laplace transforms.
Student obligations	Obligatory attendance to the course.
Exam	Written exam
Assessment	20% for regular attendance; 80% exam.
Literature	**Essential:** 1. Čaušević, M., DINAMIKA KONSTRUKCIJA, Školska knjiga, Zagreb, 2005. 2. Čaušević, M., POTRESNO INŽENJERSTVO, Školska knjiga, Zagreb, 2001. **Recommended:** 1. Chopra, A. K., DYNAMICS OF STRUCTURES – Theory and Applications to Earthquake Engineering, Second edition, Prentice Hall, New Jersey, 2001. 2. Clough, R., Penzien, J., DYNAMICS OF STRUCTURES, McGraw-Hill, New York, 1975.

Course:	**STABILITY OF STRUCTURES**

Course code: TM-403	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	The student is expected to acquire a basic knowledge and understanding of the methods of Stability of Structures for implementation in Concrete Structures, Timber Structures, Bridges
Syllabus	Static, dynamic and energy criterion of stability ; Definition of critical loading and analytical formulation of critical loading, Eigenvalues; Orthogonality; Basic assumptions and basic equations of the second order theory; The second order theory and stability of prismatic and tapered members ; Implementation od matrix approach and finite difference method; The second order theory and stability of system of members (plane frames) using the slope - deflection method; Stability of plate elements;
Student obligations	Obligatory attendance to the course.
Exam	Written exam
Assessment	20% for regular attendance; 80% exam.
Literature	**Essential:** 1. Čaušević, M., STATIKA I STABILNOST KONSTRUKCIJA – Geometrijska nelinearnost, Sveučilišni udžbenik, Školska knjiga, Zagreb, 2003. 2. Čaušević, M., TEHNIČKA MEHANIKA - kinematika, Sveučilišni udžbenik, Školska knjiga, Zagreb, 2000. **Recommended:** 1. Ghali, A.; Neville, A. STRUCTURAL ANALYSIS: A Unified Classical and Matrix Approach, E & FN SPON, An Imprint of Chapman & Hall, London, 1996. 2. Thompson, J. M. T.; Hunt, G. W. A GENERAL THEORY OF ELASTIC STABILITY, John Wiley & Sons, London, 1973. 3. Fukumoto, Y., STRUCTURAL STABILITY DESIGN-steel and composite structures, Pergamon, 1997.

Course:	**VARIATIONAL METHODS**

Course code: TM-404	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 24 exercises: 0 seminars: 6
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 3

Course objectives	1. To understand the basic energy principles and to learn how to apply them to simple problems of statics of deformable bodies and analytical dynamics. 2. To understand the essence of the energy-based approximate methods and the variational formulation of the finite-element method. 3. To acquire some preliminary skills for the course Finite-element method.
Syllabus	Introduction to the principle of virtual work and the principle of stationary total potential energy. Equilibrium, kinematic and constitutive equations of a 3D continuum. Relationship between the equilibrium equations and the energy principles. Application of the principle of virtual work to trusses and frameworks. Rayleigh-Ritz method with emphasis on beam structures. Galerkin´s method. Application of the Rayleigh-Ritz method to plates. Application of the Rayleigh-Ritz method to buckling of beams. Introduction to the finite-element method using the principle of virtual work. Shape functions for triangular wall elements. Stiffness matrix and load vector. Co-ordinate transformations. Beam finite elements. Energy methods and principle of virtual work in dynamics. Analytical dynamics and Lagrange´s equations.
Student obligations	Understanding of the course material is periodically checked through seminars, the results of which are being added to the results of the written exam.
Exam	The exam consists of the written and the oral part. Minimum of 40% of the aggregate result of the seminars and the written part is a condition for the oral part of the exam.
Assessment	The students are marked according to the aggregate result of the seminars, the written and the oral part of the exam.
Literature	**Essential:** 1. Jelenić, G.: Energy Methods (course notes), Imperial College, Department of Aeronautics, London **Recommended:** 1. Davies, G.A.O.: Virtual Work in Structural Analysis, Wiley, Chichester, 1982 (0-471-10112-5, 0-471-10113-3) 2. Henwood, D.; Bonet, J.: Finite Elements. A Gentle Introduction, MacMillan, Basingstoke, 1996 (0-333-64626-6) 3. Johnson, C.: Numerical Solution of Partial Differential Equations by the Finite Element Method, Cambridge University Press, Cambridge, 1995 (0-521-345-146, 0-521-347-580) 4. Hughes, T.J.R.: The Finite Element Method, Dover, New York, 2000 (0-486-41181-8) 5. Lanczos, C.: The Variational Principles of Mechanics, Dover, New York, 1986 (0-486-65067-7)

Course:	**PRECAST CONCRETE STRUCTURES**

Course code: NK-358	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 10 seminars: 5
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	Acquired knowledge of working concepts and properties of various bearing structures of concrete enable the competency in independent designing of precast concrete structures. It is also a background for further practical and scientific education in the field of precast concrete structures and structural engineering in general.
Syllabus	Lectures: What is precast concrete. Materials used in precast structures. Precast frame analysis. Precast concrete floors. Precast concrete beams. Columns and shear Walls. Horizontal floor diaphragms. Joint and connections. Beam and column connections. Ties in precast concrete structures. Practices: Auditor demonstration of characteristic systems ascording to the types and building technology.
Student obligations	Practical elaboration of practices contents: working out of the major project of precast concrete structure in a space concept (disposition, static structure model, resistance and stability of structure elements and the entire. Working out of programmes is adjusted to a firmly set auditor (40%) and constructive practices (60%). Second signature conditions are a successful programme.
Exam	Written part is in numerical and theoretical form. If positive, the written part is a pre-requisite for the oral exam.
Assessment	Results of exams and grades of the programme.
Literature	**Essential:** 1. Lecture and practice notes. 2. Twelmeier, H.: Betonfertigteilkonstruktionen, TU Hannover, 1973. 3. Mokk, L.: Montagebau in Stahlbeton, Akademiai Kiado, Budapest, 1968. 4. Elliott K.S.: Precast concrete structures, Butternwoorth-Heineman, 2002. 5. Elliot K.S.: Multi-storey precast concrete framed structures, Blackwell Science, 1996. 6. Seismic design of precast concrete building structures, State of art, FIB, October 2003. **Recommended:** 1. Precast concrete in mixed construction, State-of-art , FIB, June 2002. 2. Floor Connections – Precast Concrete Connection Details, Beton – Verlag, Düsseldorf, 1981. Structural Design Manual – Precast Concrete Connection Details, Beton – Verlag, Düsseldorf, 1978.

Course:	**INTRODUCTION TO COMPOSITE STRUCTURES**

Course code: NK-354	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 10 seminars: 5
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 4

Course objectives	Acquired basic knowledge of working concepts and properties of various composite structures enable the limited competency in designing of composite structures. It is also a background for further practical and scientific education in this field and structural engineering in general.
Syllabus	An introduction with EC3 and EC4: a general survey. Theory, methods and effects of bonding. Advantages, defects, scopes of practical application. Materials for composite structures: steel, concrete, reinforcing and presstresing steel, profilised metal sheets, steels for shear connectors. Basics of bonding: material properties, material interaction, effects of reology (concrete creep and tight), effective width. Elastic and plastic resistance analysis. Total, discontinuous and elastic bonding. Statical indefinite girders. Composite columns and slabs. Connectors and joints of composite structures. Composite structures of buildings and bridges: particularities. Fire-fighting safety, influential parameters, models of thermics and mechanics analysis. Composite wooden structures (EC5) systems: wood/other materials (reinforced and lightweight concrete), wood/wood and wood/ plate wooden elements. Connecors (yielding). Examples of practical application of composite wooden structures.
Student obligations	Working out of a short seminar (chosen section of the lectures and recommended topics). Second signature condition is a short seminar paper elaboration accompanied by a public presentation with teacher-student discussion.
Exam	Written part is numerical and theoretical. If positive, the written part is a pre-requisite for an oral exam as extended theoretical check.
Assessment	Results of exams and grades of the seminar paper.
Literature	**Essential:** 1. Horvatić, D.: Spregnute konstrukcije čelik - beton, Masmedia d.o.o., Zagreb, 2003. 2. Lecture and practice notes **Recommended:** 1. Johnson, R.P: Composite Structures of Steel and Concrete, Volume 1 Collins London 1986. 2. Johnson, R.P., Buckby, R.J.: Composite Structures of Steel and Concrete, Volume 2, Bridges, Collins London, 1986. 3. Johnson and all: All about EC4, in IABSE Reports Conference Davos, 1992, Volume 65, p. t

Course:	**EARTHQUAKE ENGINEERING**

Course code: NK-361	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	Ability to identify, formulate and solve engineering problems in the field of earthquake resistant analysis and design of concrete and steel structures.
Syllabus	Response of structures to ground motion; Response spectrum; Base shear coefficient; Seismic modal analysis of multi-degree-of-freedom systems using spectral theory; Matrix approach of seismic modal analxsis; Soil-structure interaction; Earthquake response and design of multistorey buildings; Eurocode 8: seismic zonation, definition of earthquake loading on buildings using spectral approach; Combination of loading after Eurocode 1 and Eurocode 8: seismic combination; Specific rules for design and construction of reinforced concred and steel structures; United States International Building Code IBC2000: implementation in Croatia.
Student obligations	Obligatory attendance to the course.
Exam	Written exam
Assessment	20% for regular attendance; 80% exam.
Literature	**Essential:** 1. Čaušević, M., POTRESNO INŽENJERSTVO, Sveučilišni udžbenik, Školska knjiga, Zagreb, 2001. 2. Čaušević, M., DINAMIKA KONSTRUKCIJA, Sveučilišni udžbenik, Školska knjiga, Zagreb, 2005. **Recommended:** 1. Chopra, A. K., DYNAMICS OF STRUCTURES – Theory and Applications to Earthquake Engineering, Second edition, Prentice Hall, New Jersey, 2001. 2. Clough, R., Penzien, J., DYNAMICS OF STRUCTURES, McGraw-Hill, New York, 1975. 3. Eurocode 8 – Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings, EN 1998-1, Doc CEN/TC250/SC8/N335, Brussels, January 2003.

Course:	**TESTING OF STRUCTURES**

Course code: NK-360	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	Qualifying of students in the field of measurement and measuring technics and direct applied in testing of civil engineering structures. Intoduction with methods of measuring and corresponding norms and standards in the field of quality control during the building and exploatation of civil engineering structures.
Syllabus	Historical development and tasks of structure testing. Regulations in the field of testing of structures. Tensometers. Review and types of sensors. Review of instruments and measuring equipmnet for statics and dynamic testing. Measuring characteristics of sensors and instruments. Review of testing methods in laboratory and in situ. Static testing: methods and data acquisition. Analysis and presentation of measurement data. Dynamic testing: methods. Methods of excitations structures and elements. Methods of acquiring of dynamic signals. Sensors during dynamic testing. Methods of dynamic analysis in the time and frequencies domain. Fast Fourier transformation of acquired signals. Experimental model analysis of structers and elements. Dynamic parameters of structural systems. Analysis of strains and stresses on the basis of measurement values. Long-time measurement on the structures or monitoring. Data acquering, analysis and presentation using PC technologies.
Student obligations	Continously obligatorily ettendence to lecture and exercises. On the exercises, the students have to acquire the data of measuring of every exercise. After it, data has to be analysed and compared with the theoretical values and made a report.
Exam	Written and oral exam after presented the testing report of exercises.
Assessment	Results of exams and testing reports.
Literature	**Essential:** 1. Separates with complete lectures (M. Rak) **Recommended:** 1. Vukotić, R.: Ispitivanje konstrukcija, Naučna knjiga, Beograd, 1990.

Course:	**SPECIAL CHAPTERS OF LIGHTWEIGHT STRUCTURES**

Course code: NK-359	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 5 seminars: 10
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 4

Course objectives	Acquisition of basic knowledge on spatial concepts of performance, bearing capacity, modelling methods (linear and non-linear FE analyses) and technology of various lightweight system constructions serve as a background for a further practical and scientific education in this field.
Syllabus	Geodesic domes: geometry, truss and panel systems, coverings, joint details, performance and assembly, modelling. Pneumatic structures: pneumatic balloons, pneumatic cushions, pneumatic beams, arches and disks, modelling. Lightweight membrane structures: structural types, the ways of membrane stabilisation, supporting, modelling. Synergetic structures: behaviour principles at overtaking of external actions, direction systems (regulation of bearing capacity and stability) and surveying. Tensional integrity systems: ultimately light space structures, integrated systems of elements in compression and tension, modelling. Lightweight aluminium and steel structures. Examples of constructed lightweight objects: types, space action, performance and assembly details, design models and behaviour simulation.
Student obligations	Second signature condition is an elaboration of a seminar paper (theory or modelling – with a mentor) from the chosen field, along with the public presentation followed by student-teacher discussion.
Exam	Written exam (1h) including the check of theoretical knowledge.
Assessment	Results of exams and the graded seminar paper.
Literature	**Essential:** 1. Žagar, Z. Drvene konstrukcije I i II, Pretei d.o.o., Zagreb, 2002./03. 2. Lecture notes. **Recommended:** 1. Fuller, B.: Sinergetics, McMillan Publ. Co. Inc., New York, 1975. 2. Mathys, P.I., Jing, T.F.: Floating Saddle Connections for Georgia Dome, USA, SEI Journal, Vol. 4., No. 3, 1994. 3. Motro, R.: Tensegrity Systems and Geodesic Dome, Space Structure Jnrl, Special Issue on Geodesic Forms, Vol. 5., No. 3&4, 1990. 4. Internet pages

Course:	**PLANNING OF BUILDINGS**

Course code: OA-463	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 15 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	Inform students about the methodology of planning and qualify them for reading and elaborating the planning documentation.
Syllabus	– Elements of historical development. Theoretical basis for evaluating an architectural work. – Approach to planning, analysis of a location, programme, orientation, physics of a building. – From a regional plan to an executional project. – Technical conditions of building, standards, regulations, fire and conservation protection, safety at work. – Function, construction, design for residential and public buildings. – Staircases and elevators, installations, heating, cooling and ventilation. – Modern facades and roof frames. – Konstruction as the basis of formation - public buildings for special purposes, halls, big sheds, stadiums, theatres, aeroports.
Student obligations	– Course attendence – Visits to building-sites and theme exhibitions – Project work: Based on the assigned general design, a part of the executional project of a small public building or a part of it.
Exam	– written exam – oral exam
Assessment	– Lecture and exercise attendance and project work 50% – Written and oral exam 50%
Literature	**Essential:** 1. Neufert, E.: Arhitektonsko projektiranje, IGH Zagreb 2002. 2. Proizvodni programi građevinske opreme 3. Planovi i projekti izvedenih rješenja. **Recommended:** 1. G. Knežević, I. Kordiš: Stambene i javne zgrade, tehnička knjiga, Zagreb 2. Encyclopaedia of 20th Century Architecture, Thames and Hudson 1989. 3. H. Pearman: Contemporary World Architecture, Phaidon 1998. 4. R. Fisher: New Structures, New York, London 1964. 5. T. Herzog: Pneumatic Structures, C.L.Staples, London 1977. 6. I. Tonković: Priča o građenju, Tehnička knjiga, Zagreb

Course:	**ROAD INTERSECTIONS AND CROSSROADS**

Course code: P-501	**Pre-requisites:** Road Design	**Hours of Active Classes:** 50 lectures: 20 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 5

Course objectives	The main objective of this course is to educate future engineers to identify, formulate and solve engineering problems in the field of road intersections and crossroads.
Syllabus	Crossroads (grade junctions): - types ("classic" and roundabouts), characteristics, design elements, capacity determination, traffic signs and road marking Intersections (up-grade - grade separated junctions and intercharges): - types, characteristics, design elements, capacity determination, traffic signs and road marking Other crossings: - with railways, rivers, channels and other engineering structures
Student obligations	Three individual seminar works ("classic" crossroads, roundabout, intersection) The project of concrete example (made in group) on idea level.
Exam	Oral exam
Assessment	15 % activity + 25 % seminar works + 30 % project + 30 % project presentation
Literature	**Essential:** 1. Pravilnik za projektovanje putova (u pripremi)A. Klemenčić: Oblikovanje cestovnih čvorišta izvan razine, Građevinski institut Zagreb, 1982 2. T. Tollazzi: Kružna raskrižja (hrvatska verzija - u tisku) **Recommended:** 1. Richtlinien für die Anlage von Landstraßen (RAL) - Planfrei Knotenpunkte (RAL-K-2), 1996 2. Richtlinien für die Anlage von Landstraßen (RAL) - Plan Knotenpunkte (RAL-K-1), 1995

Course:	**URBAN TRAFFIC**

Course code: P-503	**Pre-requisites:**	**Hours of Active Classes:** 50 lectures: 20 exercises: 20 seminars: 10
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	The student is expected to acquire knowledge of urban roads (highways) and intersections, different transport modes and their characteristics. Student will be able to prepare highway and intersection designs, design of other parts of urban traffic areas (parking areas etc.) and conduct simple transport studies.
Syllabus	- City and traffic, Urban traffic planning - Traffic planning and design - Classification of urban roads - Geometric and project element for urban roads: cross section, horizontal and vertical curves - Intersections in urban areas: types, shapes, traffic leading - Non-motorized traffic in cities: walking, bicycling - Parking areas in cities - Public transport: role and importance in urban traffic - Public transport modes - Road transit modes - Railway transit modes - Public transport routes, stations and terminals - Facilities and signalization on urban highways
Student obligations	– accepted project work (group work) and presentation of project before the end of the term or before specified date – project work consists of design of elements of traffic system on the selected urban area (in the city of Rijeka)
Exam	– written exam, oral exam – positively marked written exam is a condition for the oral exam
Assessment	35 %project work with presentation + 45%written exam+20%oral exam
Literature	**Essential:** 1. Skripta sa predavanja 2. Studija Riječkih prometnih prostora, IGH Rijeka, Rijeka, 1990 3. Vučić, R.V.: Javni gradski prevoz - Sistemi i tehnika, Naučna knjiga Beograd 1987. 4. Grad kao složeni sustav, Zbornik radova s Prve konferencije Grad kao složeni sustav, Zagreb-Karlovac, 1995. **Recommended:** 1. GUP grada Rijeke, Grad Rijeka, 2004. 2. Maletin, M., Gradske saobraćajnice, Građevisnki fakultet Beograd, Beograd 1996. 3. The geography of Urban Transportation, Edited by Hanson, S., The Guilford Press, NewYork-London, 1995. 4. Vresk, M., Grad i urbanizacija:osnove urbane geografije, Školska knjiga, Zagreb, 2002. 5. Božičević, J., Topolnik D., Infrastruktura cestovnog promta, Fakultet prometnih znanosti, Zagreb, 1996. 6. Pađen J., Osnove prometnog planiranja, Informator, Zagreb, 1986. 7. Mumford, L., Grad u historiji, Znanje, Zagreb, 1968.

Course:	**TRAFFIC ENGINEERING**

Course code: P-502	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 45 exercises: 0 seminars: 15
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 5

Course objectives	– Introducing with the relation between transport offers and demands, tecnicks of flow menagement on highways and intersections – Definitions between possible solutions and finding optimisations – Character of traffic planning and Modal split
Syllabus	– Relations between transport offers and demads – Transport planning. Modal split. Transport research. – Traffic flow. Highway network. – Traffic on highways. Capacity (Level of service). Highway demand dimensions. – Conflicts of traffic flow. Intersections. Principe of traffic regulations. Intersections design. – Strandard traffic signs. Dinamic signs. Traffic lights. – Co-ordination of traffic lights; in line; in network. – Sign posts and not standard signs. Traffic equipment. – Parking. Technology on parking places. – Technology of public transportation. Alternative transport.
Student obligations	– Acktiv comments and opinions on lectures. – Seminar work. Traffic solutions on special places (city zone, part of highway, intersection) or traffic system. Work in groups. Presentation of work. – Exam in writeing form.
Exam	Exam in writeing form.
Assessment	1/3 student's acktivity on lectures + 1/3 seminar work, presentaion and retain + 1/3 exam in writeing form.
Literature	**Essential:** 1. Cerovac, V.: Tehnika i sigurnost prometa; Sveučilište u Zagrebu - Fakultet prometnih znanosti, Zagreb 2001. 2. Padjen, J.: Prostorno-prometno planiranje, Informator Zagreb 3. Suvremeni promet, Časopis Hrvatskog znanstvenog društva za promet 4. Tehničar - Građevinski priručnik 4 - Poglavlja: 3. Putevi, 4. Saobraćaj u gradovima; Građevinska knjiga, Beograd 1978. 5. Tehničar - Građevinski priručnik 5 - Poglavlja: 1. Putevi, 2.Gradske saobraćajnice; Građevinska knjiga, Beograd 1987. 6. Zakon o sigurnosti prometa na cestama, HAK-Usluge d.o.o., Zagreb 2004. **Recommended:** 1. Građevni godišnjak '96; Legac., I.: Planerske i prometnotehničk 2. Ceste i mostovi, Časopis Društva za ceste Via Vita Kolenc, J.: Infrastruktura cestnega prometa, Univerza v Ljubljani, Fakulteta za pomorstvo in promet, Portorož 1997. 3. Tollazzi, T.: Krožna križišća, Univerza v Mariboru, Maribor 2002.

Course:	**FLEXIBLE PAVEMENT STRUCTURES**

Course code: P-508	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	Development of skills for the analysis of pavement structure and pavement design methodology taking into consideration their advantages as well as disadvantages. It is particularly important that students recognize relationship between the pavement design options and subsequent needs of maintenance and pavement management.
Syllabus	Introduction. Principles of structural pavemnet design: empirical and theoretical approach. Environment (moisture, temperature, wind). Soil freezing under the pavemnet structures. Relation between pavement design options and road management system. Cross section, shoulders and drainage. Traffic and axle loading. Surface course. Pavement foundation. Pavement materials: basic components; unbound materials; aggregates; bitumen; bound materials; hydraulic and bituminous binders; geosynthetics. Design of new pavement structures: data required for designing (traffic, climatic and environmental data, patameters describing the pavement foundation, materials for pavement courses); design and calculation of various types of pavement structures (flexible pavement, composite pavement, inverse pavement, cement-concrete pavement) provided with illustration of a pavement design example); check of pavement structure against the frost action. Pavement rehabilitation. Pavemen surface characteristics.
Student obligations	Course and exercises attendance. Elaboration and delivery of programmes with the pavement structure calculation. Seminar-work on road materials - laboratory testing of materials characteristics.
Exam	Written exam. Oral exam. Passing the written exam is a precondition for taking the oral exam.
Assessment	10% attendance + 15% seminar + 25% programme + 50% exam.
Literature	**Essential:** 1. Babić, B. and Prager, A.: Design of Road Pavement (orig. in Croatian), Građevni godišnjak, HSGI, Zagreb, 1997 2. Sršen, M.: Introduction of Modern Equipment for Assessment of Road Condition – Croatian and International Experiences (orig. in Croatian), Građevni godišnjak, HSGI, Zagreb, 1999 3. Roberts, F.L., Kandhal, P.S., Brown, E.R., Lee, D-Y and Kennedy, T.W.: Hot Mix Asphalt Materials, Mixture Design and Construction (translation into Croatian), HSGI, Zagreb, 1999 **Recommended:** 1. AASHTO Guide for Design of Pavement Structures 1993, Published by the American Association of State Highway and Transportation Officials, 1986 & 1993, Washington, D.C. USA 2. Croney, D. and Croney, P.: The Design and Performance of Road Pavements, Third Edition, McGraw-Hill, New York, USA, 1998 3. Atkins, H.N.: Highway Materials, Soils ang Concretes, Third Edition, London, 1997

Course:	**RIGID PAVEMENT STRUCTURES**

Course code: P-509	**Pre-requisites:** Theory and Technology of Concrete	**Hours of Active Classes:** 40 lectures: 25 exercises: 10 seminars: 5
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	The course provides students with a broad overview of rigid-concrete road design and construction and understanding of mechanistic behavior of rigid pavements.
Syllabus	– Concrete road history – Subgrades and subbase materials – Types of concrete pavements – Traffic loading – Stress and strain calculation for traffic and termal loading – Concrete pavements for highways – Concrete industrial pavements – Basics of airport pavements, methods for calculation – Building of concrete pavements – Distresses and maintenance of concrete pavements
Student obligations	– accepted project work until specified date, oral preliminary exam
Exam	– written and oral exam – positively marked written exam is a condition for the oral exam
Assessment	20% project work+50% written exam+30% oral exam
Literature	**Essential:** 1. Babić, B. and Prager, A.: Design of Road Pavement (original in Croatian), Građevni godišnjak, HSGI, Zagreb, 1997. 2. Babić, B.: Design of Pavement Structures (original in Croatian), HGDI, Zagreb, 1997. **Recommended:** 1. Huang, Y. H., Pavement Analysis and Design, Prentice Hall, NewJersey, 1993. 2. Croney, P., Croney, D., The Design of Road Pavements, MacGraw-Hill, 1997. 3. http://www.faa.gov/ 4. AASHTO Guide for Design of Pavement Structures 1993, Published by the American Association of State Highway and Transportation Officials, 1986 & 1993, Washington, D.C. USA

Course:	**ROADBED DESIGN**

Course code: P-510	**Pre-requisites:** Road Design	**Hours of Active Classes:** 60 lectures: 30 exercises: 20 seminars: 10
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 5

Course objectives	The student is expected to develop problem solving skills in the area of roadbed structures design and to be able to calculate asociated earthworks, produce and analyse mass haul diagrams.
Syllabus	– Cross sections of roads, railways, airportsConcrete road history – Preliminary researches (hydrological, geological, geotechnical researches) – Soil classifications for roads – Drainage issues in road design – Frost action – Preliminary works in road building process – Design and building of cuts – Design and building of enbankments – Technics for reinforcement of low-bearing soils – Geotechtiles in road building: design and construction – Cut and fill balance, mass haul diagrams
Student obligations	– accepted project work and seminar before the end of the term or before specified date – attendance to the construction site visits
Exam	– written exam, oral exam – positively marked written exam is a condition for the oral exam
Assessment	20% project work+50% written exam+30% oral exam
Literature	**Essential:** 1. Korlaet, Ž., Uvod u projektiranje i građenje cesta, Sveučilište u Zagrebu, Zagreb, 1995. 2. Opći tehnički uvjeti za radove na cestama, IGH Zagreb, Zagreb, 2001. – Knjiga I : Opće odredbe i pripremni radovi – Knjiga II : Zemljani radovi, odvodnja, potporni i obložni zidovi – Knjiga III : Kolnička konstrukcija **Recommended:** 1. Rodrigez, A.Rico, Del Castillo, H., Sowers, G.F.: Soil Mechanics in Highway Engineering, Trans Tech publications, Clausthal Zellerfeld, p.843, 1988.

Course:	**RAILWAY DESIGN**

Course code: P-512	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 45 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 5

Course objectives	With successfully acquired matter, student is expected to have basic knowledge about track bed structure and track substructure; student is qualified to design the same.
Syllabus	– Railway like a mean of transportation – Historic overview of railway and development – Classification of railway lines and trains – Cross section of railway – Track bed structure and track substructure – Track construction, rails and sleepers – Calculation of stresses; dimensioning of rails, sleepers,ballast and formation level – Railway line design – Rail route design, null-line alignment , technical elements – Railway project elements: situation, longitudinal section, cross sections, technical descriptio – Railway maintaining and reconstruction – Railway stations – Track device: switch, turntable, rail expansion joint
Student obligations	– accepted project work before specified date
Exam	– written exam, oral exam
Assessment	– 20% project work + 50% written exam + 30% oral exam
Literature	**Essential:** 1. Marušić, D., Projektiranje i građenje željezničkih pruga, GF Split, Split, 1994 2. Kožar, P., Željeznice (skripta) 3. Pollak, B., Željeznički gornji stroj, FGZ, Zagreb, 1982 **Recommended:**

Course:	**TRAFFIC, SPACE AND ENVIRONMENT**

Course code: P-504	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 0 seminars: 15
Course status: optional	**The course consists of:** lectures - seminars	**ECTS:** 3.0

Course objectives	To introduce students to the essential aspects of the various and complex influences between transport infrastructure, space, and environmental impacts. Furthermore, students should be able to objectively evaluate the different starting points and arguments in integrated decision-making process on the future spatial units, in accordance with the principles of sustainable development.
Syllabus	Plans, programs, strategic documents regarding traffic, space and environmental impact: features, types, components, development methodology, adoption and implementation. Laws, regulations (conventions), institutions (organizations), public participation and other entities in the drafting and implementation of plans and other important documents: the level of municipalities, regions, countries, international level - especially the European Union. Processing of some important topics related to the mutual impact of traffic, space and the environment: - traffic infrastructure or design of traffic networks in relation to the character and objects of spatial planning - policy instruments of spatial planning, transportation (mobility) and the impact on the environment while respecting the principles of sustainable development - economy, social and other issues. Dealing with specific thematic areas. Review and examples of using evaluation methods in the evaluation of alternatives and plans
Student obligations	The participation of students in all aspects of teaching including the preparation and presentation of a seminar paper.
Exam	The exam is written and oral.
Assessment	70% during semester, 30% final exam.
Literature	**Essential:** 1. Reference material made of a lecturer. - Documents and other sources and laws (international conventions) regarding transportation planning and related infrastructure, space, and sustainable development and environmental protection: - International: UN, EU, OECD and other international organizations, - On the national level (strategies, plans, status reports, etc.), - Zagreb: OG - At the level of regional and local governments (programs, plans, decisions, etc.) - Official Gazette of the county and others **Recommended:** 1. Our Common Future. World Commission for the Environment and Development. - N. York: UN, 1987. 2. Črnjar, M.: Ekonomija i zaštita okoliša. - Zagreb: Školska knjiga i Rijeka: Glosa, 1997. 3. Marinović-Uzelac, A.: Prostorno planiranje. - Zagreb: Dom i svijet, 2001. 4. The World in 2020. Towards a New Globale Age. – Paris: OECD, 1997. 5. Welt im Wandel: Strategien zur Bewaeltigung globaler Umweltrisiken. W. B. der B.-Regierung. Berlin: Springer, 1997. 6. Health and Environment in Suistainable Development. - World Health Organization, 1997. 7. Marinović-Uzelac, A.: Prostorno planiranje. - Zagreb: Dom i svijet, 2001.

Course:	**TRAFFIC SAFETY**

Course code: P-505	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 3

Course objectives	Main objectives of this course are: introducing the students with the system of safety in global sense, processing the relevant numerical application in analysis the traffic safety on roads, introducing the actual methods of controlling and regulating technique in all the traffic modes.
Syllabus	Development and tasks of the traffic technique Elements of the traffic safety (correlation man-vehicle-communication) Traffic- technical elements of the street and road network Dynamics of moving the vehicle (numerical application) Capacity of the road communication and nodes Management controlling systems in all the traffic modes Intelligent traffic systems
Student obligations	project task
Exam	verbal exam
Assessment	project task
Literature	**Essential:** 1. Božičević, J., Topolnik, D., Infrastruktura cestovnog prometa, Zagreb, 1996. 2. Cerovac, V., Tehnika i sigurnost prometa, Zagreb, 1997. 3. Cerovac, V., Rotim, J., Mihoci, F., Stanje sigurnosti i mjere za smanjivanje ugroženosti sudionika u cestovnom prometu, Suvremeni promet, god 17, broj 3-4, 1997. 4. Čović, M., i dr., Vještaćenje u cestovnom prometu, Informator, Zagreb, 1987. **Recommended:** 1. Baričević, H., Poletan T., Information Technology in the Analysis of Road Transport Safety Parameters, Promet-Traffic-Traffico, Vol.14, Supplement No.1,101-105., Zagreb, 2002. 2. Baričević, H., Tehnologija kopnenog prometa,Pomorski fakultet, Rijeka, 2001. 3. Božičević, J. Ceste I. i II., Zagreb, 1993. 4. Happ, Z., Rotim, J., Mihoci, F., Sigurnosni aspekti hrvatskog cestovnog prometa, Suvremeni promet, god 16, broj 3-4, 1996. 5. Highway Manual Capacity, Highway Research Board, Washington DC, 1985. i 1994.

Course:	**TECHNOLOGY OF TRAFFIC BUILDING**

Course code: P-507	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 3

Course objectives	– Traffic objects planning in space/city, traffic design, interior traffic technology and work on dimensions subjects and spaces – Definisions of posssible solutions and optimal solution traffic technology in traffic objects
Syllabus	– Traffic aproach to traffic objects – Traffic objects: garages, parking buildings, service objects, terminals of public transport – Main principe of planning and location elements – Traffic and traffic forecast; traffic demands – Funcktional aspects – Types; possible solutions – Traffic objects - Main princips of its design – Dimension work and capacities – Subjects in traffic equipment – Traffic technology and way of use
Student obligations	– Acktiv comments and opinions on lectures. – Seminar work. Solutions of traffic tehnology on special traffic object. Work in groups. Presentation of work. – Exam in writeing form.
Exam	Exam in writeing form.
Assessment	1/3 student's acktivity on lectures + 1/3 seminar work, presentaion and retain + 1/3 exam in writeing form.
Literature	**Essential:** 1. Benigar, M.: Prometne zgrade – Prometno-funkcionalni temeljni principi planiranja i projektiranja; Suvremeni promet Časopis HZDP, god. 22 (2002) Br. 6 (458-464) 2. Benigar, M., Deluka-Tibljaš, A.: Garažno-parkirni objekti – Temeljni principi planiranja i prometni zahtjevi projektiranja; Suvremeni promet, Časopis HZDP, god. 23 (2003) Br.3-4 (204-210) 3. Tehničar - Građevinski priručnik 4 - Poglavlja: 3. Putevi, 4. Saobraćaj u gradovima; Građevinska knjiga, Beograd 1978. 4. Vučić, R.V.: Javni gradski prevoz - Sistemi i tehnika, Naučna knjiga Beograd 1987. . **Recommended:** 1. Suvremeni promet, Časopis Hrvatskog znanstvenog društva za promet Zagreb 2. Tehničar - Građevinski priručnik 5 - Poglavlja: 1. Putevi, 2. Gradske saobraćajnice, Naučna knjiga Beograd 1987.

Course:	**TRAFFIC BUILDINGS**

Course code: OA-462	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 30 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	Inform students about the methodology of planning and qualify them for reading and possibly elaborating the planning documentation.
Syllabus	– A city and traffic, historical review of the development, traffic buildings in an urban environment and outside of it. – From a regional plan to an executional project. – Individual and collective garages, public garage-parking facilities, ramped and mechanized. – Petrol stations, typology, function, construction, formation. – Service centres, function, construction, formation. – Public transportation stations, taxi stations. – Bus stations and terminals. – Train stations and terminals. – Truck terminals. – Construction as the basis of formation in planning airport buildings. – Waterfront- ferry terminals.
Student obligations	– Course attendence – Visits to building-sites and theme exhibitions – Project work: Based on the general design of a concrete assignment, a segment of a traffic building, part of the general design and executional project should be elaborated.
Exam	– written exam – oral exam
Assessment	– Lecture and exercise attendance and project work 50% – Written and oral exam 50%
Literature	**Essential:** 1. Neufert, E.: Arhitektonsko projektiranje, IGH Zagreb 2002. 2. Magaš, O.: Skice za predavanja, skripte. 3. Production-programmes for building equipment. 4. Plans and projects of executional solutions. **Recommended:** 1. A. Gregory, The Golden Age of Travel, London 1991/98. 2. F.A. Cerver, The Architecture of Stations and Terminals, New York 1997. 3. R. Fisher, New Structures, New York, London 1964.

Course:	**MAINTENANCE AND REPAIR OF ROADS**

Course code: P-511	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 10 seminars: 5
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 4

Course objectives	The main objective of this course is to educate future engineers about the systematic road maintenance and repair, because those activities are of particular importance for comfortable, economical and saftier road transportation. Students will be learned about fundamental facts on technical principles of maintenance, repair and rehabilitation of roads.
Syllabus	Introduction in maintenance. Assessment of road condition (cracking, evenness, rutting, skid resistance, deflection). Visual-sensitive assessment. Pavement assessment based on technical measurements. Routine and periodic maintenance. Basis for planning of maintenance. Maintenance of asphalt pavement: simplier maintenance measure (emulsion spraying, sprinkling with chippings, repair by asphalt mixtures, ckracking repair, milling, etc.); more complex measures of maintenance and repair (surface treatment, micro-surfacing cold or hot applied, profile repair - reshape, repave, remix, asphalt reuse). Maintenance of concrete pavements: simplier maintenance measure (joint and crack sealing, repair of slab edge, repair of surface defects); more complex maintenance measures (slab consolidation, subsequent placement of dowels/anchors, slab replacement). Maintenance of drainage facilities. Pavement rehabilitation (strengthening; reconstruction). Road pavement recycling.
Student obligations	Course and exercises attendance. Elaboration and delivery of programmes with the pavement structure calculation. Seminar - work on visual-sensitive assessment of road condition as well as application of the distress identification manual.
Exam	Written exam. Oral exam. Passing the written exam is a precondition for taking the oral exam.
Assessment	10% attendance + 15% seminar-work + 25% programme + 50% exam.
Literature	**Essential:** 1. Sršen, M.: Road Maintenance (orig. in Croatian), Građevni godišnjak, HSGI, Zagreb, 2000 2. Sršen, M.: Introduction of Modern Equipment for Assessment of Road Condition - Croatian and International Experiences (orig. in Croatian), Građevni godišnjak, HSGI, Zagreb, 1999 3. Babić, B.: Design of Pavement Structures (orig. in Croatian), HGDI, Zagreb, 1997 **Recommended:** 1. Straube, E. und Beckedahl, H.: Strassenbau und Strassenerhaltung, 4. neubearbeitete Auflage, Erich Schmidt Verlag GmbH & Co, Berlin, 1997 2. Babić, B. i Horvat, Z.: Construction and Maintenance of Pavemnet Structures, University of Zagreb, 1984 3. Schweizer Norm, Beilage, SN 640 925, Schadenkatalog, VSS, Zurich, 1991

Course:	**AIRPORTS**

Course code: P-513	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 20 exercises: 10 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	The student is expected to develop problem solving skills in the area of projecting airport traffic areas and designing airport pavements.
Syllabus	- History of landing and aviation - Airport system - Airport classification and reference code - Airport layout plan: components and geometry - Signing and lighting of airports - Obstacle free zone - Traffic loading on airport pavements, Airplane classification - Flexible pavement design methods for airports - Rigid pavement design methods for airports - Maintenance and reconstruction of airports
Student obligations	- accepted project work untill specified date, oral preliminary exam
Exam	- written exam, oral exam - positively marked written exam is a condition for the oral exam
Assessment	20% project work+50% written exam+30% oral exam
Literature	**Essential:** 1. Pavlin, S., "Airports I" (original in Croatian), Fakultet prometnih znanosti, Zagreb, 2002. 2. Horvat, Z., "Airports I" (original in Croatian), Građevinski institut Zagreb, Zagreb, 1990. 3. http://www.icao.int/ 4. http://www.faa.gov/ **Recommended:** 1. Babić, B. and Prager, A.: Design of Road Pavement (original in Croatian), Građevni godišnjak, HSGI, Zagreb, 1997. 2. Babić, B.: Design of Pavement Structures (original in Croatian), HGDI, Zagreb, 1997.

Course:	**CONSTRUCTION MACHINERY**

Course code: OA-456	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	The objective of this course is acquiring the knowledge required to plann machine work costs and time, as well as to plann machine work.
Syllabus	1. Choice and work planning of construction machines 2. The efficiency of construction machines and the means of transport 3. Costs of machine work in construction 4. Reliability and effectiveness 5. Construction machines in use conditions
Student obligations	– Course attendence – Project work
Exam	written seminars
Assessment	20% project work+50% written exam+30% oral exam
Literature	**Essential:** 1. www.grad.hr-djelatnici-dr.sci. Zdravko Linarić-Dokumenti raspoloživi za download- – Učinak građevinskih strojeva – Troškovi strojnog rada u građenju – Izbor strojeva i planiranje strojnog rada u građenju **Recommended:** 1. Žaja, M., Ekonomika proizvodnje, Školska knjiga, Zagreb, 1991.

Course:	**SPATIAL PLANNING**

Course code: OA-459	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 40 exercises: 10 seminars: 10
Course status: optional	**The course consists of:** lectures exercises seminars	**ECTS:** 5.0

Course objectives	Enable students to appropriately, from the position of civil engineers, can work on solving spatial planning problems and related issues and participate in the development of spatial planning documentation.
Syllabus	Basic concepts, definitions, terminology and the genesis of urban planning, spatial planning and space design. Spatial Plans: characteristics, types, components, methodology of development, adoption and implementation. The laws and regulations and institutions involved in the process of adoption and implemention of plans. The history of cities and urban planning. Geographical, functional and other factors in the development and life of cities and regions. Analysis, planning (protection and restoration) of contents in the area: housing, labor, industry, leisure and free spaces, greenery and parks, transportation and other infrastructure systems, tourism, nature, agriculture and rural areas, cultural and historical heritage, centers etc. Methods and techniques for planning and decision making: theory and implementation. International aspects of space planning, especially in the European Union. Basic social, economic and environmental components of spatial planning. Examples of finished spatial plans, discussion.
Student obligations	Course attendance, preparation of seminar paper /project work.
Exam	Written and oral.
Assessment	20% project work+50% written exam+30% oral exam
Literature	**Essential:** 1. Priručni materijal za kolegij izrađen od nositelja kolegija. 2. Marinović-Uzelac, A.: Prostorno planiranje. - Zagreb: Dom i svijet, 2001. 3. Milić, B.: Razvoj gradova kroz stoljeća I (1994), II (1994) i III (2002) - Zagreb: Školska knjiga. 4. Marinović-Uzelac, A.: Naselja, gradovi i prostori. - Zagreb: Tehnička knjiga, 1986. 5. Zakoni i propisi u svezi prostornog planiranja i prostornog uređenja i građenja. - Zagreb: Narodne novine RH. **Recommended:** 1. Prinz, D.: Staedtebau. - Stuttgart: Kohlhammer, 1988. i 1992. 2. Mumford, L.: Grad u historiji. - Zagreb: Naprijed, 1968. 3. Šćitaroci, M.-O.: Hrvatska parkovna baština. - Zagreb: Školska knjiga, 1992. 4. Marinović-Uzelac, A.: Teorija namjene površina u urbanizmu. - Zagreb: Tehnička knjiga, 1989. 5. Meise, J., Volwahsen, A.: Stadt- und Regionalplanung. - Vieweg und Sohn, 1980. 6. Marinović-Uzelac, A.: Socijalni prostor grada. - Zagreb: SN Liber, 1986. 7. Maksimović, B.: Urbanizam. - Beograd: Naučna knjiga, 1980. 8. Prostorno-planska dokumentacija (općina, grad, županija, makroregija, država, Europska unija).

GIS u planiranju komunalne infrastructure

Course:	**PUBLIC BUILDINGS AND SPACES**

Course code: OA-460	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 0 seminars: 30
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 6

Course objectives	Inform students about the methodology of planning and qualify them for reading and possibly elaborating the planning documentation.
Syllabus	– Arranging pedestrian zones in an urban environment, historical review. – From a regional plan to an executional project. – Streets and squares, business and trade pedestrian zones, shop-windows, terraces, eaves. Traffic solutions. – Parking areas and public garages. Public transportation stations. – Traffic buildings, bus and train stations, terminals. – Markets, trade-centres, public toilets. – Green areas and recreational zones, playgrounds, walks and parks. – Sports grounds and halls. – Petrol stations in an urban environment and outside of it, info-centres. – Sound insulation of street noise and traffic corridors. – Arranging public zones outside of an urban environment, roads, bridges, tunnels and their ancillary facilities.
Student obligations	– Course attendence. – Visits to building-sites and theme exhibitions. – Project work: Based on the general design of a concrete assignment, a part of the general design and executional project for a public zone renovation should be elaborated.
Exam	– written exam – oral exam
Assessment	– Lecture and exercise attendance and project work 50% – Written and oral exam 50%
Literature	**Essential:** 1. E. Neufert: Arhitektonsko projektiranje, IGH Zagreb 2002. 2. O. Magaš: Skice za predavanja, skripte. 3. Production-programmes for building equipment. 4. Plans and projects of executional solutions. **Recommended:** 1. S. Kostof: The City Shaped, Thames and Hudson, 1991. 2. S. Kostof: The City Assembled, Thames and Hudson, 1992. 3. Gosling&Maitland: Concepts of Urban Design, Academy editions, London1984.

Course:	**URBAN WATER SYSTEMS**

Course code: H-254	**Pre-requisites:**	**Hours of Active Classes:** 60 lectures: 30 exercises: 15 seminars: 15
Course status: compulsory	**The course consists of:** lectures exercises seminars	**ECTS:** 6

Course objectives	– Introducing students to the urban water management problematic. – Developing students' methodological approach to analysing quantities and qualities of water in urban areas in the context of satisfying all water demands. – Develop students' skills in solving problems in urban systems planning and management.
Syllabus	– Dynamics of the hydrologic cycle in urban areas. – Water demands - categorisation of demands by quantities and quality standards. – External and rain water - high water problems and solving strategies. Structural and nonstructural protection solutions. – Revitalisation of waterways in urban areas. Aquatic systems as urban recreation attraction. – Ground waters in urban areas and construction problems related to them. – Methods of evaluation of recipient's capacity for wastewater disposal. Water quality modelling. – Sea as a part of urban area and recipient for wastewater disposal. – Municipal infrastructure water systems - water supply systems, drainage and sewage systems. Functional analysis and organisation. – Waste water treatment methods for water reusing. – Coastal and underwater structures. Ports, marines, coastal communications. – Urban waters and spatial planning. Legislative regulations.
Student obligations	– Course attendance in accordance to University/Faculty regulations. – Writing and presenting a paper.
Exam	– Positively marked written exam is a condition for the oral exam.
Assessment	– Writing and presenting paper 30%, exam 70%.
Literature	**Essential:** 1. Margeta, J.: Osnove gospodarenja vodama. GF Split, 1992. 2. Maksimović, Č.; Tejada-Guibert, J.A (editors): Frontiers in Urban Water Management. IWA Publishing. London, 2001. 3. Tedeschi, S.: Zaštita voda. HDGI, Zagreb, 1997. 4. Bonacci, O.: Ekohidrologija vodnih resursa i otvorenih vodotoka, GA Split i IGI, Zagreb, 2003. 5. Margeta, J.; Azzopardi, E.; Iacovides, I.: Smjernice za integračni pristup razvoju, gospodarenju i korištenju vodnih resursa, PPA, Split, 1999. 6. Linsley, R.K.; Franzini, J.B.; Freyberg, D.L.: Water Resources Engineering, 4/e, McGraw-Hill Book Comp.Inc., New York, 1992. **Recommended:** 1. Mays, L.W.(ed.): Water Resources Handbook. McGraw-Hill, New York, 1996. 2. Juanico, M.; Dor, I. (editors): Hypertrophic Reservoirs for Wastewater Storage and Reuse - Ecology, Performance and Engineering Design, 1999. 3. Jörgensen, S. E.: Fundamentals of Ecological Modelling, Elsevier, Amsterdam, 1988. 4. PAP: Planning and designing of Urban Waste water Treatment Projects in Mediteranean Coastal Towns, Split, 1992. 5. Biswas, A.K.: Water Resources: Environmental Planning, Management and Development, McGraw-Hill Book Comp.Inc., New York, 1997.

Course:	**CIVIL ENGINEERING REGULATIONS**

Course code: OA-458	**Pre-requisites:**	**Hours of Active Classes:** 30 lectures: 30 exercises: 0 seminars: 0
Course status: optional	**The course consists of:** lectures - -	**ECTS:** 4

Course objectives	The aim of the course is to provide the students, future civil engineers, with the knowledge of basic legal notions, categories, institutes and law relationships in civil engineering in a broader sense.
Syllabus	Introduction to law: notions, categories, institutes, legal relationships. Regulations on civil engineering. Commercial companies in the industry of construction materials, projects and construction. Relationship with the State. Procedures. Control. Inspections. Individual legal acts. Court procedures.
Student obligations	Seminar paper, preliminary exam, exam
Exam	written, oral
Assessment	during the lectures and on the exam
Literature	**Essential:** 1. UČUR, Marinko. Građevinska regulativa, Građevinski fakultet, Rijeka, 2004; Ustav RH, Zakon o gradnji. **Recommended:** 1. Zakon o obveznim odnosima; Zakon o vlasništvu i drugim stvarnim pravima; Zakon o radu; Zakon o zaštiti na radu; Pravilnici po Zakonu o gradnji.

Course:	**BUILDING MAINTENANCE**

Course code: OA-461	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: optional	**The course consists of:** lectures exercises -	**ECTS:** 4

Course objectives	Acquiring knowledge required to manage building maintenance.
Syllabus	1. Introduction to building maintenance 2. Maintenance management regulations 3. Regular maintenance, reconstructions and repairs 4. Life cycle costs and classification of maintenance costs 5. Construction process and Construction maintenance 6. Construction maintenance management 7. Maintenance management project 8. Planning and organization of maintenance works 9. Maintenance of listed buildings 10.Models for setting priorities in building maintenance 11.IT support for decision making in setting priorities in building maintenance
Student obligations	accepted project work before exam
Exam	preliminary exam at the end of the term + oral exam or written exam and oral exam
Assessment	preliminary exam at the end of the term + oral exam or written exam and oral exam
Literature	**Essential:** 1. internal course materials 2. Lee, R., Building Maintance Management, Blackwell Science Ltd, Oxford, 1987. **Recommended:** 1. B., Swallow, P., Building Maintance Management 2. Mills, E., Building Maintenance & preservation, Architectural Press, Oxford, 1996.

Course:	**MANAGEMENT IN CIVIL ENGINEERING**

Course code: OA-457	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 0 seminars: 15
Course status: compulsory	**The course consists of:** lectures - seminars	**ECTS:** 3.0

Course objectives	The main objective of course is acquiring basic knowledge of civil engineering companies business.
Syllabus	1) Company concept, types and objects 2) Investment characteristics and elements 3) Building companies reproduction process results 4) Production capacity economy. Costs. 5) General management thesis 6) Management role and significance in building companies business 7) Company business policy forming 8) Basis of market business. Law of supply and demand 9) Products planning and developing 10) Prices policy 11) Elasticity in consumption 12) Business decision making. Methods of decision making 13) Business communication and control system
Student obligations	Attendance to the course according to the Faculty regulations Activity in class.
Exam	Written and oral exam.
Assessment	Preliminary exams, seminars (70%), written exam (30%).
Literature	**Essential:** 1. Katavić, M., Hamarić, S., Poslovna politika, Sveučilište u Zagrebu, Građevinski institut, Zagreb, 1989 2. Žaja, M., Ekonomika proizvodnje, Školska knjiga, Zagreb, 1992. 3. Zekić, Z.: Menadžment – poduzetnička tehnologija,Ekonomski fakultet, Rijeka , 2007. 4. Senge,P.M.: Peta disciplina, Mozaik knjiga, Zagreb , 2001. 5. Skoko, H.: Upravljanje kvalitetom, Sinergija d.o.o., Zagreb, 2000. **Recommended:** 1. Bidgoli, H.: Modern Information Systems for Managers, Academic Press, San Diego, 1997. 2. De George R. T.: Business Ethics, Prentice Hall, New Yersey, 1999. 3. Harry, M., Schroeder, R.: Six Sigma,Doubleday, New York, 2000. 4. Hill, C.W.L.: International Business, McGraw-Hill, New York, 2003. 5. Miles, R.E., Theories of Management, McGraw - Hill, 1975. 6. Wagner, H.M., Principles of Management Science, Eaglewood Cliffs, N.J., Prentice-Hall, 1975. 7. Stacey, R.D.:Strateški menedžment i organizacijska dinamika, Mate, Zagreb, 1997.

Course:	**INVESTMENT POLICY**

Course code: OA-455	**Pre-requisites:**	**Hours of Active Classes:** 45 lectures: 30 exercises: 15 seminars: 0
Course status: compulsory	**The course consists of:** lectures exercises -	**ECTS:** 5.0

Course objectives	The objective of this course is to acquire basic knowledge from the area of company investment policy.
Syllabus	Company investment policy Investment program, factors and analysis of conditions Investment decision Financing sources Investment dynamics Cost analysis Calculations in market business. Relation between calculation and risk in the processes of construction. Cost planning. Cost control. Investment efficiency. Investment project evaluation. Cost-benefit analysis.
Student obligations	Attendance at the course according to the Faculty regulations Active participation in lectures and exercises Producing an autonomous work as a pre-requisite for taking the exam
Exam	Written and oral exam.
Assessment	Preliminary exams, course attendance (70%), written exam (30%).
Literature	**Essential:** 1. Žaja, M., Investicijska politika I, Fakultet građevinskih znanosti, Zagreb, 1991. 2. Bendeković, J., Planiranje investicijskih projekata, knjiga I-IV, Ekonomski institut, Zagreb, 1993. 3. Lončarić, R., Organizacija izvedbe graditeljskih projekata, HGDI, Zagreb, 1995. **Recommended:** 1. Skendrović, V., Izvođenje investicijskih radova u inozemstvu, Građevinski institut, Zagreb, 1983. 2. Francis, J.C., Investment, Analysis and Management, McGraw-Hill Inetrnational Editions, New York, , 1987.

Course:	**FINAL YEAR PROJECT**

Course code: DIPL	**Pre-requisites:** The exam can be undertaken only after all other course exams have been passed	**Hours of Active Classes:** lectures: exercises: seminars:
Course status: mandatory	**The course consists of:** - - -	**ECTS:** 30.0

Course objectives	A successfully passed final thesis exam is proof that the student has been taught throughout the studies to independently analyze, research, solve and present a solution of a complex civil engineering problem. The student is capable of producing the final thesis by respecting the positive technical regulations and scientific knowledge in a specific civil engineering field.
Syllabus	The student writes the graduation thesis during the planned 120 hours of active teaching at the Faculty and a total effort of maximum 30 ECTS credits. The graduate thesis can be both a practical and a theoretical topic related by its contents to civil engineering and to the offered courses. The student chooses the graduation thesis topic and the committee for awarding the graduation thesis gives consent during the III. semester or at the latest by the beginning of the IV. semester of the academic year in question. A part of the graduation thesis can be carried out as a field work - practical teaching (a total of up to 15 ECTS credits). The graduation thesis can be based on: • creating a civil engineering structure or construction computer model • numerical modeling of materials and processes in materials • an analysis of a more complex mechanical problem which requires additional theoretical processing and presentation of an analytical or a numerical solution procedure • static and dynamic analysis (calculation) of concrete, metal and wooden structures • creating studies related to water management • an analysis of geotechnical structure project solutions • a project and project analysis related to urban areas (transportation projects, spatial and spatial planning studies, water management structures in urban areas) • other topics related to design, analysis and construction of more complex civil engineering structures and systems. When writing the graduation thesis the student actively cooperates with his teacher-mentor who, as a rule, is the holder of the course whose contents are related to the selected topic. A teacher-co-mentor can also participate in advising the student in writing the graduation thesis if required
Student obligations	The student must submit the written graduation thesis (in the draft version) to the teacher-mentor as a prerequisite for obtaining the second signature. The student must submit the final thesis (in the final written version) to the teacher and the student administration office (2 copies) 7 (seven) work days prior to the approximate thesis presentation date.
Exam	The exam is conducted in the oral form, as a public thesis presentation. The oral exam is assessed by the committee of at least three members-teachers, one of who is the mentor. If required, the committee can ask the candidate questions related to the graduation thesis.
Assessment	75% graduation thesis + 25% presentation
Literature	**Essential:** Depending on the subject **Recommended:** Depending on the subject

3.2.2. Explanation of ETCS credits

The number of hours of active classes for all the proposed courses has been calculated on the basis of the assumed average duration of one term of 15 (fifteen) weeks (the average duration of the academic year is 30 weeks). The programme includes three regular examination periods of 4 (four) weeks each.
The proposed duration of the academic year is a total of 42 working weeks : 2x15 weeks of classes and 3x4 weeks of examination periods.
During the academic year the student gains a minimum of 60 ECTS credits for all the proposed programmes.
In view of the above mentioned, the calculation of the number of hours that make one ECTS credit would be: 1 ECTS = 42 (weeks) X 40 (working hours per week) / 60 ECTS = 1.680 hours / 60 ECTS = 28 hours.
1 ECTS CREDIT is equivalent to 28 hours of the student's study load

The number of ECTS credits allocated to the particular courses has been calculated on the basis of the complexity of the course teaching material (syllabus) and the general and cpecific obligations the student has to fulfill in connection with the course:

- the general obligations include an estimate of: the time needed to attend classes, tutorials, prepare exams, take exams, as well as of the quantity of literature he uses to prepare the exam.
- specific obligations include an estimate of the time needed for: preliminary exams, project work, seminar work, laboratory practice, fieldwork, visiting construction sites etc.

The course load coefficient is determined in proportion to the course share in the workload of the particular term so that the student gains 30 ECTS credits per term.

3.2.3. Quality assurance procedures and course (module) performance indicators

The performance of all the courses will be continuously monitored by different procedures of evaluation and self-evaluation of teachers and students.
The evaluation of the teachers and teaching activities will be carried out by the course lecturers (teachers) and will be organized by the Faculty body responsible for monitoring and identifying actions needed for the improvement of quality of the programme.

Different procedures and methods for monitoring and evaluating the quality of the teaching activities and the course performance will be used:

- **conducting research and opinion polls among students on all the aspects of teaching:**
  - **regular course delivery and organization of the teaching process**
  - **literature**
  - **methods for improvement of teaching**
  - **exams**
  - **syllabus and methodology of delivery**
  - **student / teacher relations and collaboration**
  - **work load – ETCS CREDITS**
- **publishing the results of research and opinion polls**
- **analysing the exam results (pass rate, transparency, objectivity and the like).**

The quality of the teaching performance of the particular courses will be evaluated twice during the term: for the first time 3-4 weeks after the beginning of the classes and for the second time during the last week the classes are taken. The results of the first evaluation may improve the teaching activities in the current term.
All research and questionnaires will be conducted on forms prepared in advance, in which the teachers will be able to adapt the questions to the course curriculum, methodology and other specific demands that the course has to meet.
The course lecturer will, independently and/or in coordination with the responsible persons at the Faculty, work out the plan of measure